Humpback whales

Megaptera novaeangliae

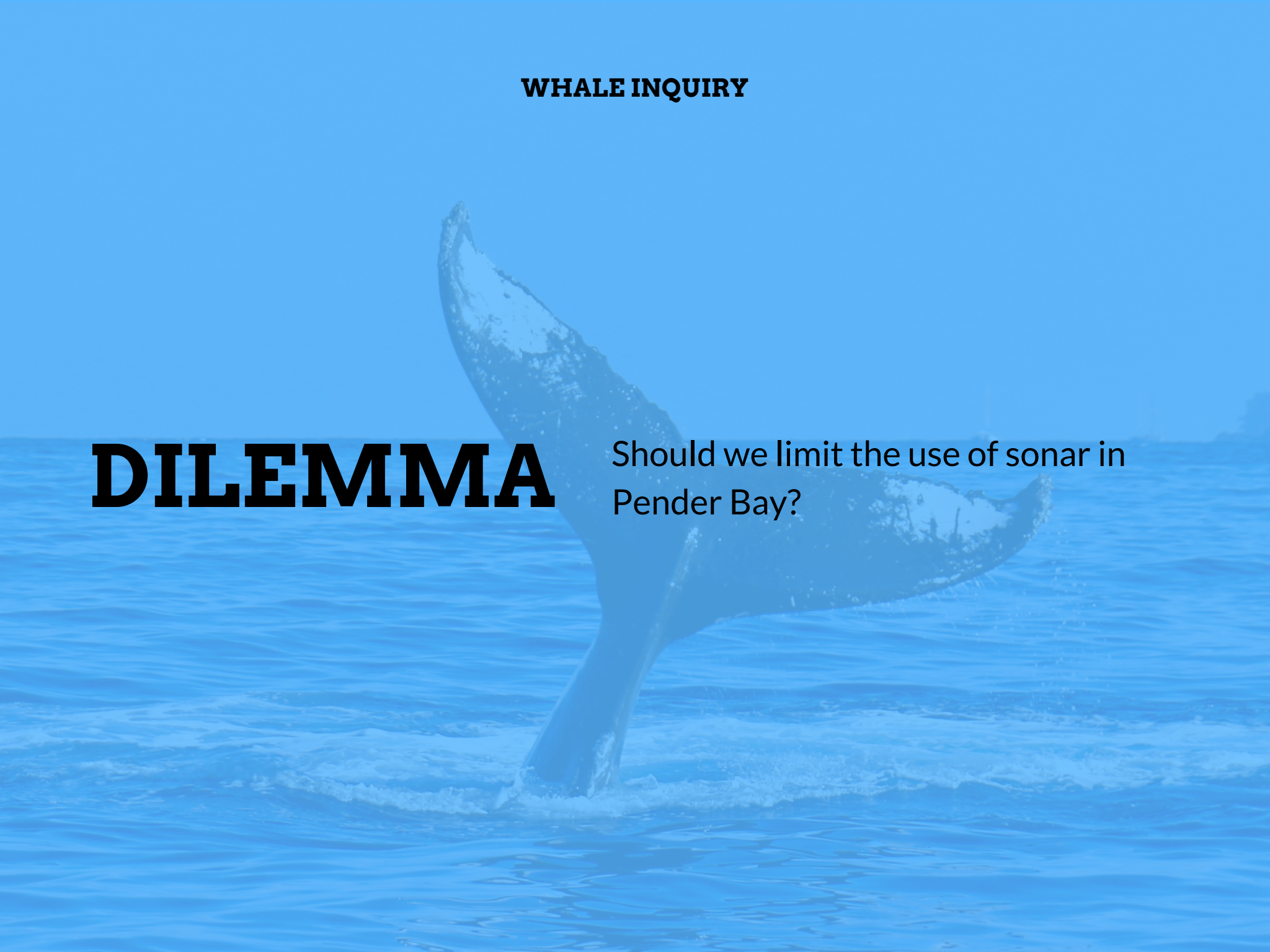
Student task

PAWSEY supercomputing centre

DIGITAL TECHNOLOGIES HUB

WESTERN AUSTRALIAN MARINE SCIENCE INSTITUTION

Australian Data Science Education Institute



DILEMMA

Should we limit the use of sonar in Pender Bay?

DID YOU KNOW?

