18.1C: The Galapagos Finches and Natural Selection

The differences in shape and size of beaks in Darwin’s finches illustrate ongoing evolutionary change.

Learning Objectives

• Describe how finches provide visible evidence of evolution

Key Points

• Darwin observed the Galapagos finches had a graded series of beak sizes and shapes and predicted these species were modified from one original mainland species.

• Darwin called differences among species natural selection, which is caused by the inheritance of traits, competition between individuals, and the variation of traits.

• Offspring with inherited characteristics that allow them to best compete will survive and have more offspring than those individuals with variations that are less able to compete.

• Large-billed finches feed more efficiently on large, hard seeds, whereas smaller billed finches feed more efficiently on small, soft seeds.

• When small, soft seeds become rare, large-billed finches will survive better, and there will be more larger-billed birds in the following generation; when large, hard seeds become rare, the opposite will occur.

Key Terms

• natural selection: a process in which individual organisms or phenotypes that possess favorable traits are more likely to survive and reproduce
Visible Evidence of Ongoing Evolution: Darwin’s Finches

From 1831 to 1836, Darwin traveled around the world, observing animals on different continents and islands. On the Galapagos Islands, Darwin observed several species of finches with unique beak shapes. He observed these finches closely resembled another finch species on the mainland of South America and that the group of species in the Galápagos formed a graded series of beak sizes and shapes, with very small differences between the most similar. Darwin imagined that the island species might be all species modified from one original mainland species. In 1860, he wrote, “seeing this gradation and diversity of structure in one small, intimately related group of birds, one might really fancy that from an original paucity of birds in this archipelago, one species had been taken and modified for different ends.”

Natural Selection

Darwin called this mechanism of change natural selection. Natural selection, Darwin argued, was an inevitable outcome of three principles that operated in nature. First, the characteristics of organisms are inherited, or passed from parent to offspring. Second, more offspring are produced than are able to survive; in other words, resources for survival and reproduction are limited. The capacity for reproduction in all organisms exceeds the availability of resources to support their numbers. Thus, there is a competition for those resources in each generation. Third, offspring vary among each other in regard to their characteristics and those variations are inherited. Out of these three principles, Darwin reasoned that offspring with inherited characteristics that allow them to best compete for limited resources will survive and have
more offspring than those individuals with variations that are less able to compete. Because characteristics are inherited, these traits will be better represented in the next generation. This will lead to change in populations over generations in a process that Darwin called “descent with modification,” or evolution.

Studies of Natural Selection After Darwin

Demonstrations of evolution by natural selection can be time consuming. Peter and Rosemary Grant and their colleagues have studied Galápagos finch populations every year since 1976 and have provided important demonstrations of the operation of natural selection. The Grants found changes from one generation to the next in the beak shapes of the medium ground finches on the Galápagos island of Daphne Major.

The medium ground finch feeds on seeds. The birds have inherited variation in the bill shape with some individuals having wide, deep bills and others having thinner bills. Large-billed birds feed more efficiently on large, hard seeds, whereas smaller billed birds feed more efficiently on small, soft seeds. During 1977, a drought period altered vegetation on the island. After this period, the number of seeds declined dramatically; the decline in small, soft seeds was greater than the decline in large, hard seeds. The large-billed birds were able to survive better than the small-billed birds the following year.

The year following the drought when the Grants measured beak sizes in the much-reduced population, they found that the average bill size was larger. This was clear evidence for natural selection of bill size caused by the availability of seeds. The Grants had studied the inheritance of bill sizes and knew that the surviving large-billed birds would tend to produce offspring with larger bills, so the selection would lead to evolution of bill size. Subsequent studies by the Grants have demonstrated selection on and evolution of bill size in this species in response to other changing conditions on the island. The evolution has occurred both to larger bills, as in this case, and to smaller bills when large seeds became rare.

Figure 1: Finches of Daphne Major: A drought on the Galápagos island of Daphne Major in 1977 reduced the number of small seeds available to finches, causing many of the small-beaked finches to die. This caused an increase in the finches’ average beak size between 1976 and 1978.