Life of the Royals

An Educational Resource Following Northern Royal Albatross from Egg to Ocean

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New Zealand

Science Communication
The Centre for Science Communication

Royal Albatross Centre

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Image: Aaron Heimann

Introduction

Please meet the Northern Royal Albatross.

This species and its close relatives are seabirds that can live into their 60s, spend about 85% of their lives at sea, and come to land to breed almost exclusively on remote, offshore islands. They are global birds of seafaring myth and legend, adapted perfectly to a life so different from our own that our paths rarely cross.

How, then, can we hope to study and learn more about the lives of these ocean birds?

Taiaroa Head/Pukekura is the most accessible albatross colony on the planet. There, Northern Royal Albatross nest a mere 40-minute drive out of Dunedin's City Centre in southern New Zealand. It's unique and special to have these seabirds close to our shores, let alone choosing to nest here.

With the proximity of the albatross colony on the Otago Peninsula comes opportunities for scientific study, education, and public outreach. The birds have been studied at Taiaroa Head/Pukekura since the early 1900s, but recent technological advances have given ornithologists new research tools. Improvements in GPS technology provide insights into the lives of these birds when they are away from land. Camera and network technology allow birds to be monitored on their nests night-and-day with remote video.

On Taiaroa Head/Pukekura, the N.Z. Department of Conservation has a live-streaming webcam focused on a Northern Royal albatross nest. This educational resource is based on research that has been done at the Royal Albatross Colony and will tie in well with the 'Royal Cam'. It is comprised of four units that are designed to be incremental and used together, but can also be stand-alone activities. The benefits of the 'Royal Cam' is that it brings the life of an albatross to any screen in the world connected to the internet. These resources can be used at the colony, but they can be used in the classroom as well, even abroad.

The following resource units are intended to link with *The New Zealand Curriculum*. Their content targets Year 9 and 10 students and addresses Science Levels 4-6 of the N.Z. Science Curriculum, specifically the 'Nature of Science,' 'Living World: Life Processes,' and 'Living World: Ecology' strands.

1. Chick on the Nest: This first unit focuses on the albatross chick on the nest, and can link with the webcam chick of that given year. It sheds light on how the chick is fed by its parents and recent research of the feeding process.

2. Parent Foraging at Sea: This second unit investigates the journey of the parent albatross seeking out food to bring back to its chick at the nest. Recent GPS tracking data of the parent birds foraging off the Otago coastline highlights the distance and locations parents travel to find a meal.

3. Chick Leaves the Nest: This third unit looks at the webcam chick as it fledges from the colony. It is based on research using GPS tracking in 2007 that provides insights into Northern Royal albatross' first year at sea.

4. Adapted for the Ocean: This fourth and final unit follows the young albatross as it travels away from the colony. It is here where it uses its adaptations for life at sea for the first time. The resource addresses evolutionary adaptations, keying in on the salt glands that help the albatross process the seawater it drinks.

Each unit is comprised of three sections: 'Food for Thought,' 'Reading,' and 'Questions.' The 'Food for Thought' section introduces the topic covered through a series of thought-provoking questions that invite brainstorming and collaboration with peers. The main body of text and true focus of the unit is the 'Reading' section. The 'Questions' section reflects on the information provided in the 'Reading' and can be either a self-directed activity or used by an educator for further discussion.

Research conducted on the Taiaroa Head/Pukekura colony has advanced scientific knowledge about the lives of these far-flung birds of the open ocean. These Northern Royal albatross resources endeavor to bring recent research to educators and their students in an easily-accessible way. By focusing on a couple of scientists and how they have gone about their research, it is hoped that students will be engaged with the scientific process, learn about the life history of these special birds, and be encouraged to seek out answers to their own questions about the natural world.

Thank you,

Aaron Heimann

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1. Chick on the Nest

Image: Junichi Sugishita

Food for thought

We all know when we feel full after a meal. How could you figure out how much food you've eaten? How could you measure it?

How much food does an albatross chick need to survive? We cannot ask it directly, of course. How could we measure their meals?

We don't want to disturb wildlife unnecessarily. Is there a way that wouldn't bother the albatross as much?

Reading


Image: DOC

The chick waits. It is always waiting for its parents.

