Name_____

DATA Nugget

When whale I sea you again?

Featured scientist: Logan J. Pallin from Oregon State University
Written by: Alexis Custer

Research Background:

People have hunted whales for over 5,000 years for their meat, oil, and blubber. In the 19th and 20th centuries, pressures on whales got even more intense as technology improved and the demand for whale products increased. This **commercial whaling** used to be very common in several countries, including the United States. Humpback whales were easy to hunt because they swim slowly, spend time in bays near the shore, and float when killed. Before commercial whaling, humpback whales were one of the most visible animals in the ocean, but by the end of the 20th century whaling had killed more than 200,000 individuals.

Today, as populations are struggling to recover from whaling, humpback whales are faced with additional challenges due to **climate change**. Their main food source is krill, which are small crustaceans that live under sea ice. As sea ice disappears, the number of krill is getting lower and lower. Humpback whale population recovery may be limited because their main food source is threatened by ongoing ocean warming.

Images of humpback whales at the Palmer Station LTER in the Western Arctic Peninsula. Photo credit: Beth Simmons.

One geographic area that was over-exploited during times of high whaling was the South Shetland Islands along the Western Antarctic Peninsula (WAP). The WAP is in the southern hemisphere in Antarctica. Humpback whales migrate every year from the equator towards the south pole. In summer they travel 25,000 km (16,000 miles) south to WAP's nutrient-rich polar waters to feed, before traveling back to the equator in the winter to breed or give birth. Today the WAP is experiencing one of the fastest rates of regional climate change with an increase in average temperatures of 6˚ C (10.8˚ F) since 1950. Loss of sea ice has been documented in recent years, along with reduced numbers of krill along the WAP.

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Logan working at the Palmer Long-Term Ecological Research Field Station.

Logan is a scientist who is studying how humpback whales are recovering after commercial whaling. Logan's work helps keep track of the number of whales that visit the WAP in the summer. He also determines the **sex ratio**, or ratio of males to females, which is important for reproduction. The more females in a population compared to males, the greater the potential for having more baby whales born into the next generation. Logan predicts there may be a general trend of more females than males along the WAP as the season progresses from summer to fall. Logan thinks that female humpback whales stay longer in the WAP because they need to feed more than males in order to have extra nutrients and energy before they birth their babies later in the year. This extra energy will be needed for their milk supply to feed their babies.

Humpback whales only surface for air for a short period of time, making it difficult to determine their sex. In order to identify surfacing whales as female or male, scientists need to collect a **biopsy**, or a sample of living tissue, in order to examine the whale's DNA. Logan worked with a team of scientists at Oregon State University and Duke University to engineer a modified crossbow that could be used to collect samples. Logan uses this crossbow to collect a biopsy sample each time they spot a whale. To collect a sample, Logan aims the crossbow at the whale's back, taking care to avoid the dorsal fin, head, and fluke (tail). He mounts each arrow with a 40mm surgical stainless steel tip and a flotation device so the samples will bounce off the whale and float for collection. The samples are then frozen so they can be stored and brought back to the lab for analysis. Logan also takes pictures of each whale's fluke because each has a pattern unique to that individual, just like the human fingerprint. Additionally, at the time of biopsy, Logan records the pod size (number of whales in the area) and GPS location.

Once the samples are processed, Logan's data are added to the long-term datasets collected at the WAP. To address his question he used data from 2010-2016 along the WAP and other feeding grounds. Logan's data ranges from January to April because those are the months he is able to spend at the research station in the WAP before it gets too cold. Logan has added to the scientific knowledge we have about whales by building off of and using data collected by other scientists.

The patterns on a humpback whale's fluke are as distinct as the human fingerprint and can be used to identify individuals.

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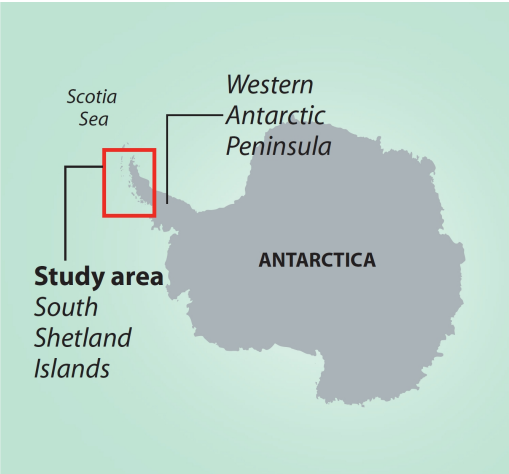
Scientific Question: In what ways does the abundance and/or sex ratio of male and female humpback whales change over the course of the year in the Western Antarctic Peninsula?



