

8310 HOMEWORK 3. (and my appreciation to John Drake for letting steal, with modification, one of his problems)

The goal is to work with some basic evolutionary principles to help cement the concepts.

In 1 and 2, we'll let *Biston betula* provide the context. Assume that our system is diploid, undergoes sexual reproduction, has a very large (infinite) population, matings are random: i.e., Hardy-Weinberg equilibrium can be assumed. Also assume that the gene that determine color morph has two alleles (A and a), with A (dark morph allele) dominant to a (the light morph allele).

1) Kettlewell (1956) reported that the *carbonaria* phenotype (the dark morph) comprised 87% of all moths collected at a site near Birmingham. Assuming Hardy-Weinberg equilibrium, calculate: a) the frequency of the dominant allele; and b) the proportion of the *carbonaria* moths that are heterozygotes.

2) Now, assume the allelic frequencies are 0.8 (dark allele) and 0.2 (light allele) and that there is selection against the dark morph (the relative fitness of the dark morph is 0.6 and the relative fitness of the light morph is 1.0). Assume that the differences in fitness are based entirely on survival up to the age of reproduction. Find: a) the frequency of the two *morphs* AFTER selection (if the allelic frequencies before selection were .8 and .2); b) the frequency of three *genotypes* AFTER selection; c) the frequency of the two *morphs* at the start of the next generation; d) if you continued this process for many generations (assuming the environment remains constant) what will be the eventual frequency of the dark morph and of the light morph? e) give two reasons why the light allele might persist in the system?

3) For the following phase-plane for two *competitors* (note the non-linearities), please a) sketch the vector field on the phase plane (i.e., draw the initial trajectories of the system for a bunch of different density combinations); and b) for the point marked 'X', draw the ensuing dynamics, both as a trajectory on the phase plane AND in a plot of N vs. time. The thin black dashed lines are manifolds (separatrix lines).

