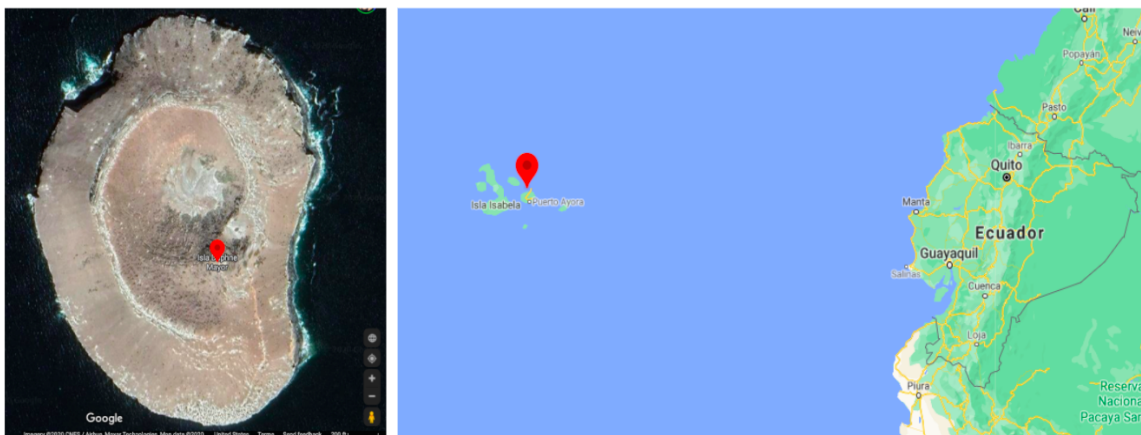


Finch Data Packet

Overview: Finches Beaks

The medium ground finches are one of 14 different types of finches that live on the Galápagos Islands off the coast of Ecuador. They typically live their entire lives on a single island. Where this population of ground finches lives is a desert-like island with sparse vegetation that is called Daphne Major. It is only about a half mile across at its widest point. No people have ever lived there.



On Daphne Major the ground finches, as their name suggests, forage for food that they find on the ground. They occasionally catch and eat insects, but they mostly survive by eating the seeds of the few plants that grow on the island.

Here are the three types of plants that are the sources of these seeds:



chamaesyce



portulaca



tribulus

Each year, these finches mate, lay eggs, and produce offspring called fledglings during the wet, rainy season that typically lasts from January through May. The fledglings grow to adulthood during the dry season that typically lasts from June through December. These young birds can mate and reproduce during the following wet season. The adult female ground finches and the fledglings are speckled brown in color. The adult males are black.



The finches on the Galápagos Islands have been studied for over 100 years, starting with research done by Charles Darwin. Modern researchers, Peter Grant and Rosemary Grant, were interested in finding out whether they could observe any differences among the populations of finches on some of these small islands. So starting in 1973, they set out to collect as much information as they could about the finches and the islands they live on.

In their studies, the Grants traveled to the isolated Daphne Major island each year during the wet season and during the dry season. While there, they caught and banded every finch that lived on the island, including every finch born that year. Then, when they returned each year, they collected, counted, observed, and measured all the finches as well as many of the other organisms living on Daphne Major. They kept records of the number and kind of plants on the island and how many seeds they produced each year. They recorded information about over 90 individual finches over the course of their study from 1973 to 1978. During the years 1976-1978 they saw the average length of the beaks of the population of finches on Daphne Major change.