High above the waves, this young northern royal albatross has one of the best views around. It sits looking out over the Pacific, into the increasing wind, hoping one of its parents will soon return to Taiaroa Head/Pukekura.

The chick is hungry. It has been a couple days since its last squid smoothie.

It looks like a massive cotton ball: white, round, and fluffy. It sits stoically on a nest of dirt and grasses waiting patiently for its mum or dad to return.

The land drops steeply in front of the nest, and the incoming wind hits the cliff face and flows upward.

Riding this updraft elevator, an adult albatross appears, gliding effortlessly up to the colony on the wind. It is the chick's father. Both of the chick's parents come back every few days to feed the waiting chick.

Excited having recognized him, the cotton ball with a beak stands up in the nest and calls out, shaking its downy feathers and spreading its growing wings to flap in anticipation. The chick's dad wastes little time

soaring above Taiaroa Head/Pukekura, and instead lands almost right beside its chick on the nest. He has a job to do.
The chick waddles to the edge of the nest to meet Dad, clacking its beak and rattling it against the underside of its father's pink bill. They greet and chortle to one another before the adult opens its beak wide and regurgitates a slurry of squid, fish, and a nutritious oil into the waiting mouth of the downy chick.

Yum.

Dinnertime doesn't last long. Once full of squid with a side of fish, the chick settles back into the nest and its father faces the wind. With open wings, he lets the updraft lift him skyward where he banks to the right and heads back to sea. Off to gather more kai moana for its growing offspring.

The chick does not know it, but as it sits and is fed on the nest, it is contributing to science.

Junichi Sugishita was curious about how much food albatross parents on Taiaroa Head/Pukekura bring to their offspring. As an albatross scientist, he wanted to collect data but he did not want to unnecessarily disturb the chick at the nest.


Image: DOC

One of the only defense mechanisms of an albatross chick is to vomit at a possible threat that approaches it at the nest. For scientists like Jun, it is better to leave the bird alone as much as possible so it doesn't get stressed and lose its lunch - and so the researcher isn't doused in bird puke!

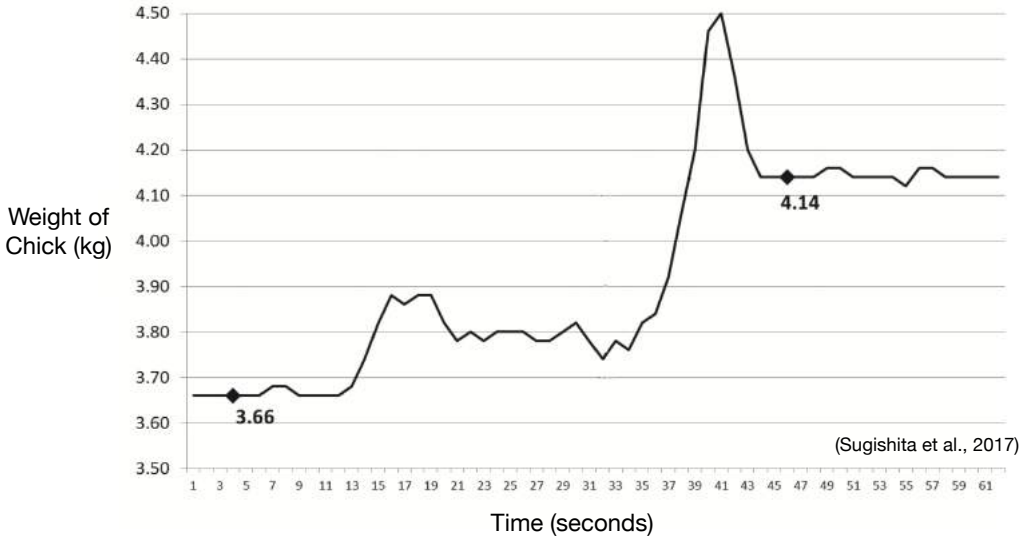
So, Junichi added something beneath the nest of dirt and grasses. Under the natural nest is a scale, balanced and adjusted to measure the weight of the chick.

Without interfering with the chick's dinner, Junichi can measure and record the size of the meal it has eaten with this scale. Every time a parent feeds the chick, it gets noticeably heavier and the scale records the weight gain.

Watch the 'Royal Cam' chick being fed!