What is the hypothesis? Find the hypothesis in the Research Background and underline it. A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.

Scientific Data:

Use the data below to answer the scientific question:

Table 1

Number of humpback whales biopsied in **2014**				
	January	February	March	April
Female	33	14	13	No data
Male	45	17	14	No data
Sex Ratio* (male:female)				No data
Percent Male and Female				No data

Table 2

Number of humpback whales biopsied in **2015**				
	January	February	March	April
Female	50	3	18	No data
Male	45	1	11	No data
Sex Ratio (male:female)				No data
Percent Male and Female				No data

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Table 3

Number of humpback whales biopsied in **2016**				
	January	February	March	April
Female	15	28	29	41
Male	14	30	24	19
Sex Ratio (male:female)				
Percent Male and Female				

Table 4

Average number of humpback whales biopsied from **2014-2016**				
	January	February	March	April
Average Number Females	33	15	20	41
Average Number Males	35	16	16	19
Average Sex Ratio (male:female)	1.1	1.1	0.8	0.5
Average Percent Male and Female	51% male 49% female	52% male 48% female	44% male 56% female	32% male 68% female

**Sex ratio is calculated as the number of males, divided by the number of females. The greater the number above 1, the more males there are relative to females. The smaller the number below 1, the more females there are, relative to males. If the number is 1, then there are equal numbers of males and females.*

What data will you graph to answer the question?

