Narwhal Identification

ACTIVITY TIME

120 minutes

LEARNING OUTCOMES

- Understand key aspects of narwhal life history and how these can affect population growth.
- Implement techniques to assess population size and distribution.
- Explore the mark-recapture method with photo-identification.
- Complete fractions and rearrange formulae to demonstrate results from data.
- Understand how research surveys can help identify key habitats and inform the protection and management of narwhal populations.

OVERVIEW

WHY?

Narwhal are harvested for food in some Inuit communities and much of what we know about this hard-to-study species is informed by Inuit knowledge. The species is threatened by climate change and human activities. A study technique called mark-recapture can help researchers monitor the narwhal population.

WHAT?

- Narwhal natural history
- A research method called "Mark Recapture".
- Use data to estimate population size

HOW?

Play a game

Review research techniques and background

Practice a mark-recapture method of research

Draw conclusions based on the data

Discussion questions

CONTENTS

PREPARATION

MATERIALS

- Dried beans (white), approximately 100 per group
- Plastic cups, two per group
- Permanent marker

RESOURCES

Rapid-fire Narwhal Q & A Game
Break the class up into 2 teams and, if possible, give each team a bell or buzzer. Each time a question appears in the presentation, the first team to buzz gets to answer. If they answer incorrectly give the other team a chance to answer.
https://arcticeider.com/links/nwi09

National Geographic Narwhals video
Two minute video explaining the basics of Narwhal and showing them trapped in sea ice.
https://arcticeider.com/links/nwi06

Video Solves Mystery of How Narwhals Use Their Tusks
National geographic drone footage taken in the far northeastern regions of Canada finally sheds light on how narwhals use the massive tusks protruding from their heads.
https://arcticeider.com/links/nwi10

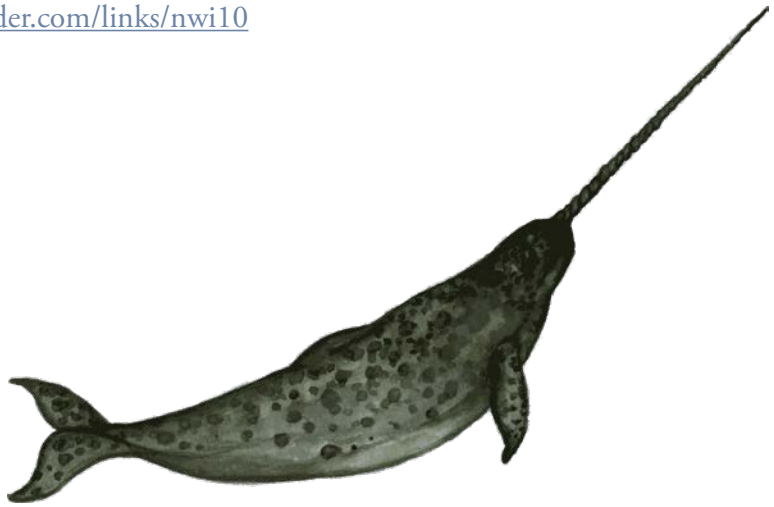


IMAGE 1 Narwhal, Allanguaaq ᐊᒡᓚᖃᐊᖅ, Monodon monoceros (S. DesRoches)

BACKGROUND

PART I: LIFE HISTORY

Narwhal, Monodon monoceros or Aahanngiq, is a type of toothed whale that belongs to the same family as the beluga. Like beluga, narwhal live in arctic waters and grow to be about four to five metres long. Unlike other relatives, such as orcas and porpoises, narwhal do not have a dorsal fin. Narwhal are best known for the unique tusk found on adult males. This tusk is, in fact, a tooth that erupts from the upper left lip, grows in a spiral pattern, and has earned these whales the moniker, "unicorns of the sea".

Narwhal is a long-lived species that reproduces slowly, but many basic facts about its life history are still debated. Narwhal can live for around 50 years. Males mature at 9-16 years. Females mature sooner — at 4-9 years of age. Calves are born in the summer after a 14-month gestation. Like all mammals, newborn narwhal drink milk from their mother. When they are born, calves are about 1.5 metres long and weigh about as much as an adult human (roughly 80 to 100kg). They are dependent on their mother for a year or two.