1. Whales communicate, navigate, and hunt using sound.

2. Whale song is also thought to be used for mate selection.

3. Mass whale strandings can be caused by ships and the military using sonar.

HOW DO WHALES USE SOUND?

Whales use echolocation to find their food. They make a clicking noise and listen to the click echo from objects in their environment. That gives them a surprising amount of information about the shape of the objects, as well as how far away they are.

Any activity that puts a large amount of noise into the marine environment can interfere with whale behaviour, such as:

1. naval sonar technology (which works in a very similar way to whale clicks to allow sonar operators to map their environment)

2. oil and gas drilling or even

3. or even noisy ships.

WHALE INQUIRY

WHAT IMPACT WOULD DEVELOPMENT OF PENDER BAY HAVE ON HUMPBACK WHALES?

WHAT KIND OF DEVELOPMENT?

HOW LOUD WOULD IT BE?

EXACTLY WHERE WOULD IT BE?

WHEN WOULD IT BE NOISIEST?

WHEN DO WHALES USE PENDER BAY?

WHO STUDIES WHALES?

- One of the scientists who collected the data we will use is Dr Michele Thums.

- Dr Thums studies the ecology, distribution and movement behaviour of marine megafauna such as dolphins, whales, sea turtles, and sharks.

DO SOME RESEARCH:

Open the links to these websites.

- Introduction to humpback whales
- Baleen whales and sonar
- Accuracy of humpback whale navigation
- New research on humpback use of sonar

To learn about the humpback population in Pender Bay, use the Whale dataset.

It records scientific data collected about the whales observed in Pender Bay from 2009 to 2012

A BIT ABOUT THE DATASET

Observers stand at an observation point on the shore of Pender Bay in groups of usually 2-4 people, and record the whales they can see during 5-minute sweeps of the bay every 20 minutes. The observations typically happen during whale season - roughly from June to November.

The observations haven't been completely consistent. Sometimes there are more observers. Observations can be more or less frequent- sometimes they start in June, sometimes in July. Sometimes they finish in October, sometimes in November. Sometimes observers recorded environmental conditions such as temperature and wind direction. Sometimes they didn't.

EXPLORING THE DATASET

	A	B	C	D	E	F	G	H	I	J	K	L
1	Day	Month	Year	Start	Finish	No. of Observers	No. of Adult Whales Sighted	No. of Calves Sighted	Total Whales sighted	Breaching	Blowing	Lobtailing
2	8	August	2009	7:45 AM	750	5	91	0	91			
3	4	August	2009	8:30 AM	835	3	85	0	85			
4	8	August	2009	8:00 AM	805	5	81	1	82			
5	5	August	2009	9:45 AM	950	3	80	0	80			

Open the Pender Bay data in a spreadsheet program such as Excel, Numbers, or Google Sheets.

EXPLORING THE DATASET

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There are 7203 rows and 42 columns of data, which is really difficult to make sense of at first glance.

What can you do to understand it?

Start by grouping the headings

For example:

About the session: day, time, number of observers

About the whales: number, adults, calves, behaviour

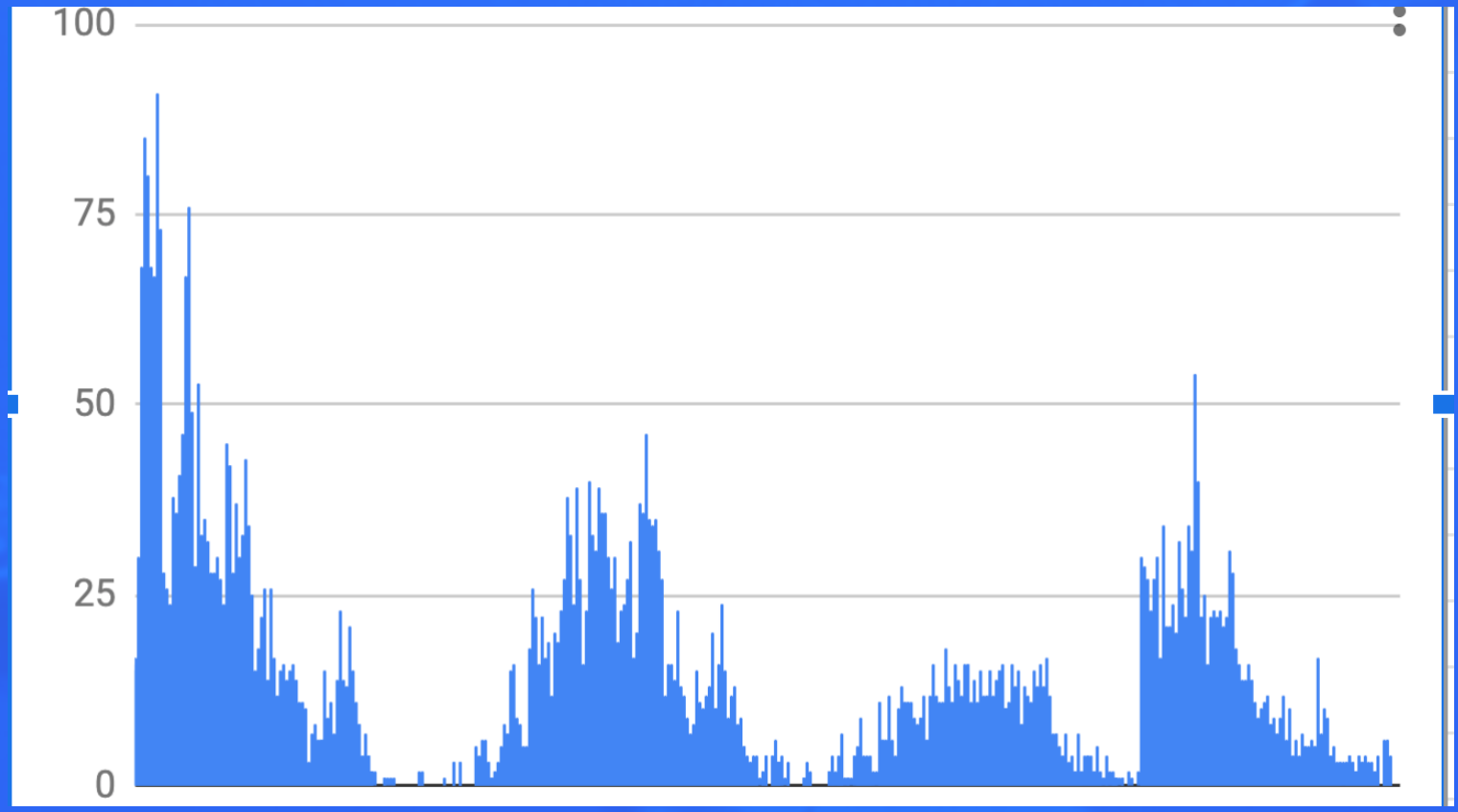
About the conditions: temperature, wind speed, tides etc.

Try sorting the data by the total number of whales.

When are the most whales observed? We want to know if and how numbers are changing.

What's the best way to display the data so that we can find that out?