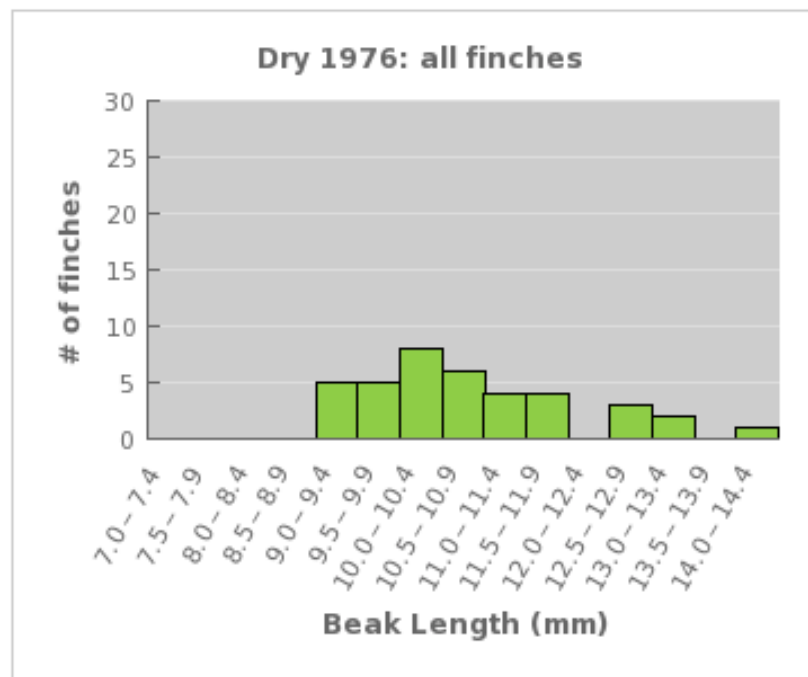
Data Subset 1: Studies of the Population of Finches at the Beginning

For this study, the researchers caught, banded, and measured all the finches living on Daphne Major during the years 1973-1978. Each year some of the birds died and some new birds were hatched and grew to adulthood. They collected a lot of information about each one of the finches. Over all 5 years of this study, they saw the following range of variations in the traits they measured:

Trait variation in the adult finch population from 1973 to 1978

Leg length (mm)	17.70 to 19.94
Beak length (mm)	8.90 to 14.35
Wing length (mm)	62.51 to 73.67
Weight (g)	11.01 to 19.10

The researchers were particularly interested in the size of the birds' beaks since that usually predicts what kind of seeds it will eat. Smaller-beaked birds are able to eat only small seeds, while larger-beaked birds can break open larger seeds and eat those. When researchers measured the length of the beaks of the adult birds in 1976 during the dry season when all the birds on the island had reached their adult size, they saw this:



Consider the questions listed below in your analysis of the data and what they mean. Then write your summary in the box below.

<p>A. Identify: What do I see in the data?</p> <ul style="list-style-type: none">• What is the trait of interest in this study?• What is the range of variations for this trait in the population?• What is the median value for this trait in the population? <p>Your summary:</p>	<p>B. Interpret: What does this mean?</p> <ul style="list-style-type: none">• Is this a trait with many variations?• What do you think might be the effect of having a longer beak for finches living on Daphne Major?• What do you think might be the effect of having a shorter beak for finches living on Daphne Major? <p>Your summary:</p>
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Data Subset 2: Environmental Studies

The Grants began their research study in 1973. Because they were interested in keeping track of everything that happened on Daphne Major, they not only recorded information about the finches, but they also kept a record of other things in the environment, like temperature, rainfall, and the finches' food sources on the island. Ground finches mostly eat plant seeds that they find as they forage on the ground, though they will also eat the occasional insect. The researchers' records of the three plants (chamaesyce, portulaca, and tribulus) that produced the seeds providing most of the finches' food sources showed this:

