Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Biol120 recitation: Evolution Activity

In this activity we will define evolution, examine a framework for evaluating evidence of evolution by natural selection, investigate classic types of selection, and make predictions about causes of evolutionary phenomena.

First, we are going to watch a short clip from “The origin of species: The beak of the Finch” created by Howard Hugh’s Medical Institute’s BioInteractive. If you would like to watch the entire 15 minute film, here is the link: <http://www.hhmi.org/biointeractive/origin-species-beak-finch>. Please use the space below to take any notes:

Part A. Peter and Rosemary Grant’s surveys of *Geospiza fortis* on Daphne major over the past 40 years. Consider the figure below and answer the following questions (Part A 1-4).

Figure 1. Evolutionary trajectory of *G. fortis* beak size over 40 years. Means and 95% confidence limits are shown for all birds alive in each year. Parallel horizontal lines mark the upper and lower 95% confidence limits on the first estimate of a mean based on a large sample size (*n* = 221) in 1973 (Grant and Grant 2014).

1. What do you notice about the changes in beak depth in the population of *G. fortis* over the past 40 years?

2. Given the differences that you described above, do you think the population has evolved between 1973 to 2013? Why or why not?

3. In general, how would you determine if a population is experiencing evolution at a given trait? What would you want to know about that trait?

4. Darwin’s postulates provide a framework for establishing if changes in a population over time are due to natural selection. Recall that evolution is defined as the change in allele frequencies over time. Therefore, to demonstrate that a population has evolved due to natural selection we must establish that…

* There must be variation in the population for the trait (phenotype) in the population we are examining. (Darwin’s postulate #1)
  + Why does evolution by natural selection require trait variation in the population?
* The trait (phenotype) we are examining must be heritable. (Darwin’s postulate #2)
  + Why does that trait determination need to have a genetic component?
* Many more individuals in the population are born than survive. (Darwin’s postulate #3)
  + How is this postulate relevant to evolution?
* Survival and reproduction is non-random with respect to the trait we are examining in the population. (Darwin’s postulate #4)
  + Why is non-random survival required for evolution by natural selection?

Part B. According to Darwin’s framework we should be able to determine if a species of Darwin’s finches, in this case *G. fortis,* is evolving by natural selection. As you saw in the video Peter and Rosemary Grant have been collecting and conducting research on Daphne major for the past 40 years. The Grants have recently published a book summarizing their monumental research on the finches in the Galapagos Islands. In this activity, we will be using their publicly available published data and data made available through the Howard Hugh’s Medical Institute (HHMI) from their research to investigate Darwin’s postulates for evolution by natural selection as they apply to the very finches he was so well-known for studying.

Your group will work through evidence of evolution by natural selection by examining data relevant to one of the four postulates. Follow the instructions and answer the questions for your group, then upload your completed file to Blackboard. We will discuss all of the postulate investigations as a group using your figures.

Part C. Answer the following as we discuss the results from each group. Keep in mind our initial question: Is there evidence of evolution of beak depth in *Geospiza fortis*?

1. Postulate #1: Is there evidence that the population is variable for beak depth? How can you tell?

2. Postulate #2: Is there evidence that beak depth is heritable? How can you tell?

3. Postulate #4: Is there non-random survival and reproduction with respect to beak depth? How can you tell?

Part D. Consider a summary figure of your class Postulate #4 investigations and answer the questions below.

Figure 2. Summary of changes in beak depth (filled triangles) and population size (open squares) of *G. fortis* on Daphne Major, Galapagos Islands July 1975 to January 1979. 95% confidence intervals on average beak depth (mm) reported. Redrawn from Grant and Grant 2014.

1. How did population averages for beak depth change from 1975 to 1979?

2. When considering patterns of selection, what type of selection do you predict is driving the changes in beak depth in the population?

Circle a pattern: Stabilizing Directional Disruptive

Justify your answer:

3. What do you think might be driving the changes in beak depth in this population?

4. Go to the dataset “Seedsize\_rain\_beak\_longterm.xlsx”. Explore the changes in beak depth with respect to year, climatic features, and resource type and abundance. Create one figure and draw conclusions from that figure about the cause of beak changes. If time permits, feel free to explore multiple variables. You will not need to provide the figure, but do write your conclusions below.

5. What were the conclusions of the class? What is driving beak depth population changes?

Finches and beyond…

Looking toward the future: Re-examining Figure 1, you notice that beak depth increases from 1976 to the late 1980s/early 1990s, but continues to decrease from peak to today. Why might the average beak size be decreasing?

Relating this to Hardy-Weinberg Equilibrium: Thinking back to Postulate #2, researchers compared beak depth between parents and offspring to estimate heritability of beak depth. Hypothesize why researchers cannot use Hardy-Weinberg Equilibrium to evaluate evidence of evolution of beak depth in the population.