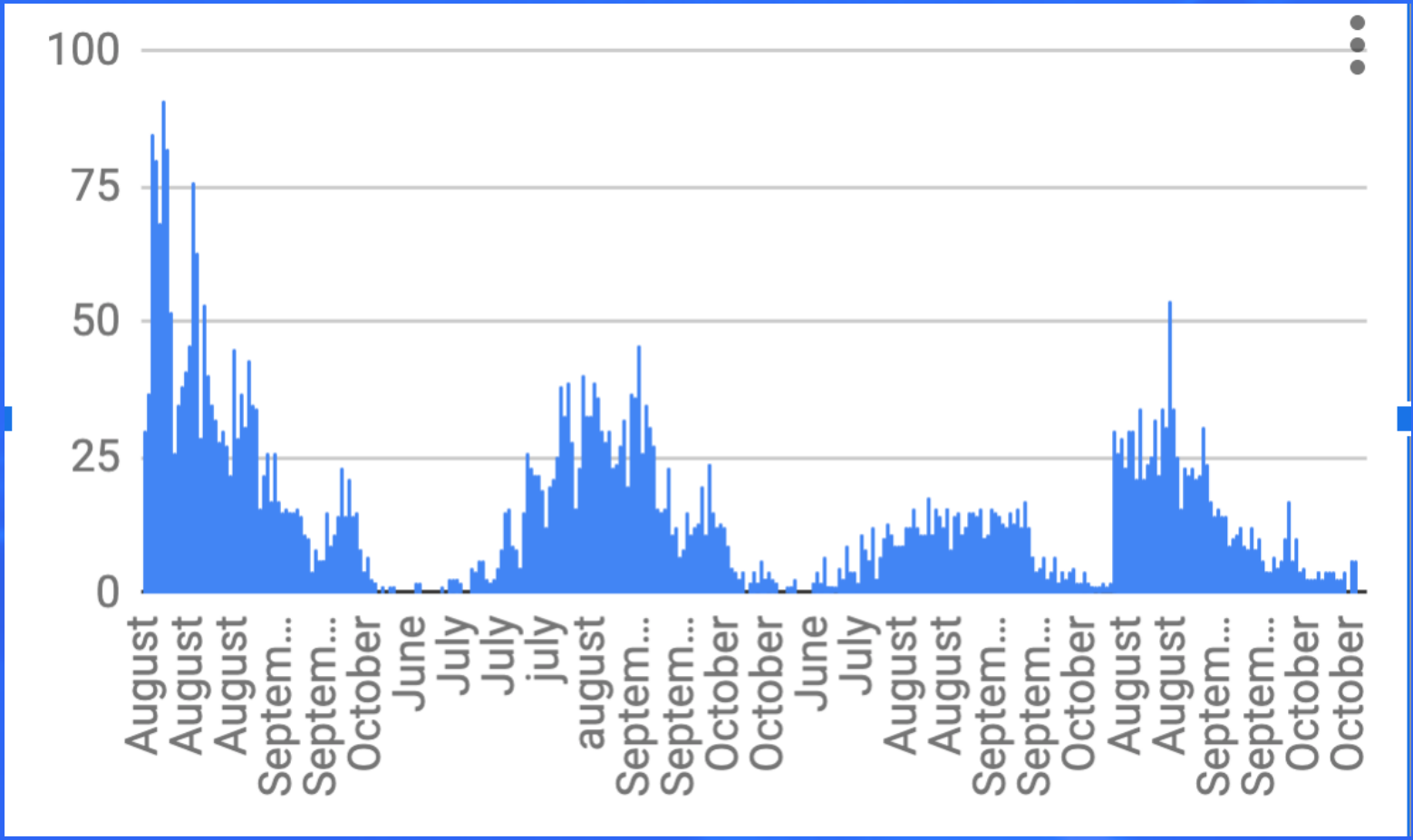
Try graphing the total number of whales.



When are the most whales observed?

What other information do you need to add to the graph to answer that question?

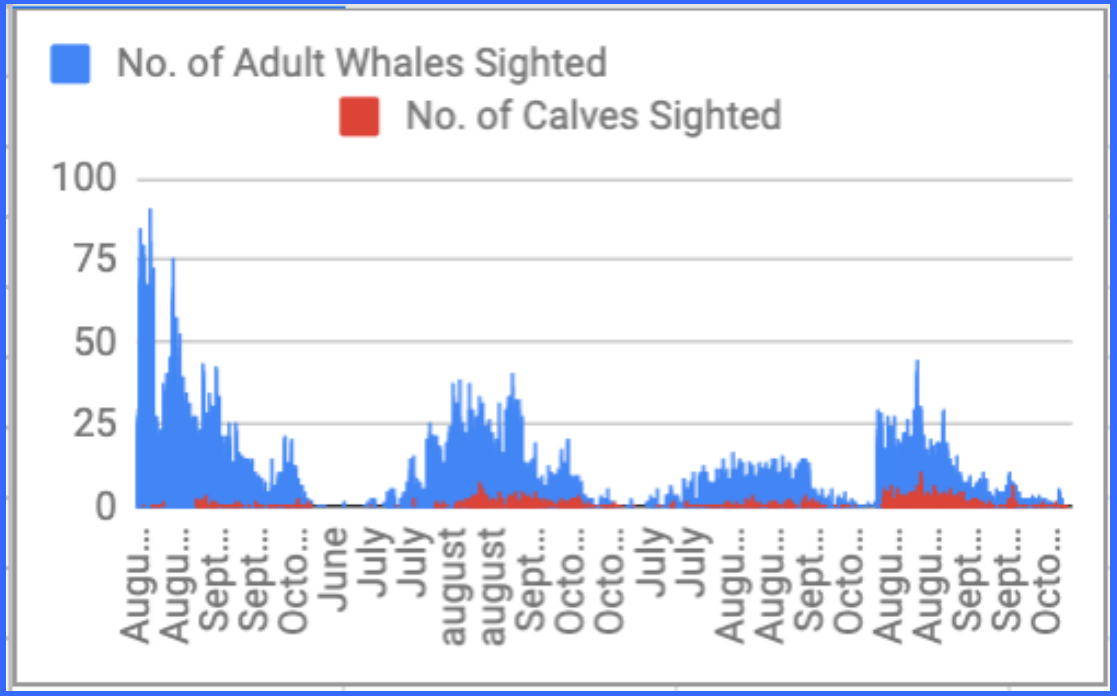
Try graphing the total number of .