Questions

Review the data collected by Jun from the scale placed beneath the nest. Describe what you think has happened to make the weight of the chick change.

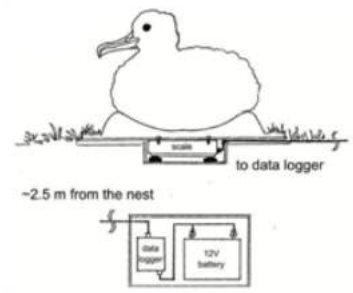


(Sugishita et al., 2017)

How much food, in kilograms, did the albatross chick eat?

Why do you think the change is not smooth? Why does the reading on the scale bounce up sharply but come back down?

The Department of Conservation rangers check the health of the chicks by weighing them. They lift them in a basket attached to a hand-held scale. List some pros and cons for weighing chicks by hand with a basket and with Junichi's method of a scale always under the nest.

	Pros	Cons
 Image: DOC		
 (Sugishita et al., 2017)		

Which weighing method do you think is better? Why?

What other questions do you have? How could you find the answers?

2. Parent Foraging at Sea

Image: Junichi Sugishita

Food for Thought

Read the passages below and discuss with others which feeding strategy you would choose if you were an adult albatross looking for food, or write in an alternative. Be prepared to share the rationale for your decision with the class.

Foraging Option #1

You, the parent albatross, follow fishing boats. When the fishermen have successful fishing trips they provide a reliable source of food and you often find them close to Taiaroa Head/Pukekura. Boats mostly discarded offal, or guts and other unused parts of the fish they catch. This is typically not as nutritious as the food you would find yourself and there is more competition for these scraps. There is an inherent danger in feeding behind boats, especially if they are working fishing boats with gear deployed in the water like baited hooks or cables hauling in nets.

Foraging Option #2

As a parent albatross you are wary of fishing boats and prefer to forage alone. You must fly far and wide in search of nutritious food for yourself and your chick waiting on the nest. It takes you longer to get enough food to bring back to the chick and you occasionally get marooned far from Taiaroa Head/Pukekura on the surface of the ocean waiting for the wind to pick up. You have little competition for food when you find it, however, and risks to your life are minimal while foraging.

Forage Option #3:

_____

_____

_____

_____

_____

Note to Educators:

Albatross are scavengers. It is in their nature to take food as they can get it. If albatross have a predisposition to take advantage of the food discarded from behind fishing boats, how might humans discourage this behaviour?

Reading

The chick is over a month old and the parent Northern Royal albatross trust it to stay home alone - no sitter required. Mom and Dad only return during mealtimes.

Having just fed its chick, the father is quickly off to sea again. Feeding a growing chick is a lot of work, and before long the beaked fluff ball will be hungry again.

Flying out from Taiaroa Head/Pukekura, the parent albatross swoops low over the waves. He is following his nose, and just upwind something smells *great*. Kilometer after kilometer he glides on the prevailing winds, out over the horizon.

A boil-up of fish ripples the otherwise regular waves of the ocean surface like a pot of water on the stove just before you add the spaghetti. Every now and then a silvery tail of a barracuda flashes and slaps the surface as it pursues smaller bait fish. Those bait fish, in turn, are after a bloom of even smaller krill that gives the sea a reddish tinge.

Birds of all shape, size, and speciality have been attracted to this commotion in the ocean. Small shearwaters dive beneath the waves. A carpet of gulls continuously folds over itself, gulls leap-frogging their neighbors as they follow the moving feast. And albatross wait patiently on the surface for a fish to swim too close.

The Northern Royal albatross parent lands to try his luck. But, as quickly as it appeared, the boil-up is gone. The sea becomes its regular wavy self and the birds are left in the lurch.

As if on cue, many birds take to the sky and fly toward a shape in the distance, occasionally hidden by a rising wave.

Swaying side-to-side in the lazy ocean swell rocks a small fishing boat, cleaning its catch. A cloud of seabirds around the boat signal it has been a successful morning. The fishermen are discarding unwanted scraps and, for the birds, it is a quick and easy meal. Small petrels and shearwaters flit about while large albatross glide and argue over the largest of marine scraps thrown overboard. The sound of the boat's

engine mixes with the cries of gulls and the gurgling, clacks, and wailing of seabirds.