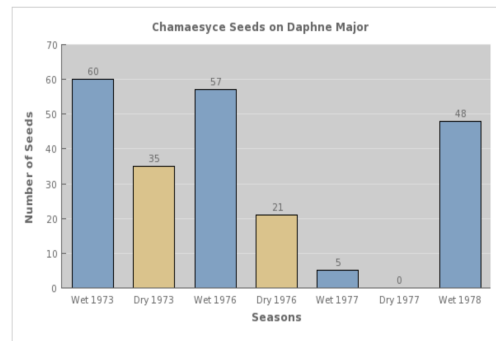


chamaesyce

Properties of Seeds

Seed Length	0.8 mm
Seed Volume	0.3 mm
Seed Rigidity	Soft

Number of Seeds

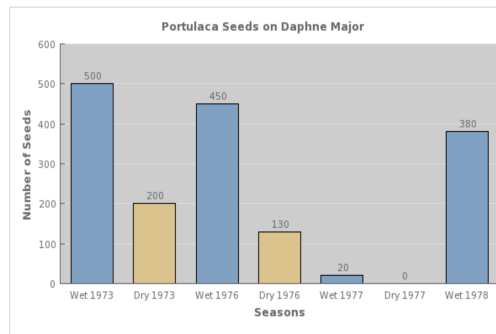


portulaca

Properties of Seeds

Seed Length	1.0 mm
Seed Volume	1.8 mm
Seed Rigidity	Soft

Number of Seeds

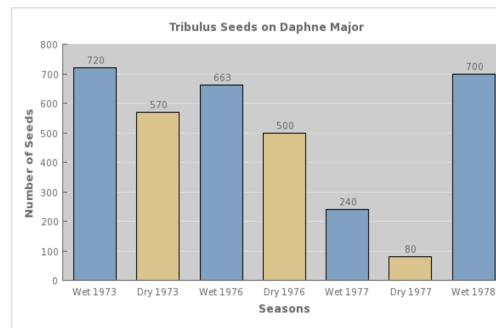


tribulus

Properties of Seeds

Seed Length	5.8 mm
Seed Volume	12.0 mm
Seed Rigidity	Hard

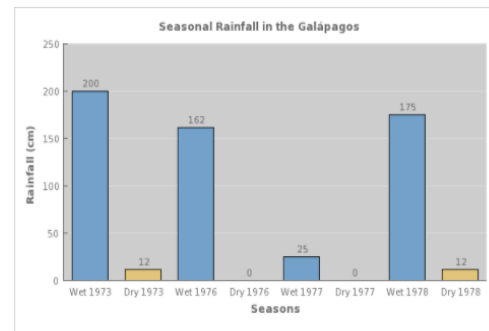
Number of Seeds



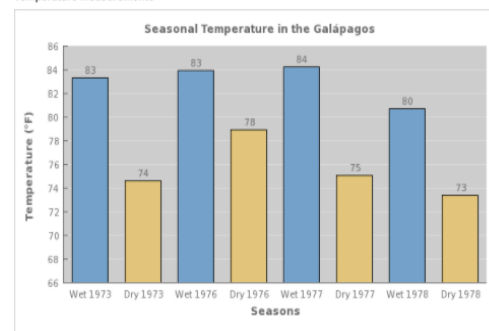
Rainfall and temperature: Scientists noticed an interesting pattern in the seed data. They wondered what might have caused it, so they analyzed the record they had for other things in the environment, such as the total rainfall and average temperature on the island in the dry and wet seasons for each year. Their records of temperature and rainfall are shown in the graphs to the right.

Consider the questions listed below in your analysis of the data and what they mean. Then write your summary in the box below.

Rainfall Measurements



Temperature Measurements



A. Identify: What do I see in the data?

- What patterns do you notice in seeds available over these years?
- What patterns did you notice in temperature and rainfall data over these years?

Your summary:

B. Interpret: What does this mean?

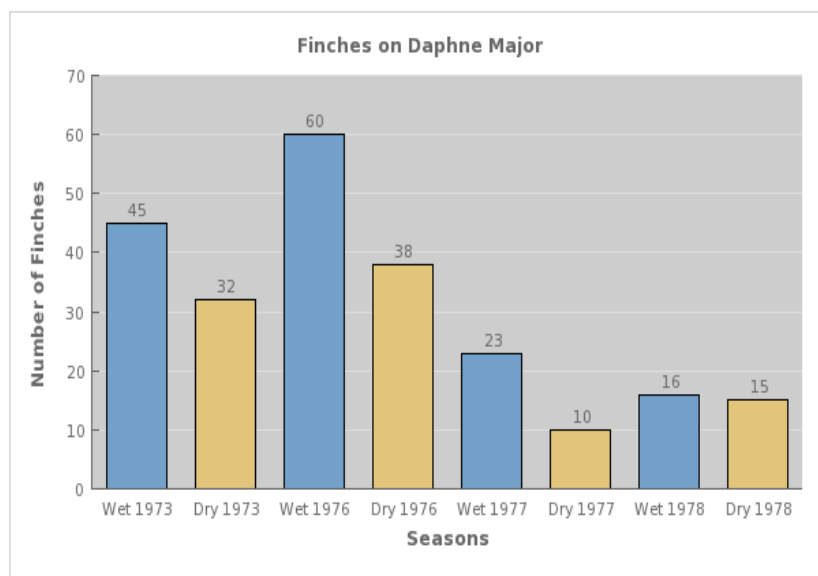
- What change in the environment could have caused the change in the seeds available?
- How do you think this might have affected the finches?