IMAGE 2 A pod of Narwhal (K. Laidre, NOAA)

Narwhal are social animals that travel together in pods. Winter pods are often small with up to 20 individuals, but in summer larger pods form with hundreds or thousands of narwhal. Narwhal spend their winters amid pack ice in the Davis Strait. When the ice starts to melt, they undertake a migration of 3,000 km or more to reach their summering grounds in the fjords and bays of Baffin Island and Greenland, where it is possible to observe them from the shore. Observations by Inuit and researchers suggest narwhal return to the same locations year after year. Narwhals eat squid, shrimp and fish (Arctic cod, Arctic char, Greenland halibut).

VOCABULARY

Quota: A fixed number of an animal that a group is allowed to harvest.

Sustainable harvest: A harvest that maintains, or allows an increase in, a population.

Echolocation: Sound waves reflected back to an emitter, usually in order to find prey.

While narwhal may use their tusk occasionally to assert social dominance in the pod, researchers now think the tusk is mainly a tool for communication and as a sensory organ that can detect changes in temperature, pressure, and other signals to help it survive in the cold arctic waters. National Geographic has recently documented, via a drone video, a narwhal using its tusk to stun its prey – Video Solves Mystery of How Narwhals Use Their Tusks (pg. 2).

Narwhal can produce a variety of whistles, pulsed and click sounds to communicate among their pod and they use **echolocation** to navigate, find breathing holes and prey and to avoid predators.

PART II: USES, THREATS AND CONSERVATION

About 80,000 narwhal exist globally. Some researchers are concerned about how the species will adapt to changing arctic conditions because of their long migration routes and site fidelity. While winter pack ice provides shelter from predators (such as orcas), it can also be a dangerous place for narwhal if conditions change suddenly and access to breathing holes are cut off. Entrapments can be important to Inuit hunters since whales confined to a small area of water are easier to hunt. Skin, or maktuk, is an important source of nutrients and one of the few sources of vitamin C in a traditional winter diet. With an excellent sense of hearing, narwhal are also very wary and will dive deep underwater to avoid boats. This makes them challenging to observe and until recently, little scientific knowledge had been accumulated. Inuit knowledge about narwhal has helped us better understand the species.

Changing sea ice in the Arctic may increase entrapments of narwhal and other marine species since ice can become less predictable, altering the distribution of food resources or timing of important seasonal events. Recent studies also suggest narwhal are sensitive to human activity. Seismic surveys used in oil and gas exploration use compressed air or acoustic waves to map ocean depth and sea-bottom formations. Researchers suspect the noise created underwater from these surveys can negatively impact narwhal and disrupt migrations and their ability to use echolocation. Increasing numbers of orca in Hudson Bay and the Arctic Ocean because of climate change are another possible threat to narwhal.

From climate change to resource development - and to a lesser extent, hunting - narwhal populations face many pressures. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lists the narwhal as a “species of special concern”, while the International Union for Conservation of Nature (IUCN) describes narwhal as “near threatened”. In its latest report, the IUCN highlights the need for more information about narwhal populations.

PART III: COUNTING POPULATIONS

Researchers and wildlife managers count animals for many reasons. Population size, monitored over time, tells us whether the population is growing or declining. It can also provide other indicators of population health, such as the rates of birth and survival of young animals and the population structure. Additionally, monitoring the population allows wildlife managers to collect data about animal distribution and migration behaviour.

Population size and makeup can help resource managers set hunting and fishing **quota**s or determine sensitive breeding grounds that require protection. Quotas are a guideline designed to make sure that too many animals are not taken so a sustainable population can be maintained.

IMAGE 3 We can learn a lot from aerial surveys of narwhal however it isn't always an accurate way to measure their population. (K. Laidre, NOAA)

Counting every individual in a population would be impractical, if not impossible. Therefore, researchers count a sample of the population and use that to make an estimate of population size and trends. Because of their large geographical range, and ability to dive to avoid humans, narwhal populations are challenging to count. Currently, population estimates are informed by traditional ecological knowledge from Inuit communities, aerial surveys, and harvest reports. There are many techniques used to count populations and each one has strengths, weaknesses and assumptions. Using more than one technique, understanding an animal's life history and incorporating traditional knowledge into the study's design can help improve the accuracy of population estimates.