Add the month column to your graph as the x-axis.

How much easier is this to understand?

Try graphing the number of adults and calves against the months.



What does this tell you about the population?

Why is there a sharp increase in the final year (instead of the gradual increase we see in other years)?

Consider the following questions. How could you use the data to answer them?

- **What time of year do whales use the area? (What data is missing for this question? Why?)**
- **When are whales most active – morning or afternoon? (What data is missing for this question? Why?)**
- **During which months are juveniles observed?**
- **How have whale numbers changed over the observation period?**
- **How do whales actually use the bay?**

Break up the data into separate sheets for each year

Calculate the the average number of adults, calves and totals for each year.

Do the same for each month. Use the average function.

How has the number of whales changed over time?

Copy the averages into a new column in a new sheet and graph the changes. Does this make it easier to see how the numbers have changed? Is it easier to read as one graph or with separate graphs for adults, calves, and totals?

What differences do you notice in the data for different years?

The same data hasn't been collected every year. How does this impact what you can learn from the data?

Consider the data collection technique.

- The number of observers varies. What impact might this have on the number of whales spotted?
- Different days have different numbers of observation sessions at different times. Can you compare days? Months? Years?
- What kind of comparisons might be valid? What can you compare from day to day without skewing your results?

Consider the data collection technique

- Average number of whales per sweep?
- Average number of whales per day? What if it’s the same whales from sighting to sighting, and whales happening to hang out within sight of the shore get counted on every sweep?
- What about the maximum number of whales in one sweep in a day?

Consider the data collection technique

Bear in mind that the number of whales observed is not the same as the number of whales present, so you won’t get absolute numbers.

Like many forms of data collection , the data you get (how many whales the observers saw each time they observed) is a proxy for the data you actually want (how many whales actually use the area).

CONSIDER

Write a proposal to study whale numbers in Pender Bay to determine the impact of sonar and other noise pollution.

List the ideal setup for your study, including details such as timing of observations, number of observers, and types of information to record.

Not a lot is known about the response of humpback whales to sonar. What kind of experiments could you conduct to determine the impact of sonar activity in Pender Bay?

What are the ethical considerations of running that kind of experiment?

Write a proposal to run your experiment. Remember to include the reasons why the experiment is important, as well as the details of what the experiment is and how it should run.

CONSIDER

In your proposal, think about the following:

The ethics of your experiment. What will you do if it becomes clear it is harming the whales or scaring them away?

The resources required to conduct your experiment. How many people will you need, and for how long?

Why should we be concerned about protecting whale habitat?

Be prepared to argue your point of view against others in your class.

HOW WILL I BE ASSESSED?

