

VALLEY OF THE WHALES

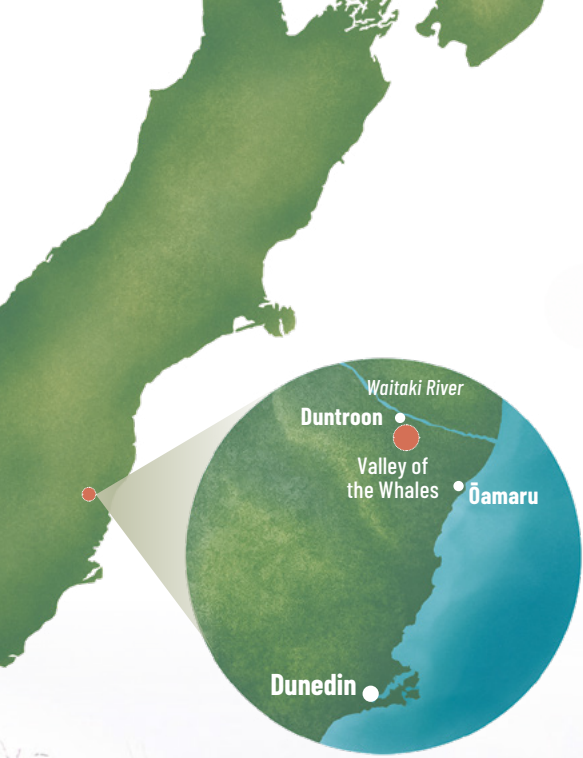
BY BILL MORRIS

LIMESTONE LAYERS

How did these huge animals come to exist? To help answer questions like this, **palaeontologists** visit the countryside north of Dunedin. They don't look to the ocean for answers but to the ground beneath their feet. That's because the land there hides a layer of limestone,

a kind of rock that formed over millions of years as shells, sand, fish bones, and corals slowly built up on the sea floor. Also buried in the limestone are the remains of some much bigger creatures, including whales, dolphins, sharks, and penguins.

Deep in the hills of North Otago, there's a place known as the Valley of the Whales. The valley holds the secrets of the biggest animals that ever lived. These animals aren't dinosaurs. They're not even extinct. They are of course whales, the biggest of which is the giant blue whale. Blue whales can be longer than a truck and trailer and weigh the same as a big plane.



SAVING TREASURES

Limestone is found in many parts of Aotearoa. Near Duntroon, a few hours north of Dunedin, the rock is an attractive creamy-white. This means it's dug up to be used as a building material, as well as for fertiliser, and sometimes diggers uncover the bones of ancient whales and dolphins. The digger drivers can't stop to collect everything they find. Most of the bones are crushed by their machines, but landowners and scientists work together to save a few fossil treasures before they're lost forever.

On a warm summer day, I head into the hills with one of these scientists. Ewan Fordyce is a palaeontologist at the University of Otago. We drive through the Valley of the Whales, a deep gash carved in the limestone by the Maerewhenua River. Incredibly, this place once lay at the bottom of the sea. I imagine strange species of whales and dolphins swimming high above the farmland, sharks and penguins zipping through clear, warm water.

We park at a **quarry** and start to walk. Ewan points out a whale bone sticking out from the rock. He explains that what we're looking at is just the end of the bone, which has been cut by a bulldozer blade. He doesn't know what else the rock might hide. There may be an entire skeleton. Getting any bones out is always a big job. Ewan and his team will cut into the limestone using special saws. Then they'll take the huge chunks to the university in Dunedin.



BACK IN THE LAB

Back in the university's lab, a team of people cleans the bones. Sophie White leads the work. She uses tiny picks and brushes and other tools to remove sand and dirt. Progress is slow. "We spend just a few days in the field, getting the bones," Sophie says, "but it takes a couple of years to clean them." Luckily, limestone is easy to work with, and the bones are in great condition. "It's hard to believe they are millions of years old," Sophie adds.