Your summary:

Data Subset 3: Survival and Reproduction Studies

Medium ground finches in the Galápagos Islands may live for up to 12 years, though most do not live that long. Adult finches breed soon after the first big rain of each wet season in the Galápagos, which usually starts in January and lasts through May. The baby birds hatch, are fed by their parents, and grow to fledglings during the remainder of the wet season when food on the islands is plentiful. During the dry season, from about June to December, when food is scarcer, they achieve their full adult size and hunt for food on their own. They are able to mate and produce offspring during the next wet season.

Number of survivors: Over the course of the study, the researchers kept track of the total number of finches surviving on the island during each season. This is what they saw:

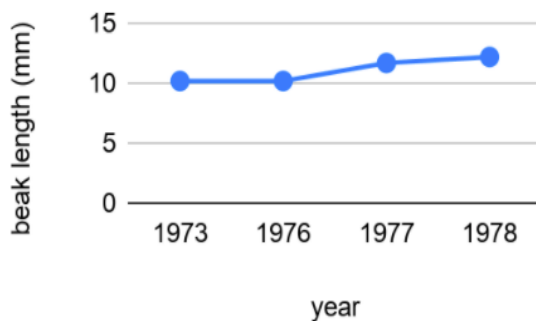


Number of offspring: They were also interested in how many offspring would be produced each year. This is what they saw:

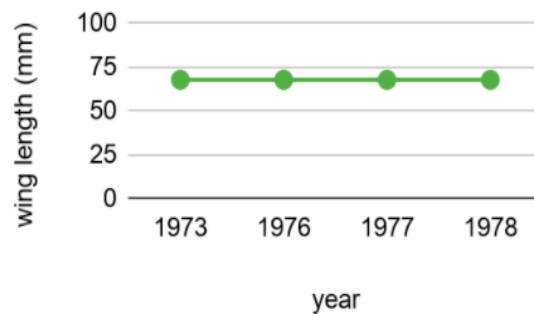
Year	Total # of breeding adults	Total # of offspring
1973	21	24
1976	31	29
1977	23	0
1978	8	8

Characteristics of survivors: Based on the pattern the researchers saw in the number of finches in each season, they wanted to know more about the characteristics of the birds that survived during 1976-1978 when the overall size of the population changed significantly. During the dry season of each year, those fledglings that survive have grown to their adult size, so they measured the birds during the dry season. The population of birds during the dry season includes the birds that were adults at the beginning of the year together with any adult offspring. They knew that the weight of the birds changed a lot even after they were adults, so they measured some of the traits that did not change once the birds were full grown--wing length and beak length. Scientists already knew from studying other kinds of birds that longer wings allowed birds to fly better over long distances, such as between the islands and the mainland. Shorter wings allow birds to take off from the ground more quickly and maneuver more easily as they fly. They also knew that the size of a bird's beak usually predicts what kind of seeds it will eat. Smaller-beaked birds are able to eat only small seeds, while larger-beaked birds can break open larger seeds and eat those. For each characteristic, they determined the median length for the whole population. This is what they saw:

Median Beak Length



Median Wing Length



Consider the questions listed below in your analysis of the data and what they mean. Then write your summary in the box below.