Harvest (catch reported by fishermen) is one way to estimate population size. Simply put, if a fishing effort is the same year after year, but harvests increase, managers can predict that the population is growing.

Aerial surveys allow pods of narwhal to be photographed from above. Understanding migration routes can help researchers track narwhal.

THE MARK-RECAPTURE TECHNIQUE

Mark and recapture is another technique used to estimate a population. In this lesson it is used in conjunction with photo identification. This method assumes that every individual in a population has an equal chance of being captured, or in this case, photographed. Mark-recapture studies require at least two rounds of observations, then a simple mathematical equation can be used to estimate the population size.
One can make inferences about the population using the proportion of recaptured animals with marks: if most of the individuals recaptured have marks, then a large proportion of the population has marks suggesting that the population size is small. However, if only a few marked animals are recaptured, it suggests that a small proportion of the population has marks, which means that the population size is likely large.

In the first round, live traps are deployed and a sample of animals are captured. Animals are counted and identified either by attaching a mark (for example ear-tags, leg bands or even coloured hair dye for chipmunks), or they are identified using permanent marks on their bodies (e.g. sperm whale flukes, orca saddle patches, zebra stripes), and released back to the environment. After a sufficient period of time, another sample of the population is captured, counted and examined for marks.

Photo identification is becoming an important tool that lets researchers and communities track narwhal. During their migrations, narwhal sometimes swim near shore, which allows them to be photographed. Narwhal have unique identifying marks on their bodies, including a tooth-like ridge on their back (called the dorsal ridge), so they can be identified and counted using photographs instead of traps.