Independent variable(s): _____

_____

Dependent variable(s): _____

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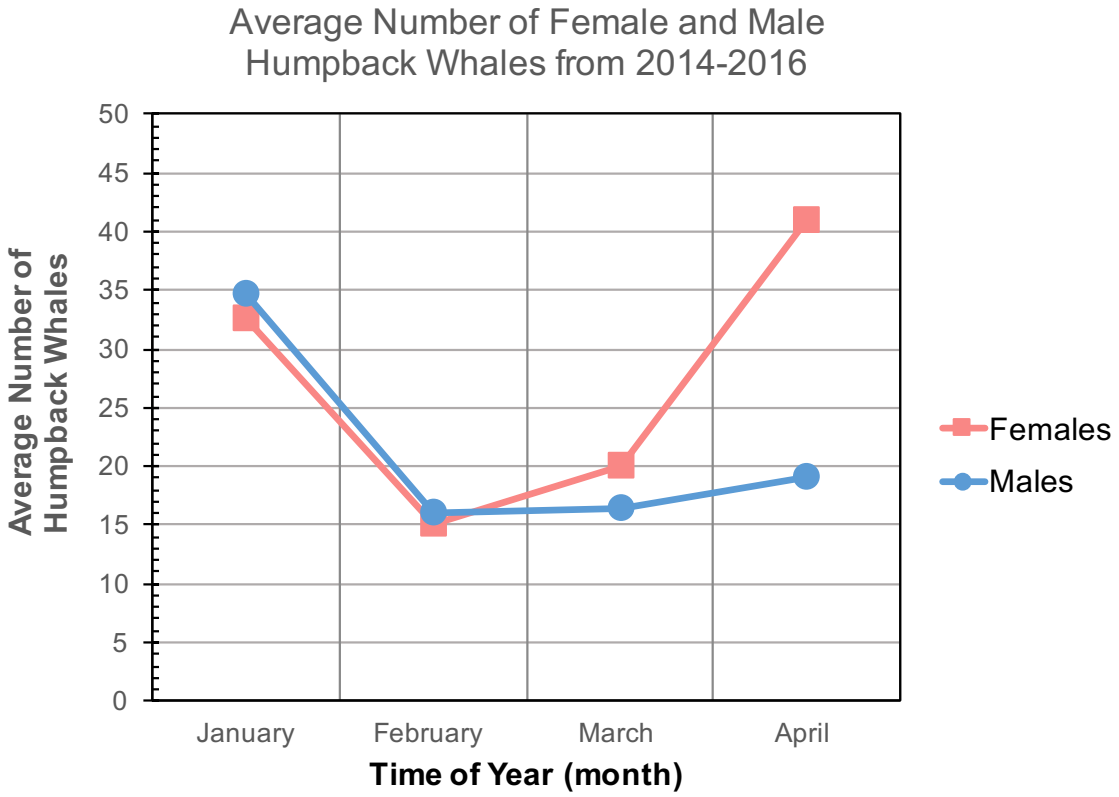
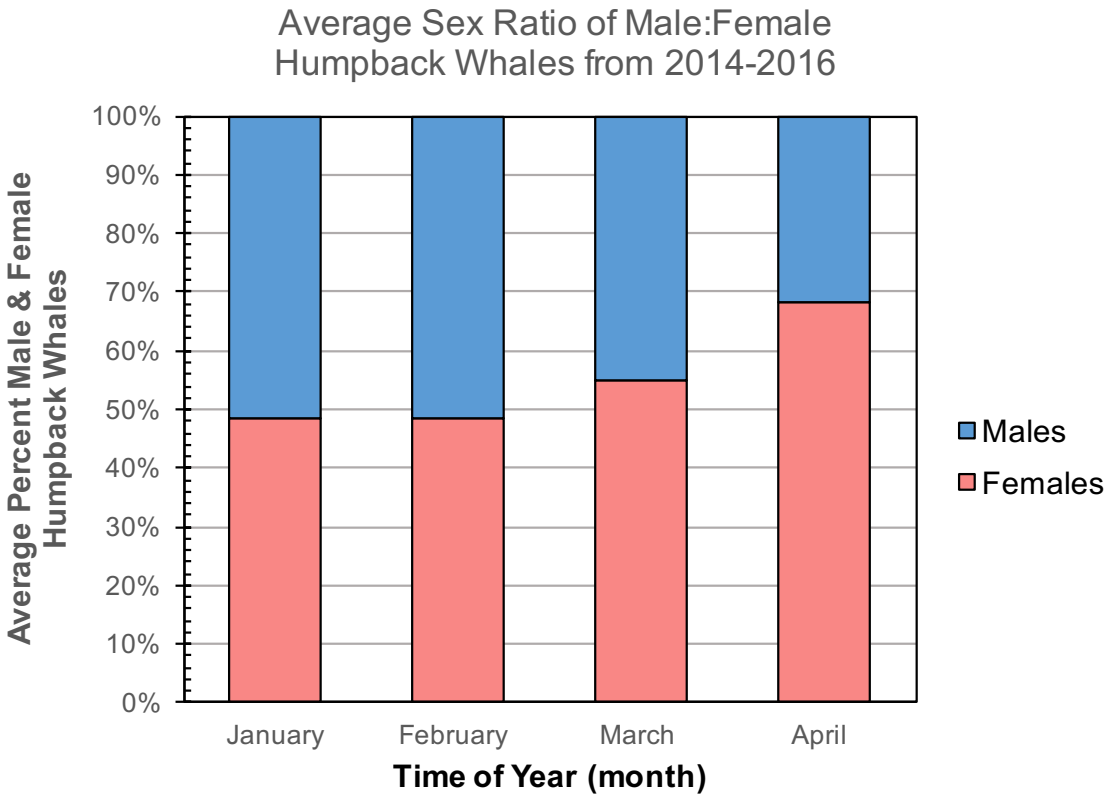
Below are graphs of the data: Identify any changes, trends, or differences you see in your graphs. Draw arrows pointing out what you see, and write one sentence describing what you see next to each arrow.





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Interpret the data:

Make a claim that answers the scientific question.

What evidence was used to write your claim? Reference specific parts of the tables or graphs.

Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about the importance of the WAP for whale populations during their yearly migration.

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Did the data support Logan's hypothesis? Use evidence to explain why or why not. If you feel the data were inconclusive, explain why.

Your next steps as a scientist: Science is an ongoing process. What new question do you think should be investigated? What future data should be collected to answer your question?