<p>A. Identify: What do I see in the data?</p> <ul style="list-style-type: none">• What is the trend in the data for the survival of the finches?• What is the trend in the data for the number of offspring?• What is the trend in the data in the characteristics of survivors? <p>Your summary:</p>	<p>B. Interpret: What does this mean?</p> <ul style="list-style-type: none">• What do you think might be causing the effects on survival that you saw?• What do you think might be causing the effects on the number of offspring produced?• What do you think might cause the trend in the characteristics of survivors? <p>Your summary:</p>
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Data Subset 4: Offspring and Inheritance Studies

The scientists studying the finches were unable to determine exactly which birds were the parents of each fledgling they caught and banded. However, for each year, they did know which birds were the breeding adults that could be the parents of one or more of the offspring that year and which birds were hatched during that year (offspring).

They recorded the number of breeding adults and the number of offspring each year. This is what they saw:

Year	Total # of breeding adults	Total # of offspring
1973	21	24
1976	31	29
1977	23	0
1978	8	8

Characteristics of parents and offspring: Each bird on the island was tracked individually, and their weight as well as their leg, beak, and wing lengths were measured each year. So the researchers knew what the characteristics of the breeding population (parents) were each year, and they knew what the characteristics of the offspring were that were hatched each year. They found the following things:

- Each year, the offspring had characteristics that were similar to but not exactly the same as the parents.
- Once birds were adults, their weight varied a lot. It typically changed by about a gram between the wet and the dry seasons of a single year, as well as changing as much as 3.5 grams from one year to the next.
- Once birds were adults, their beak lengths, wing lengths, and leg lengths did not change from season to season or from year to year.

Genes affecting beak length: Another set of researchers looked carefully at whether particular genes were involved in determining how long finches' beaks were. They were particularly interested in the size of the birds' beaks since that usually predicts what kind of seeds a bird will eat. Smaller-beaked birds are able to eat only small seeds, while larger-beaked birds can break open larger seeds and eat those. They found that there is a gene that has a large effect on determining how long the beak of the finch is. This gene is called *HMGA2* and has a long allele (L) and a short allele (S). They examined the genetic information from 71 medium ground finches and determined which alleles each bird had (genotype). This is what they found:

Genotype	Number of birds	Median beak length
LL	20	significantly longer than SS birds
LS	32	midway between LL and SS birds
SS	19	significantly shorter than LL birds