Once the bones have been cleaned, scientists study them for clues. This helps them to understand how different whale

species **evolved**. "It's like dealing with a crime scene," Ewan says. "Only this crime scene is from long ago ... It's important that we take our time."

First of all, the scientists want to find out which whale species the bones are from. They note important details: the position of a blowhole, the shape of an ear bone, the size of the teeth. The scientists also look for connections between the species to build a family tree. Having a family tree helps to answer another important question. How are the whale species related?



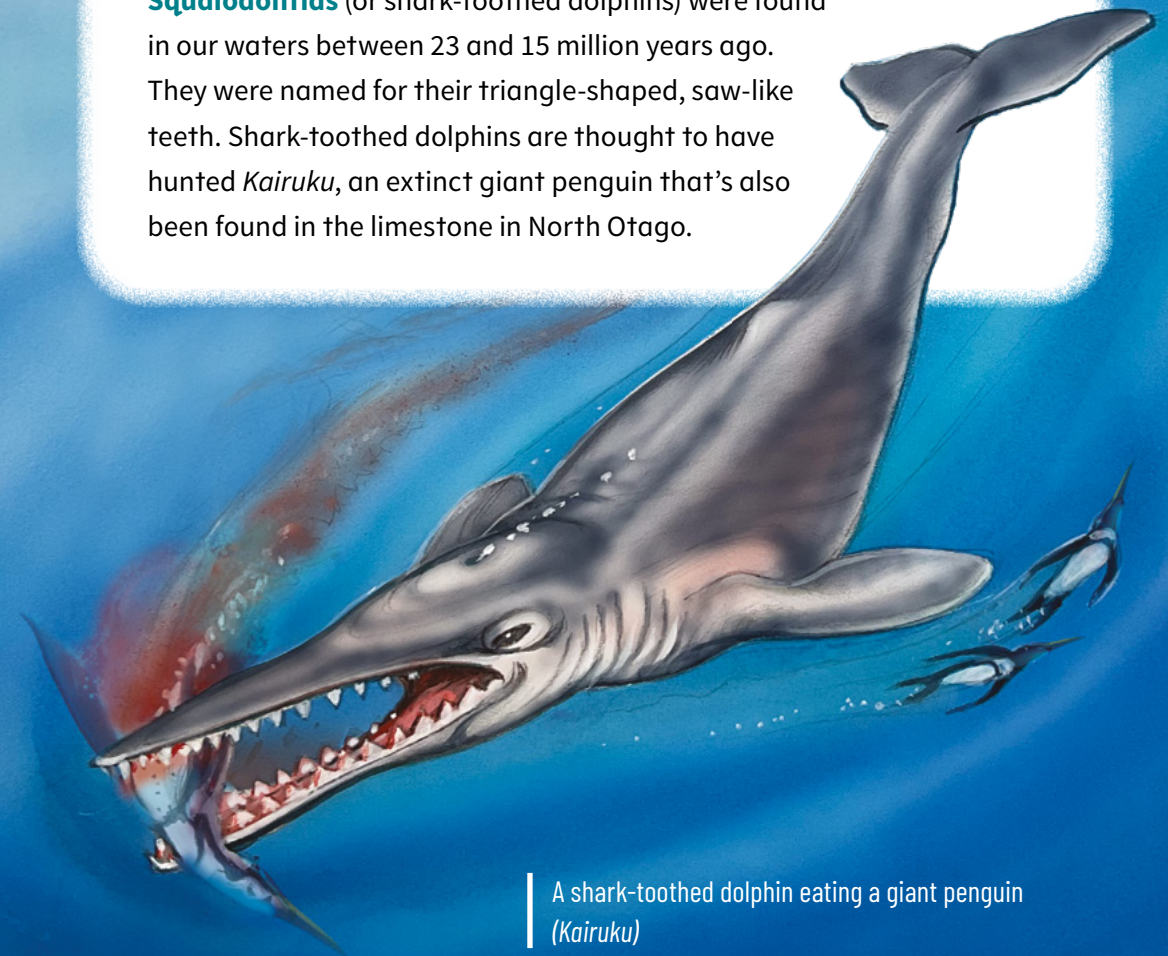
Sophie White cleaning whale bones found in the Valley of the Whales

Some ancient whale and dolphin species

Eomysticetes (or dawn baleen whales) were similar to modern whales, such as humpback, blue, and right whales. Dawn baleen whales had narrower snouts than modern baleen whales, and their blowholes were further forward on their heads.

