Cliff Swallow Data Packet

Overview: Cliff Swallows’ Wings

Cliff swallows are songbirds that gather in large colonies and build nests out of mud that they attach to hard or rocky vertical areas with overhanging surfaces, like those found on many cliffs. Sometimes there are thousands of nests in one colony.

Cliff swallows spend half the year in South America and migrate north in large flocks to nest and produce young during the summer months. This behavior of staying with the flock and returning to their colonies makes it more likely that each bird will find a mate and be able to reproduce. Their colonies are established near muddy areas close to water sources which provide them sufficient mud for nest building as well as sufficient food sources. Their diet is made up of flying insects.

As the number of highways expanded throughout much of the United States, large populations of cliff swallows left their original nesting sites on natural cliffs and began nesting in highway overpasses and culverts and beneath bridges. Soon there were huge colonies nesting under highways.

These man-made areas were more protected than the cliffs where the birds had been nesting before, and they had the same kinds of hard, vertical surfaces with overhangs that the swallows needed in order to build their nests. In addition, since many of these overpasses and bridges were built over rivers and other waterways, there were plenty of muddy areas and a lot of flying insects near the highways.

Researchers Charles Brown and Mary Bomberger Brown were interested in whether there would be any change in the birds themselves when they changed the locations where they nested from cliffs to under highways. Starting in the mid-1980s and continuing for many years, they studied large numbers of colonies of these birds that nested near highways in Nebraska, collecting specimens and banding, counting, measuring, and keeping track of birds over time.

From 1983 to 2012, the researchers observed that the average length of the wings of the population of cliff swallows in Nebraska changed.
Data Subset 1: Studies of the Population of Cliff Swallows at the Beginning

For this study, scientists captured birds from several different colonies nesting under highways in Nebraska in 1992 and 1996, banded and weighed them, and measured and recorded the length of their wings and several other parts of the birds' bodies. Scientists already knew from studying other kinds of birds that longer wings allow birds to fly better over long distances, such as during their yearly migration. Shorter wings allow birds to take off from the ground more quickly and maneuver more easily as they fly.

When scientists measured the length of the wings of a large number of birds during two years in the middle of their study (in 1992 and 1996), they saw this:

![Graph](image)


All data adapted from the following source:
Consider the questions listed below in your analysis of the data and what they mean. Then write your summary in the box below.

<table>
<thead>
<tr>
<th>A. Identify: What do I see in the data?</th>
<th>B. Interpret: What does this mean?</th>
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</thead>
<tbody>
<tr>
<td>• What is the trait of interest in this study?</td>
<td>• How many different categories of variation are there in this trait?</td>
</tr>
<tr>
<td>• What is the range of variations for this trait in the population?</td>
<td>• What do you think might be the effect of having longer wings for the swallows living under highways?</td>
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<tr>
<td>• What is the median value for this trait in the population?</td>
<td>• What do you think might be the effect of having shorter wings for the swallows living under highways?</td>
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Your summary:

Your summary:
Data Subset 2: Environmental Studies

Cliff swallows got their name because, historically, they nested on cliffs. But during the mid-1900s, many new highways were built in the United States. The swallows began relocating their nests under highway bridges. As they moved into nesting sites underneath and around highways, one of the biggest changes in their environment was that there were now cars moving through the areas near their nesting sites. Their original nesting sites on cliffs were generally far away from roads and did not encounter much traffic. Very few swallows were killed by cars in these low-traffic nesting sites.

Scientists were interested in what effect nesting so near highways might have on the cliff swallows. First, they wanted to know how much traffic the birds were encountering. So, they gathered data about the car traffic that was present in the area where they were working in Nebraska during the years of their study.

Since they could not count the exact number of cars that actually were moving through the cliff swallows’ environment throughout the entire time of their study, they estimated the likely amount of traffic during that time based on how many people drove to the Lake McConaughy recreation area in Nebraska on the same holiday weekends every year (the Memorial Day weekend and the July 4th weekend). This recreation area is in the middle of the region in Nebraska where many of the cliff swallows were. People visiting this recreation area would have to drive on the highways where cliff swallows were nesting to get there. The graphs here show what they found.

All data adapted from the following source:
Consider the questions listed below in your analysis of the data and what they mean. Then write your summary in the box below.

A. Identify: What do I see in the data?
   - How did the cliff swallows' environment change?
   - What was the greatest difference between their previous environment and their new environment?

   Your summary:

B. Interpret: What does this mean?
   - What change occurred in the traffic over the time scientists were studying the cliff swallows?
   - How do you think this might have affected the cliff swallows over time?
   - What would swallows need to be able to do to survive in their new environment?

   Your summary:
Data Subset 3: Survival and Reproduction Studies

Cliff swallows generally live only 4–6 years. During that time, they form mating pairs and build nests each year during the nesting season in many places throughout North America. The behavior of staying together with their flock as they migrate increases the likelihood that they will form a mating pair and be able to reproduce. The population that was studied nested in Nebraska. Each pair raises 2–4 offspring every year. By the end of the nesting season, the offspring are fully able to fly and can migrate south with their parents to the winter feeding grounds. They then return to Nebraska the following year to mate and, if successful, raise another generation of offspring.

