NAME: _____ **Time Started: _____**
BIO 112: Organisms, Evolution, and Ecosystems **Review 1**
Dr. Chris Paradise Fall 2007

Instructions: This review is worth 150 points (15% of your course grade) and will be due by 5:00 pm on Tuesday, 10/2/2007. No exceptions; late reviews will result in at least a 5% deduction. **You may not consult** any references or any other person while working on this review. Your signature at the bottom of the last page signifies that the work is yours alone and is pledged under the Honor Code. When you break the seal on the envelope you will have **three hours to complete the review**. Print legibly; I can only grade what I can read. For each question or part to a question, limit your answers to the space below each question, unless otherwise specified. Any part of your answer outside of the space provided **will not be graded**.

1. Answer **all** of the following questions regarding natural selection (15 pts).
   a. Discuss how Darwin's theory of evolution by natural selection explains the unity of life.

   b. Consider the article by David Quammen (Was Darwin Wrong? NO) and our class discussions, and describe how the theory of evolution by natural selection explains the diversity of species-rich groups like orchids.

   c. List three requirements necessary for biological evolution by natural selection to occur.

2. Name three mechanisms of evolution, other than natural selection, and describe how they work together or against one another to cause **or** prevent changes in allele frequencies (15 pts).

3. Periodical cicadas (a type of insect) have a very wide distribution in North America, and can be found all over the eastern half of the continent. Immature nymphs live in the soil, feeding on roots of trees. In one species, nymphs take 17 years to develop, with a different brood emerging each year, and each brood emerging as adults only once every 17 years. Adults live only for a couple of months in the summer, mate, lay eggs, and die. Each female is capable of laying dozens to hundreds of eggs. Answer **all** of the following questions (15 pts).
   a. What kind of reproductive isolation exists between broods?

   b. What is your prediction regarding the potential for speciation among populations (i.e., broods) of cicadas?

   c. If cicadas underwent speciation in this example, what kind of speciation would it be?

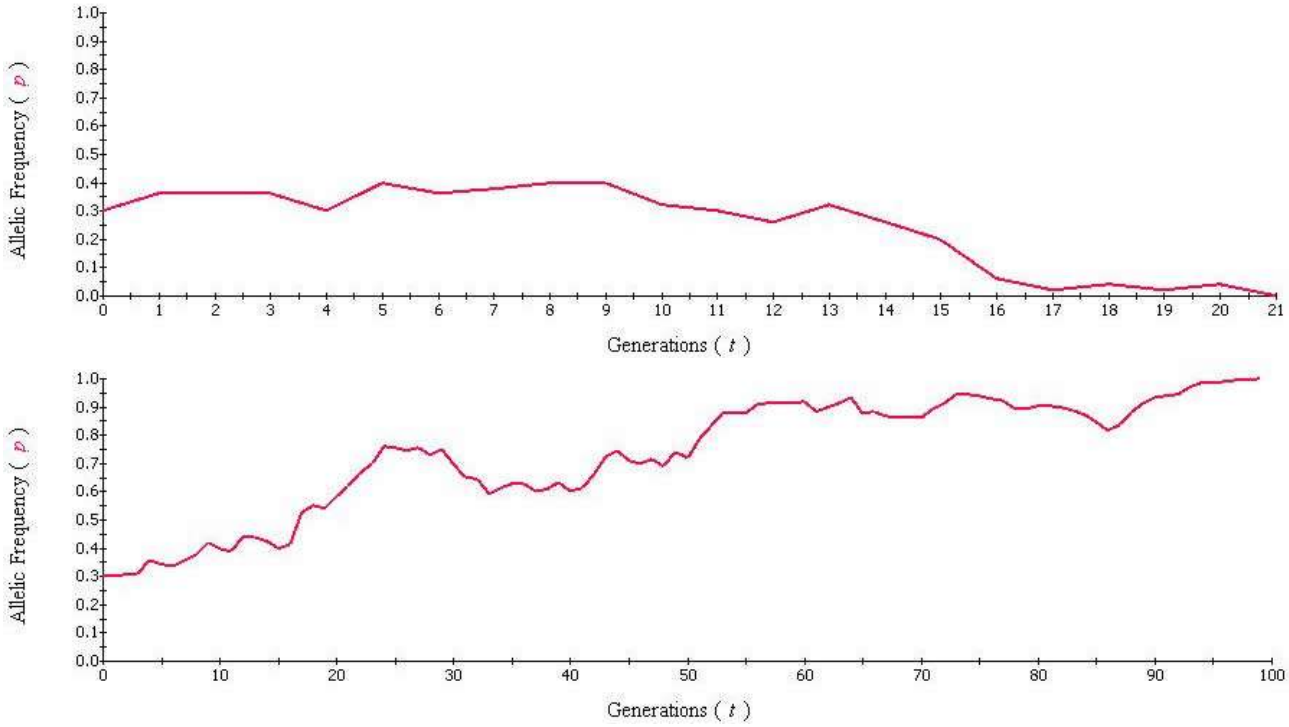
   d. What would you predict might be a consequence to between-brood variation and within-brood variation for broods isolated in such a manner?

4. In the graphs below, depicting the allele frequency of a dominant allele ("A"), all the initial conditions are the same, except that in the top graph, the population size is 25 and in the bottom graph it is 100. There is weak selection against the homozygous recessive phenotype (W_{aa} = 0.9). Answer **all** of the following questions (15 pts).

a. Heterozygotes have equal fitness to homozygous dominants, so how is it that the "A" allele is fixed in the bottom graph, and lost in the top graph?

b. What are the fitnesses of heterozygotes and homozygous dominants?

c. If we ran this simulation again, would we get the same result? Explain.