Waipatia maerewhenua swam in the waters around Aotearoa 25 million years ago. This dolphin species was identified after a skull was found in North Otago. *Waipatia* had unusual teeth that pointed forward. Scientists think the dolphin snapped them together to trap fish and squid. Like many modern dolphins and whales, *Waipatia* probably hunted prey using sound.

Squalodontids (or shark-toothed dolphins) were found in our waters between 23 and 15 million years ago. They were named for their triangle-shaped, saw-like teeth. Shark-toothed dolphins are thought to have hunted *Kairuku*, an extinct giant penguin that's also been found in the limestone in North Otago.



A shark-toothed dolphin eating a giant penguin (*Kairuku*)

THE FIRST WHALES

Every whale that ever existed can be traced back to *Pakicetus* or a species very much like it. This four-legged animal walked on land around 50 million years ago in the part of the world we now call Pakistan. Over time, animals that **descended** from *Pakicetus* and its relatives began to spend more time in the water. Scientists think some of the first whales behaved like crocodiles. They probably lived and hunted in water and crawled onto land to rest.

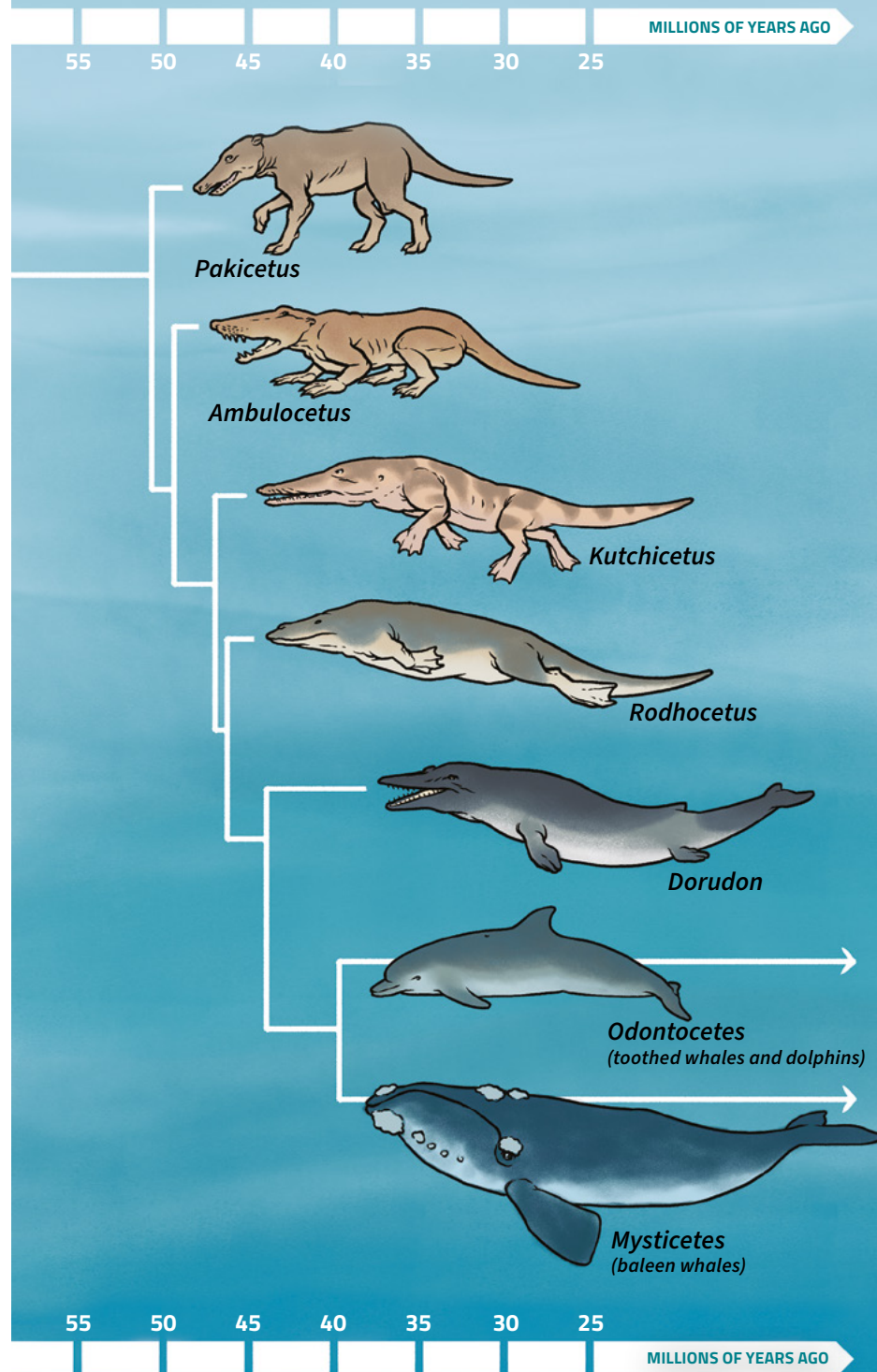
By about 40 million years ago, whales spent all of their time in the water. Eventually, they lost their legs because they no longer had any use for them. They evolved **flukes** on their tails for swimming, and their nostrils moved to the tops of their heads, becoming blowholes. These early whales became large predators. No longer stuck on land, they spread around the world, including the ocean near New Zealand.