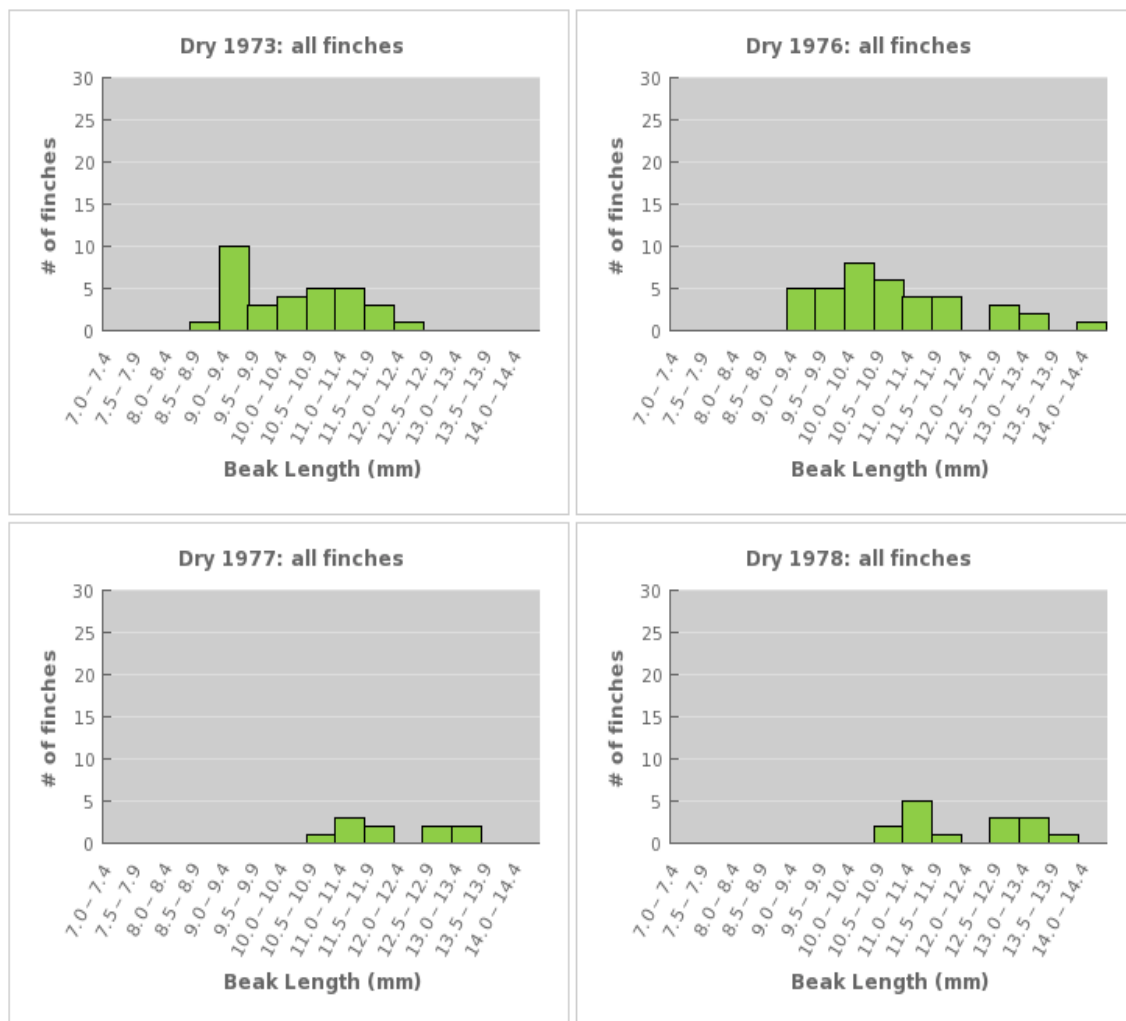
Consider the questions listed below in your analysis of the data and what they mean. Then write your summary in the box below.

<p>A. Identify: What do I see in the data?</p> <ul style="list-style-type: none"> • What is the trend in the data over time for the number of offspring? • Do the characteristics of offspring show evidence that beak length is heritable in finches? Explain. • Do the gene studies show evidence that beak length is heritable in finches? Explain. <p>Your summary:</p>	<p>B. Interpret: What does this mean?</p> <ul style="list-style-type: none"> • Would the weight or the beak length be more likely to be passed from parent to offspring? • Why would it matter if a trait is heritable or not if we are trying to understand what could cause changes in a whole population of descendants over several generations? <p>Your summary:</p>
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Data Subset 5: Studies of the Population of Finches at the End

As the scientists studied the medium ground finches, they collected a lot of measurements of all the birds on the island of Daphne Major. They were particularly interested in the size of the birds' beaks since that usually predicts what kind of seeds a bird will eat. Smaller-beaked birds are able to eat only small seeds, while larger-beaked birds can break open larger seeds and eat those. Over all the years of the study, they measured the beak length of the entire population of finches living on the island.

When researchers measured the length of the beaks of all the adult birds surviving on the island each year from 1973 through 1978, they saw this:



Consider the questions listed below in your analysis of the data and what they mean. Then write your summary in the box below.

<p>A. Identify: What do I see in the data?</p> <ul style="list-style-type: none">• What is the trait of interest in this study?• What is the range of variations in 1976? What is the range in 1978?• What is the median value for this trait in 1978?• Describe any differences in the distribution of the trait in 1976 and 1978. <p>Your summary:</p>	<p>B. Interpret: What does this mean?</p> <ul style="list-style-type: none">• What change occurred?• What do you think might be the effect of having a longer beak for finches living on Daphne Major?• What do you think might be the effect of having a shorter beak for finches living on Daphne Major? <p>Your summary:</p>
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