The parent Northern Royal follows the boat at a greater distance than the other seabirds, biding its time for something worth its while. Then, something large is tossed into the melee of saltwater and feathers.

Image: Aaron Heimann

It's an octopus.

An unwanted creature hauled up in the trawling net, this octopus is bycatch for the boat but a tasty meal for the albatross. The Northern Royal changes its flight plan and heads right for the eight-armed snack. Other birds, including the smaller albatross, or mollymawks, are already tearing and fighting over the large octopus. But once the massive Northern Royal swoops in, landing and clacking its massive hooked bill, the other birds move to less contested morsels.

It does not take long for the albatross father to gobble down the octopus, leaving nothing behind. It will help fuel the rest of his foraging trip, and some will go to his growing chick at the nest.

Adult northern royal albatross can go far offshore to get food for their growing chick on the nest. Once albatross leave the colony, it is difficult for researchers to know where they go. Junichi Sugishita, an albatross scientist, wondered where the adult birds went to get food for themselves and their chick.

It is a unique and special opportunity to study how parent albatross forage for food for their growing chicks. The Taiaroa Head/Pukekura colony gives researchers like Junichi ready access to these far-flying birds of the open ocean.

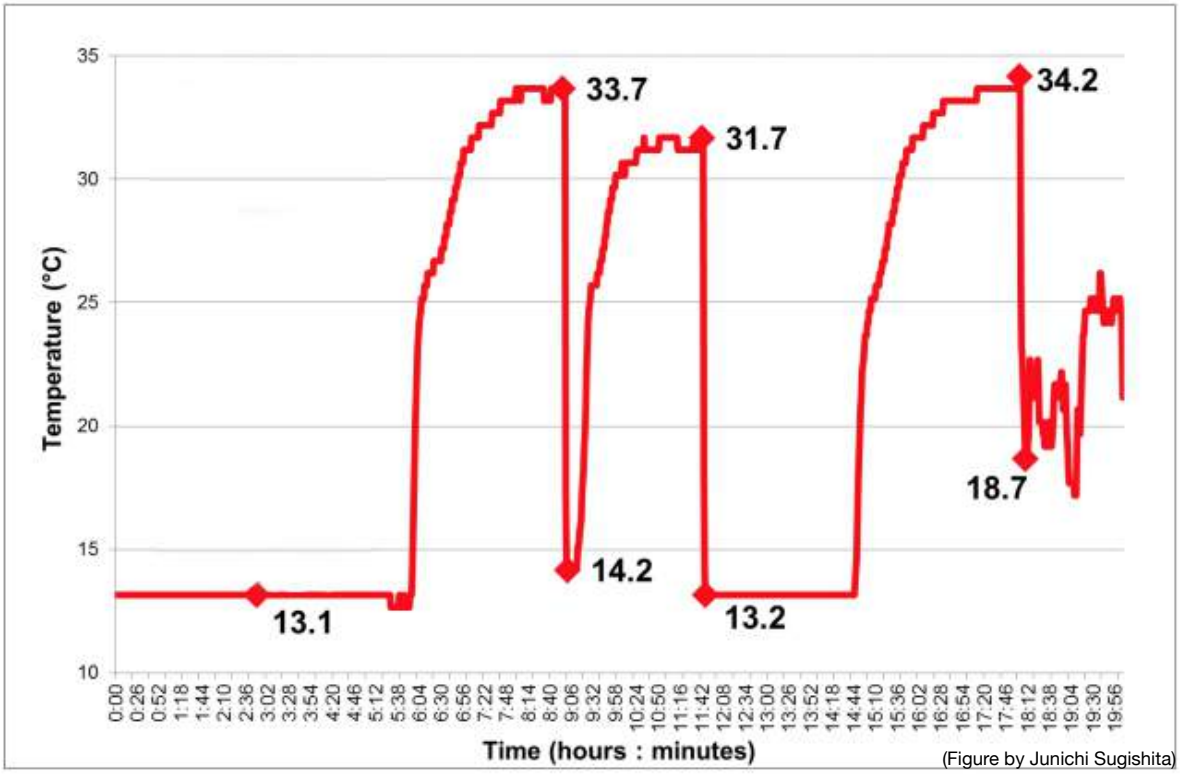
With a tiny GPS taped to a few birds' back feathers, Junichi tracked exactly where the birds went to get food for their young. In addition to the identification tags on the birds' legs, Jun attached a small anklet that recorded temperature. The waters off the Otago coastline are chilly, so when the albatross land on the surface to rest or to feed, their large, webbed feet paddle in cold water. Albatross in flight tuck their feet into their warm, cozy feathers.