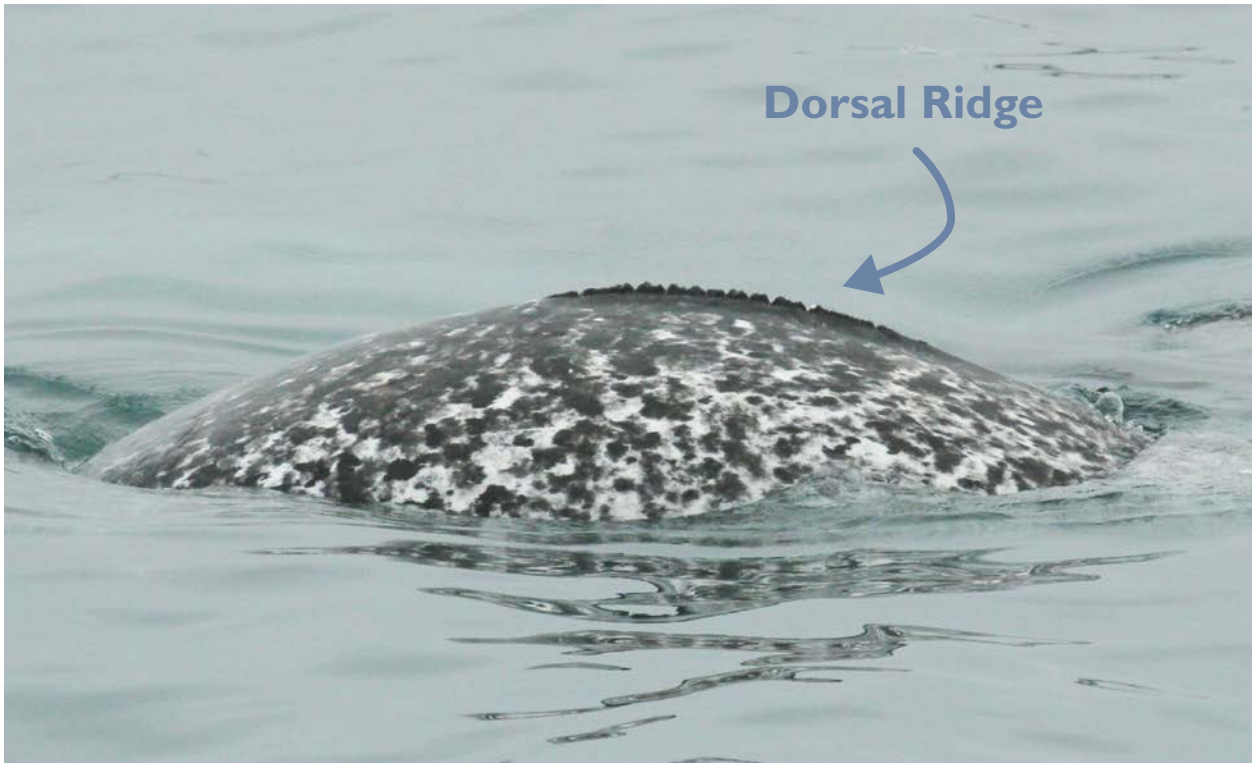


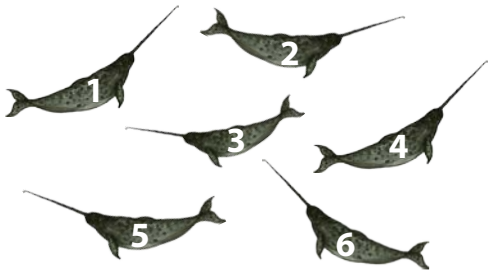
IMAGE 4 Dorsal ridge marking can be used to identify individual narwhals. (M.Marcoux)

PART IV: IDENTIFICATION SAMPLE

5. We estimate the number of whales using the formula:

1. We want to estimate the size of a population of whales in the ocean.

2. We capture a random sample of individuals in a first collection and give each captured individual a numbered tag (6 whales).



3. We release the "marked" individuals back into the population.

4. The next year, we capture another random sample of whales in a second collection and count the total number of whales captured (8 whales), and the number of these whales that have marks (3 whales).

$$\frac{\#\ of\ whales\ in\ first\ capture}{(\#\ of\ marked\ whales\ from\ recapture\ /\ number\ of\ whales\ recaptured)} = estimated\ total\ population$$

$$\frac{8}{(3/6)} = estimated\ total\ population$$

$$estimated\ total\ population = \frac{8}{0.5}$$

$$estimated\ total\ population = 16$$

DORSAL RIDGE MARKING PHOTO EXEMPLARS

Locate and circle any identifying marks on the narwhal photos shown below.

IMAGE 5 There is a chunk missing from the left side of the dorsal ridge. (M.Marcoux)

IMAGE 6 There is a dip on the left side of the dorsal ridge. (M.Marcoux)

IMAGE 7 The dorsal ridges has very few notches and is thus barely visible. (M.Marcoux)

WORKSHEET

1. Collect materials (per group)

   - White beans (about 100)
   - Two plastic cups
   - Permanent marker

2. Place all beans in one cup. One person grabs a handful of beans out of the cup. Mark each bean pulled out with a black dot or x (on both sides of the bean) with the permanent marker. This is the only time you will mark the beans.

   - Number of beans marked from first capture: _____

3. Put the marked beans back in the cup with the others and pour the beans between the two cups a few times until well mixed.
4. Pull out another handful of beans. Count how many beans you collected in total (captured) and how many were marked (recaptured). Record this data in *Table 1* below. Mix all the beans back together again.
5. Repeat steps 3-4 a total of 10 times.
6. Calculate the averages in the bottom row of *Table 1*.

FIGURE 1 In this sample, fifteen beans were captured. Two of them were previously marked (recaptured).

7. Using your data from *Table 1*, complete the equation below:

$$\frac{\textit{Number of beans in first capture}}{\textit{Average number marked (recaptured) beans / average number of beans sampled in each round}} = \textit{estimated total population}$$

8. The estimated bean (narwhal) population is: _____

9. Compare your results as a class.

Sampling Round #	Captured *# beans in the handful*	Recaptured *# beans that have a mark on them*	Write Fraction *# Captured / #Recaptured*
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Total			
Average *(total divided by 10)*			

TABLE 1 Record the data from your experiment here.

IMAGE 8 Narwhal researcher Marianne Marcoux (right) looks out through binoculars from a rocky outcrop to see a narwhal in the ocean below. (M.Marcoux)

DISCUSSION QUESTIONS

1. Why is it important to count animal populations?

2. How can animal populations be managed if they are too low, or too high?

3. Why do narwhal migrate?

4. What are the major threats for narwhal populations?

IMAGE 9 Muktuk is made form the skin and blubber of Narwhal, Beluga and Bowhead whale (L. Risager)