Survival: When they began their studies of the cliff swallows nesting near highways, the scientists noticed along the sides of the roads many swallows that had been killed by cars. Every year, the scientists drove approximately the same number of miles over the same roads while they conducted their research. They watched along the side of the road and collected all the road-killed specimens they saw each year. This is what they found:

Reproduction: Scientists wondered if the changes they saw in the number of cliff swallows killed by cars was happening because the overall population of cliff swallows was decreasing. They estimated the number of cliff swallows in their study area each year by counting the number of nests. There are 2–6 birds inhabiting each nest. This is what they found:
**Characteristics of the swallow population:** Each year, the researchers collected all the road-killed specimens and measured and recorded information about them. They also collected and measured a set of birds that represented the population at large. That is, they had the same characteristics as the entire population of swallows living that year. They were especially interested in their wing length because they knew from studying other kinds of birds that longer wings allowed birds to fly better over long distances, such as during their yearly migration, while shorter wings allowed birds to take off from the ground more quickly and maneuver more easily as they fly. This is what they observed:

![Average Wing Length of the Population at Large](image)

Reprinted from Current Biology, 23(6), Brown, C. et al. Where has all the road kill gone? R234, (2013), with permission from Elsevier. Figure S1, modified.

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<tr>
<td>• What is the trend in the data for the survival of the swallows?</td>
<td>• What do you think might be causing the change in survival in the population over time?</td>
</tr>
<tr>
<td>• What is the trend in the data for the reproduction of the swallows?</td>
<td>• What do you think might be causing a change in overall population size over time?</td>
</tr>
<tr>
<td>• What is the trend in the data in the characteristics of the population at large?</td>
<td>• What do you think might cause a change in the characteristics of survivors in this population</td>
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<td>over time?</td>
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Your summary:

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The scientists studying cliff swallows did not do any experiments to determine whether wing length was an inherited trait in cliff swallows. However, scientists in southern France, studying a different bird called the European Bee Eater, did collect information about parents and offspring living in the wild in order to find out whether offspring mostly inherited their wing length from their parents or whether they developed their wing length mostly as a result of their diet and how they exercised.

**Characteristics of offspring:** These scientists banded the birds the year they were born and measured their weight and wing length when they were fully grown at the end of that year. Then each following year, they recaptured and remeasured the adult birds while they were nesting. Once again, they banded and measured the baby birds that were in the nest. Now they had information about the weight and wing size of both the offspring and their parents over several years. They found the following things:

- Once birds were adults, their weight often changed by as much as 7.5 grams on average from year to year and even during a single breeding season.
- There was no association between the weight of parents and the weight of their adult offspring.
- Once birds were adults, their wing size did not change from year to year.
- There was an association between the wing length of parents and the wing length of their adult offspring.

They calculated the most common wing length in offspring from different sets of parents:

<table>
<thead>
<tr>
<th>Male parent wing length</th>
<th>Female parent wing length</th>
<th>Offspring wing length (most common)</th>
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<tbody>
<tr>
<td>long</td>
<td>long</td>
<td>long</td>
</tr>
<tr>
<td>short</td>
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<td>short</td>
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<tr>
<td>long</td>
<td>short</td>
<td>medium</td>
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<tr>
<td>short</td>
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<td>medium</td>
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**Genetic studies:** By doing genetic studies, the scientists were able to calculate that about 60% of the variation in wing length of offspring was due to genes.

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<td>• Do the characteristics of offspring show evidence that wing length is mostly heritable in swallows? Explain.</td>
<td>• Would the weight or the wing length be more likely to be passed from parent to offspring?</td>
</tr>
<tr>
<td>• Do the genetic studies show evidence that wing length is mostly heritable in swallows? Explain.</td>
<td>• 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?</td>
</tr>
</tbody>
</table>

Your summary:
As the scientists studied the cliff swallows, they collected a lot of measurements of the birds. Over all the years of the study, from 1983 to 2012, they measured the wing length of two different sets of birds. One set was birds killed by cars. The researchers collected all the road-killed birds they found each year. The second set was birds that died accidentally while being captured for banding. To band birds, they caught the live swallows in mist nets, untangled them from the nets, then banded and released them. The vast majority of the birds caught and banded in this way were released totally unharmed. However, during the mist net capture, a few of the birds that were caught in the nets each year accidentally died. These dead birds were collected and studied as well. The mist net-killed birds represented the birds in the population that were not killed by cars (i.e., the population at large).

**Distribution of wing length in the two groups:** Scientists were interested in the wing lengths of the swallows since they already knew from studying other kinds of birds that longer wings allow birds to fly better over long distances, such as during their yearly migration. Shorter wings allow birds to take off from the ground more quickly and maneuver more easily as they fly. For each year that the researchers measured wing length, they had a set of road-killed birds and a set of birds representing the population at large. Overall, they had 104 road-killed birds and 134 birds representing the population at large that they had collected throughout 1983-2012. When they compared the wing lengths in the set of roadkill and the set representing the population at large that were not killed by cars, this is what they saw:

![Distribution of Wing Length in Roadkill and Population at Large](image-url)

Average wing length over time: In addition, for each year they determined the average wing length of the road-killed birds and the average wing length of the birds representing the population at large that they collected during that particular year. Their data showing average wing length from 1983 to 2012 are shown below.

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<td>• What is the trait of interest in this study?</td>
<td>• What change occurred in this trait over time in the population at large?</td>
</tr>
<tr>
<td>• What is the most common value for this trait for road-killed birds? What is the most common value for the population at large?</td>
<td>• What do you think might be the effect of having longer wings for the swallows living under highways?</td>
</tr>
<tr>
<td>• What is the trend over time in the average value for this trait for the population at large?</td>
<td>• What do you think might be the effect of having shorter wings for the swallows living under highways?</td>
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<tr>
<td>• What is the average value for this trait in the population at large in 1983? What is the average value in the population at large in 2010?</td>
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Your summary: |