25 MILLION YEARS AGO

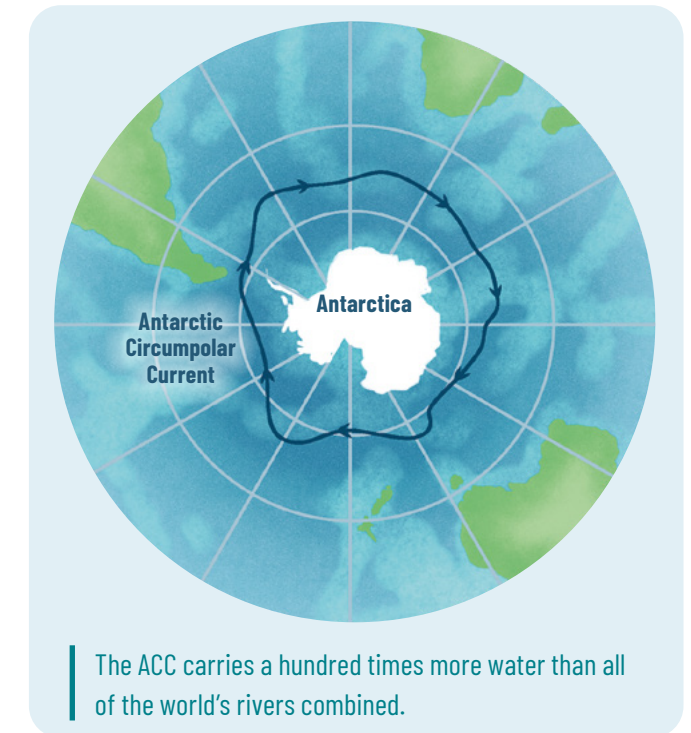
The limestone in Otago was formed around 25 million years ago. Back then, New Zealand was a string of islands surrounded by a warm sea. Turtles and other tropical species swam in this water. Coral reefs grew.

By this time, South America had separated from Antarctica. When the two land masses finally broke apart, an ocean current was able to flow around the bottom of the planet. We call this the Antarctic Circumpolar Current (ACC).