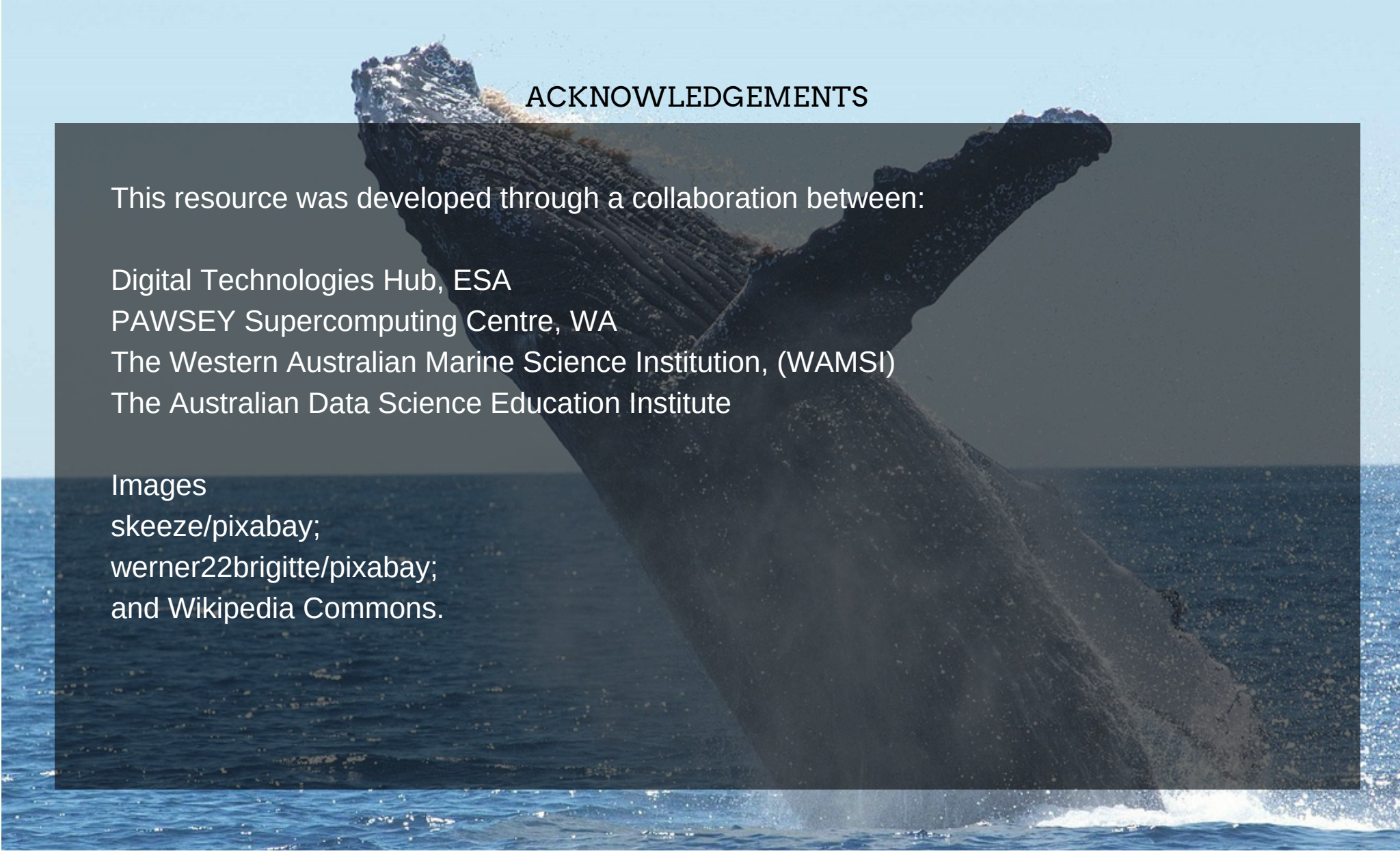
Use this rubric to help you and your team self-assess your work on the proposal.

Experimental Design and Data Analysis	1	2	3	4
Science (Experimental science)	I did not use scientific ideas.	I designed a new experiment that doesn't collect the data needed	I designed a new experiment that collects some of the data needed	I designed a new experiment that collects most of the data needed
Cross Curricular Capabilities (Sustainability)	I did not consider sustainability in my experimental design	I considered sustainability or ethics but not both in my experimental design	I considered both sustainability and ethics in my experimental design	I adapted my experimental design to be more ethical and to collect multiple types of data needed to assess the sustainability of development in Pender Bay

HOW WILL I BE ASSESSED?

Use this rubric to help you and your team self-assess your work on the proposal.

Experimental Design and Data Analysis	1	2	3	4
Research into humpback whales (ICT Capability)	I didn't use any references.	I viewed up to three references and recorded brief notes.	I viewed up to three references and recorded notes in a table to organise the information.	I viewed more than three references and recorded detailed notes in a table to organise the information.
Whale dataset and using a spreadsheet (Digital Technologies)	I didn't use the whale dataset.	I sorted the whale dataset to help answer a question.	I created a chart to present the data visually.	I was able to draw conclusions from the data and create information used in the experimental design.



ACKNOWLEDGEMENTS

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Digital Technologies Hub, ESA
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