Image: Junichi Sugishita

By analyzing the temperature data collected, Junichi could determine whether the albatross was likely floating on the ocean or flying above it. Together with the GPS tracking, Jun could use this temperature data to paint a better picture of where the adult albatross was likely feeding and see if it fed close to working fishing boats.

Questions

Look at the following graph created from data retrieved from an albatross' temperature logger. Mark when you think the albatross is flying and when you think it is sitting on the ocean surface.
How much time did the albatross spend in the water? In the air?

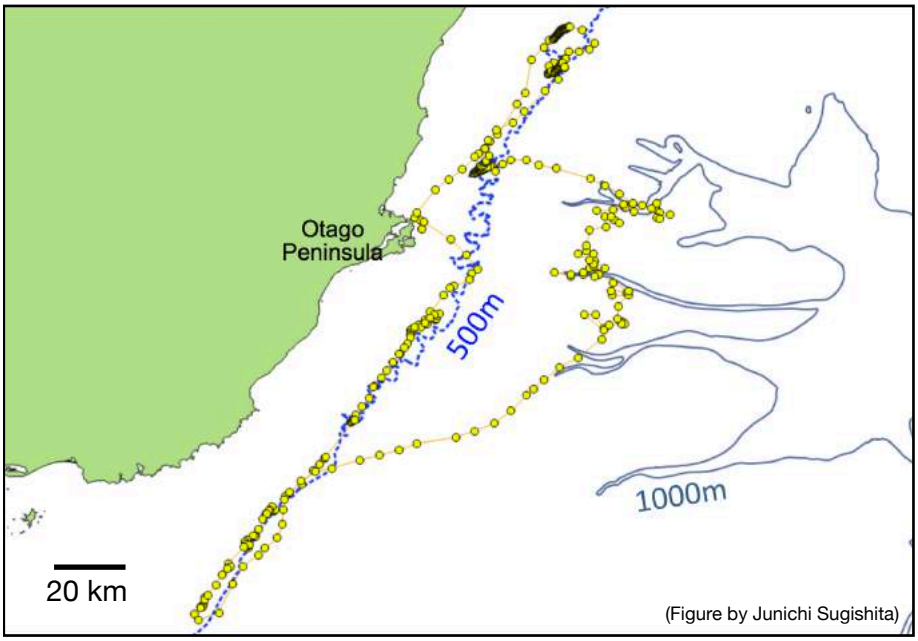


(Figure by Junichi Sugishita)

What do you think the albatross is doing when the temperature suddenly changes?

What do you think the variable temperature readings at the right might tell us about what the albatross is doing?

The round dots on the map below represent the GPS locations of a parent albatross on one foraging trip from Taiaroa Head/Pukekura. Looking at the map below, do you notice any pattern in where this tracked albatross went?



About how far away from Taiaroa Head did the albatross fly to get a meal?

Why do you think that Junichi is interested in knowing if the Northern Royal albatross parents forage for food around fishing boats?

What could be some possible risks for albatross and other seabirds around fishing boats? What could be some possible benefits to the birds?

What are some ways humans could lessen the risks to albatross and other seabirds that approach fishing boats for food?

What other questions do you have? How could you find the answers?

3. Chick Leaves the Nest

Food for thought

Close your eyes and recall your first day of primary school. The moment when you said goodbye to your family and were off on your own.

Did you feel prepared for that moment? How did it feel to be on your own?

In what ways do adults in your life help you prepare to leave home? Can they prepare you for everything?

Think about examples of other wildlife helping their young before they leave their home. Brainstorm with your neighbor and share two examples.

Reading

The wind is right. It blows strongly from the Northeast, but not too strong.

This young one has had more visits by hunger than by its parents in recent days, so it is time to find its own meal. Once overfed and anchored to the ground by its own weight, the chick now faces the wind, hops into the air and hovers.

☑ Tick. Part one of the pre-flight checklist complete.