The evolution of whales



The ACC formed a belt of cold water that circled the whole of Antarctica. The huge movement of water caused nutrients to be drawn up from the depths, creating a zone rich in marine life, especially **plankton**. This led to an enormous explosion in sea life, including tiny creatures called krill, which feed on plankton.



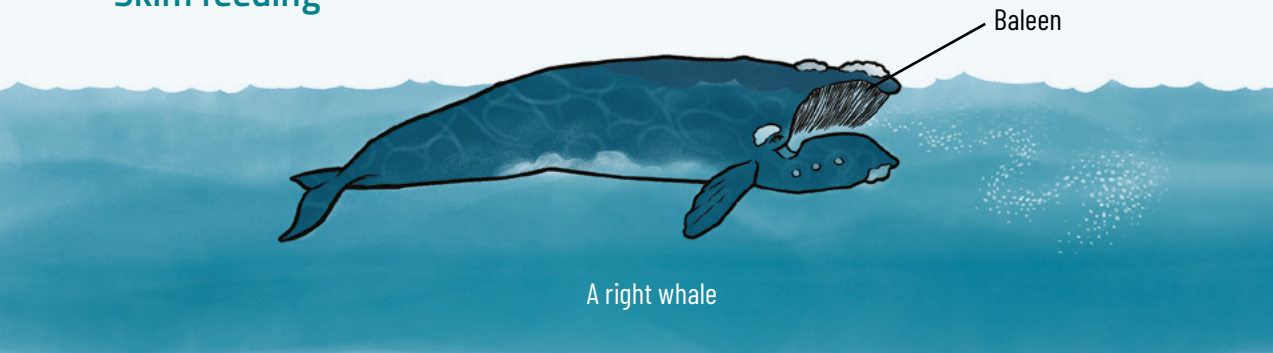
To make the most of this new supply of food, Ewan thinks some species of whales in the Southern Ocean evolved to eat krill and other small marine species. Because they were no longer hunting large animals, these whales had no need for their teeth. Instead, they grew bristles, called baleen. They used their baleen like a sieve to catch prey.

A MASSIVE FEED

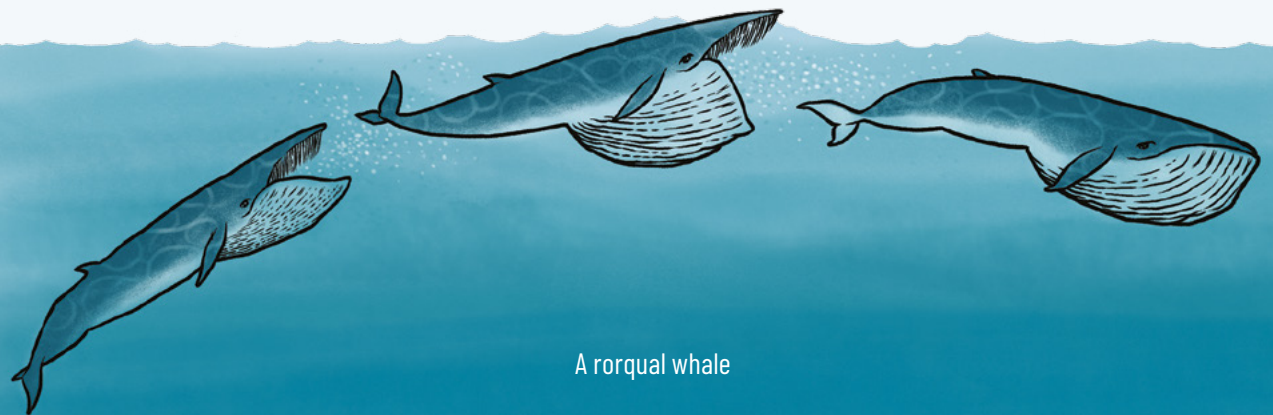
Some baleen whales, including right whales, skim the water's surface to collect food on their baleen. Other whales have evolved a way to eat even bigger meals through lunge feeding. Whales that lunge-feed open their mouths wide, then push their bodies through the water with great force. The movement drives a massive amount of water into the whale's mouth. After closing its mouth, the whale pushes the water out through its baleen, leaving the food behind.