5. Consider the following questions regarding speciation (15 pts):
   a. What is the mode of speciation where populations are separated by geographic barriers?

   b. What kind of nonrandom mating is more likely to lead to a speciation event than the other kind of nonrandom mating?

   c. What kind of natural selection is most likely to lead to a speciation event?

   d. Can a cline lead to speciation, and if so, what mechanisms of evolution facilitate speciation, and what is the mode of speciation?

   e. What is the most common mechanism of speciation in populations living in the same geographical region?

6. Discuss **one of the following two** questions (10 pts):
   a. What is the evidence that supports the endosymbiotic theory of evolution in eukaryotes?

OR

   b. Discuss how relative and absolute dating methods are used to determine the age of the Earth, and how both point to a very old age (determined to be about 4.6 billion years).

7. In a population of the Common Sunflower *Helianthus annuus*, 100 individuals were sampled, and gel electrophoresis was used to determine the genotypes at the alcohol dehydrogenase (ADH) locus. Three alleles were found, which we'll call "a", "b" and "c"; none was determined to be dominant to the others. The following genotypic frequencies were found in this sample; aa = 15, ab = 16, bb = 11, ac = 26, bc = 24, and cc = 8. Answer each of the following questions (**SHOW WORK** – 15 points).

   a. Calculate the allele frequencies (set a = p, b = q, and c = r).

   b. Calculate the expected genotypic frequencies for the ADH locus in *Phlox* under Hardy-Weinberg equilibrium assumptions.

   c. Is there evidence for evolution occurring in this population? If so, what microevolutionary mechanism may be in operation, judged by actual vs. expected genotypic frequencies? **(If not, state that evolution is not occurring)**

8. Discuss the interdisciplinary approach (molecular biology, animal behavior, ecology, paleontology, and geology) that was used to determine the evolutionary history of cats (F. Felidae). Be specific in your description, although you don't need to use all of the listed disciplines in your answer (10 pts).

9. Discuss generality and applicability of the Morphological Species Concept (10 pts).

10. Are protists (Kingdom Protista) a true lineage? Briefly describe the characteristics of the kingdom and depict their phylogeny in relationship to the other Eukarya Kingdoms using a cladogram (10 pts).

11. Major advances in animal evolution have led to changes in animal body plans, which then have led to adaptive radiations. Discuss one such major advance, indicate how it provided a selective advantage to the animals possessing it, and describe how it led to changes in animal diversity – be specific (10 pts).

12. Consider the cladograms on the next page, which represent three possible scenarios of the evolution of pulse rate in the mating songs of crickets in the genus *Gryllus*. The pulse rate character was divided into two traits (< 35 pulses per second, or > 35 pulses per second), and is overlaid on top of an accepted cladogram of the species in the genus, developed using other characters. Answer the following questions (10 pts).

a. What is meant in the caption below the figure that the scenarios are equi-parsimonious?

b. What is the ancestral pulse rate in the middle cladogram (B)?

c. Pulse rate in the mating song of crickets seems like a character that may change relatively easily with the right kind of selection pressure. Briefly describe a scenario where a mating song may change over evolutionary time.

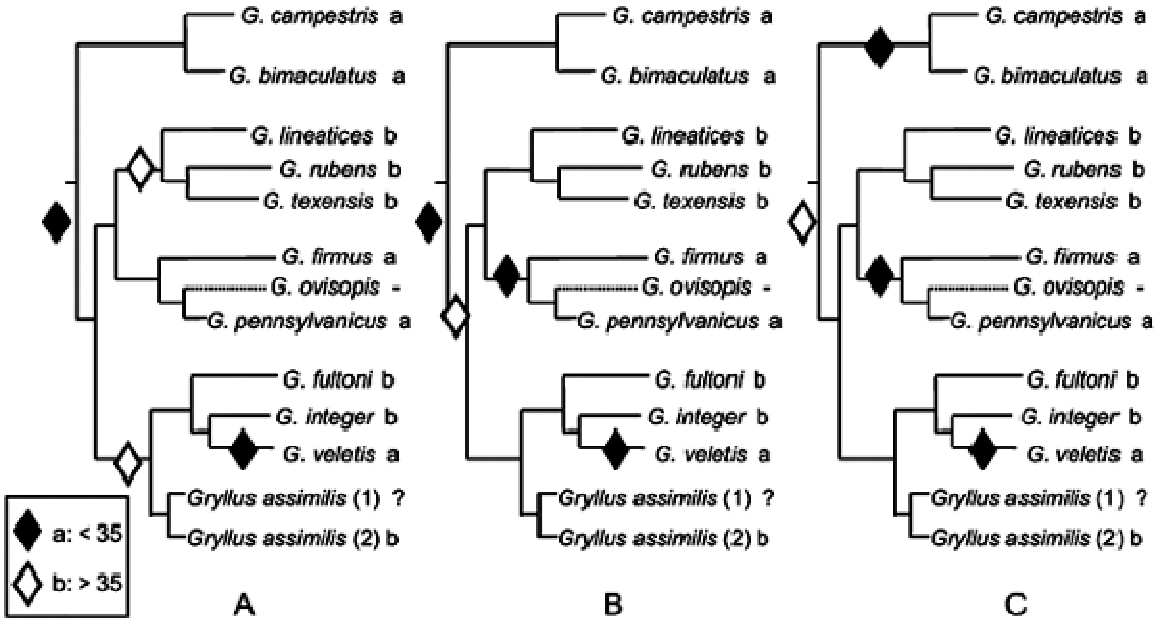


Fig. 4 – Evolution of pulse rate in *Gryllus* song. (A, B, C), alternative equi-parsimonious scenarios. Outgroup taxa not represented. Dotted line: song loss. After Desutter-Grandcolas and Robillard (2003).

Pledged: _____ Time Finished: _____