EEB 2245/2245W Spring 2010

Study guide for exam #3

Questions for the exam will be drawn from topics covered in lecture. The exam will consist of a combination of short answer questions and problems similar to those on the practice problems. 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.

Evolutionary change

- Be able to describe and recognize the differences between microevolution and macroevolution.
- Remember the example of plumage color in house sparrows, and be able to explain why it is an example of evolutionary change.
- Be able to define evolutionary change (at the level of microevolution).
- Be able to define the key terms in the definition of evolutionary change ("population" and "genetic composition") .

Population genetics

- Be able to explain the relationship between population genetics and Mendelian genetics and between population genetics and evolutionary biology.
- Hardy-Weinberg
    - Be able to state the four assumptions underlying Hardy-Weinberg.
    - Be able to identify the evolutionary processes associated with violating each assumption.
    - Be able to calculate allele frequencies and genotype frequencies from counts of alleles or genotypes, and be sure that you know the difference between allele and genotype frequencies.
    - Be able to calculate the expected number of individuals in different genotype classes when genotypes are in Hardy-Weinberg.
    - Be able to suggest evolutionary processes that could produce an observed deviation from Hardy-Weinberg proportions.
- Genetic drift
    - Be able to provide a definition of genetic drift and to identify when it's important.
    - Know the 3 additional assumptions about a population that make it "ideal".
    - Know how the probability that an allele becomes fixed is related to its current frequency.
    - Know how to interpret the importance of drift in terms of the *effective* population size and how the *effective* population size differs from the number of individuals you would count in that population.

    - Know the basic consequences of genetic drift, e.g., how the loss of diversity is related to effective population size.
- Migration
    - Know how migration for a population geneticist is different from migration for an ornithologist.
    - Know how to calculate the migration rate from the population size and the number of individuals that are migrants.
    - Know how to calculate the consequences of migration, given an allele frequency in the population, an allele frequency in migrants, and a migration rate.
- Drift & migration
    - Given the effective population size and the migration rate, know how to determine whether drift or migration will be the predominant process in the population.
    - Be able to draw a simple graph illustrating the distribution of allele frequencies among populations given particular values of the effective population size and the migration rate.
- Non-random mating
    - Be able to name at least two ways in which there may be departures from random mating.
    - Know how genotype and allele frequencies change as a result of inbreeding.

Natural selection

- Be able to list the assumptions underlying the theory of evolution by natural selection.
- Be able to describe the case of *Biston betularia* and how it provides an example of evolution by natural selection.
- Be able to describe the sickle-cell polymorphism in human populations and how it provides an example of evolution by natural selection.
- Be able to distinguish between selection within a generation and evolution by natural selection.
- Be able to calculate genotype frequencies before and after selection.
- Be able to recognize patterns of selection and to describe the ultimate genetic composition of the population (polymorphic, monomorphic for a particular allele regardless of initial frequency, monomorphic for one allele or the other depending on the initial frequency).

Practice problems on natural selection

1. A scientist observed:

GENOTYPE →	AA	Aa	aa
# of eggs	33	100	45
Viability	0.3	0.7	0.4
# of adults			

   a. Calculate the number of adults that were observed. (See table above)

   b. Using the data in the table calculate the genotype frequency of AA (before and after selection) and the allele frequency of A (before and after selection).

   c. What will be the ultimate genetic composition of the population be if natural selection is the only evolutionary process affecting this population.

2. Egg-to-adult survival rates in a laboratory population of Drosophila melanogaster is as follows: 90%, 70%, and 60% for genotypes A_1A_1, A_1A_2, and A_2A_2, respectively.

   a. Complete the table below

Genotype	A_1A_1	A_1A_2	A_2A_2
# eggs	50	55	70
	W_{11}=	W_{12}=	W_{22}=
# adults			

   b. Calculate allele and genotype frequencies before and after selection.

   c. After the selection event from egg-to-adult, the adults are allowed to breed. Assuming that the four conditions assumed in calculating Hardy-Weinberg apply, what are the allele and genotype frequencies of eggs in the next generation?

   d. What will the ultimate genetic composition of the population be if natural selection is the only evolutionary process affecting this population.