Scientists think that the evolution of lunge feeding was one of the things that allowed baleen whales to grow to a huge size. These days, **rorqual** whales have taken lunge feeding to the extreme. Before swallowing a swarm of krill, a rorqual whale is able to drop its lower jaw to almost 90 degrees. It can then take in 80,000 litres of water in a single gulp – along with half a ton of krill.

Skim feeding



Lunge feeding



THE DEEP PAST

Ewan tells me that North Otago is one of the best places in the world to explore the evolution of whales. “The bones we find there help us learn what whales were doing in the Southern Ocean 25 million years ago,” he says.

For Sophie, the chance to peek into the deep past is a reward for all their hard work. “It’s an amazing experience, carving away the stone. Out comes this creature that hasn’t seen the light for millions of years. It’s like looking back in time to another ecosystem.”

Glossary

descended: came from (an ancestor)

evolved: changed very slowly over millions of years

fluke: the two pointed parts of a whale’s tail

palaeontologist: a person who studies plants and animals that lived millions of years ago

plankton: tiny marine creatures and plants that drift on ocean currents

quarry: a large pit from which rock is dug

rorqual: a kind of baleen whale with a pleated throat and dorsal fin

Valley of the Whales

by Bill Morris

The text is copyright © Crown 2023.

The images on the following pages are copyright © Crown 2023:

12 (map) and 16–18 by Mat Tait

15 by Spike Wademan

The images on pages 10–11, 12–13 (main image), 14, and 19 are copyright © Bill Morris and are used with permission.

For copyright information about how you can use this material, go to:

<http://www.tki.org.nz/Copyright-in-Schools/Terms-of-use>

Published 2023 by the Ministry of Education,
PO Box 1666, Wellington 6140, New Zealand.
www.education.govt.nz

All rights reserved.

Enquiries should be made to the publisher.

ISBN 978 1 77697 029 2 (online)

ISSN 2624 3636 (online)

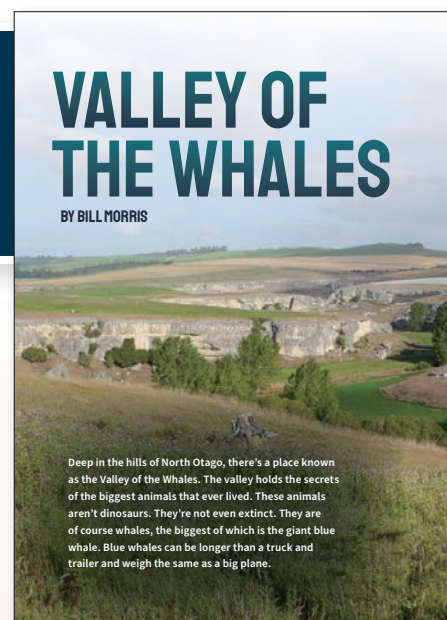
Publishing Services: Lift Education E Tū

Editor: Susan Paris

Designer: Liz Tui Morris

Literacy Consultant: Melanie Winthrop

Consulting Editor: Helen Pearse-Otene



SCHOOL JOURNAL LEVEL 4 JUNE 2023

Curriculum learning areas	Science: the living world Social sciences: ANZ histories – place and environment Mathematics: Geometry and Measurement
Reading year level	Year 6
Keywords	Antarctic Circumpolar Current, baleen, dolphins, Duntroon, evolution, fossils, history, krill, limestone, Maerewhenua River, Otago, palaeontology, penguins, plankton, quarry, scientists, Southern Ocean, species, whales



**Te Tāhuhu o
te Mātauranga**
Ministry of Education

**Te Kāwanatanga
o Aotearoa**
New Zealand Government