Microevolution by way of natural selection in Darwin's Finches

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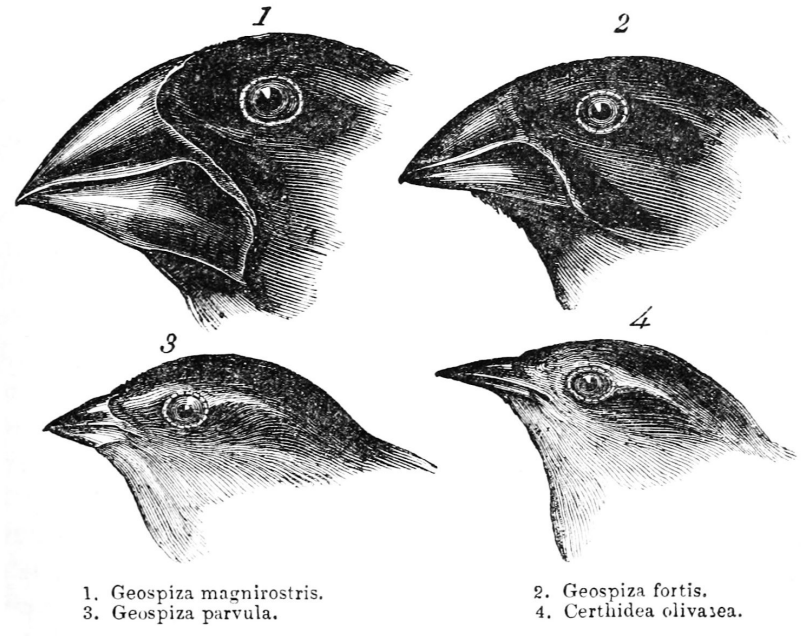

Darwin's Finches. Image Courtesy of Wikimedia.

An informal definition of evolution can be expressed as changes brought about in organisms of a population over time. Within the same context, one of the most classic of examples is Darwin's finches on the famous archipelago known as the Galápagos Islands, who have been shown to exhibit heritable phenotypes that have changed over time by natural selection (Carja & Plotkin, 2007).

In terms of mechanisms, and supplementing the informal definition of evolution above, evolution is carried out by way of the processes of natural selection and genetic drift, both of which act on such variations within a population, thus leading to phenotypic characteristics either becoming more rare or more common within the population (Scott-Phillips et al., 2014). Looking at the finches of the Galápagos Islands, the initial observations of Charles Darwin and a more recent study by evolutionary biology researchers Peter and Rosemary Grant showcases natural selection acting on finch populations.

According to Smith and Smith (2015), natural selection is the differential successes of individuals of a population that are a result of the population's interactions with the environment. In short, organisms of a population that are better adapted to the surrounding environment are more likely to survive and reproduce, thus resulting in offspring that, for the time being, have improved fitness (Smith & Smith, 2015). It must be stressed, however, that natural selection will not occur unless specific conditions are met.

For natural selection to occur, individuals of a population must exist in heritable fashion. In addition, environmental conditions must be right. As Gregory (2009) observes, natural selection will result from the confluence of basic conditions under the auspices of heredity and ecology. When weighing the environment with individual variation within a population, such forces will invariably lead to organism differences as it relates to survival and reproduction resulting from their interactions with environmental variables, also known as energy allocation to reproduction (Smith & Smith, 2009).

Digging down beyond heritability and the environment itself, there are four specific conditions required for natural selection to take place: phenotypic variation, heritability, selective pressures, and fitness, the latter of which is known as the varying levels of reproduction within a population (Godfrey-Smith, 2007).

For example, a given population of finches on the the Galápagos Islands would be defined as a grouping of individuals from the same species occupying a given area such that individuals will have the chance to mate with members of the opposite sex from within that group (Levin, 2009). Darwin observed measurable variations that existed between individual populations of finches. Two phenotypic examples include beak size and color. Likewise, heritability upon which the phenotypic variation is passed down was also observed, though it should be mentioned that Darwin was unaware of the role of genetics at the time. Selective pressures would include the abiotic and biotic factors—spatial and temporal climatic changes, changes in resource availability, predation or lack thereof—that can alter individual finch behavior and concomitant fitness from within a greater population. Finally, such fitness can be measured by energy allocation to reproduction success. Ultimately, natural selection is one of the ultimate drivers of evolutionary changes in that it promotes adaptation. To put it rather simply but succinctly, some finches will leave more offspring than others, and some finches will not leave any offspring.

Drs. Peter and Rosemary Grant discovered that spatial and temporal environmental conditions and resource competition via food availability triggered changes that impacted the behavior, morphology, and ultimately the microevolution of finches (Nair, 2011). By observing gene frequency, the Grant's found that natural selection occurred within a specific finch population on the island of Daphne Major following a drought that occurred during the late 1970s.

The phenotype that the Grant's observed were beak sizes consisting of three causative genotypes: small-sized beak genes, average-sized beak genes, and large-sized beak genes. They also discovered that after the drought, the frequencies in the genotype and alleles for beak genes in the same finch population did not remain at equilibrium when compared with the previous finch generation (Smith & Smith, 2015). In fact, beak sizes changed as observed in a higher proportion of finch offspring with larger beaks in the post drought generation, thus adapting to the particular food resource made available by changing conditions. In this case, adaptive radiation to fulfill the proper ecological niche was viewed as evolution occurring by

natural selection as the finch food supply changed resulting from the drought (Grant & Grant, 2003). Peter and Rosemary Grant (2003) provide the following excerpt:

> Birds with small beaks and small body size suffered selective mortality in 1977, during a severe drought. The larger members of the medium ground finch population survived on a diet of large, hard seeds, which increasingly dominated the food supply as a result of an initial preferential consumption of small seeds. Smaller birds, lacking the mechanical power to crack the large seeds of *Tribulus cistoides* and *Opuntia echios*, died at a higher rate than large birds. An evolutionary response to directional natural selection followed in the next generation, because beak size variation is highly heritable.

For anyone fascinated by birds—ornithologist or avid bird watcher—the Grant study is one of the best recent examples of evolution in action. In this case, selective pressures favored specific traits within the finch population, which then increased in the next generation of finches.

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