An unassuming gust of wind is the one. With head bowed, the young albatross chick jumps with wings outstretched off the sheer cliffs rising from Lighthouse Bay.

On wobbly wings, it shakes its tail feathers and tucks its banded legs into its downy feathers for the first time - *flying*.

Well, falling with a means of turning, at least.

Eight months out of an egg, the Northern Royal albatross chick is setting off on his own from Taiaroa Head/Pukekura.

In that one jump, a Northern Royal Albatross chick becomes a fledgling. After eight months of only knowing the undulating grasses of Taiaroa Head/Pukekura underfoot, it sails over the largest expanse of water in the world - the indomitable Pacific Ocean.

When on land, the large Northern Royal albatross are hallmarks of the landscape, but they are not very mobile. Their paddle-like webbed feet are set way back on their bodies, making them ungainly on solid ground. But when over the ocean - in their element - the Northern Royals are nothing if not graceful sailors.

Except, perhaps, during this first flight. The fledged chick is still learning the ropes and how to best manipulate the wind.

Out to sea and out of sight, but where do inexperienced albatross go? Bindi Robertson (née Thomas), from Massey University, wanted to know just that. For her research, she used modern, miniaturized technology to her advantage.

With small GPS trackers taped to the feathers on the lower back of the birds, Bindi knew the locations of the tagged birds until they naturally moulted their feathers and the device fell off or the device itself failed to transmit.

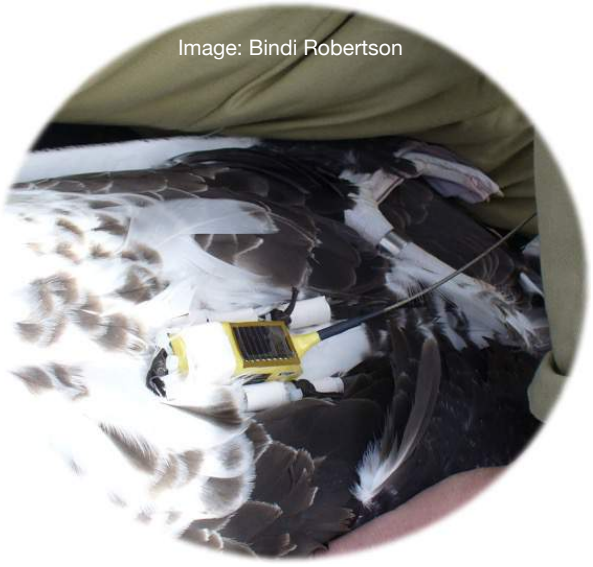


Image: Bindi Robertson

The GPS tags worked a bit like satellite phones. Every day the birds - or at least their 40-gram GPS backpacks - would send the equivalent of four text messages to Bindi telling her their location, speed, direction, and altitude. After a while, stringing these messages together like connect-the-dots on a map, Bindi had a good idea where the albatross went, how they got there, and could infer what they were up to.

Into the prevailing Northeasterly winds, the birds first flew north over the coastal waters of New Zealand after that first leap. After edging their way up the coast, they plucked up the courage to steer away from land entirely and set out toward the open ocean.

For the three departing fledglings, something urges them across the ocean. As Bindi Robertson's research shows, these birds all seem to have the same location in mind, about 8,500 kilometers away - the coast of Chilé, South America.

The birds Bindi Robertson tagged in 2007 wasted no time crossing the open ocean. Topping out at 1,047 kilometres traveled in 24-hours and reaching a maximum speed of 110 kilometres per hour, they reached the Chilean coast in as few as 16 days. These young birds stay at sea for at least three or four years, eventually foraging in the raging Southern Ocean that rings Antarctica before typically coming back to where they hatched.

The sound of pealing bells fills Dunedin streets and schoolyards on a very special day each year. They toll for an albatross. It is the first bird to return for the next breeding season on Taiaroa Head/Pukekura.

The rangers on the hill are always on the lookout for the telltale sign of a returning albatross not seen since it fledged. The returning juveniles tend to make an abrupt, unforgiving landing on the solid ground where they were raised. These birds wouldn't have touched soil since they jumped off the cliff all those years ago. Clumsy on departure, their return is typically no different. Someday, they will see the milestone homecoming of the Royal Cam chick.

With practice, these young adults gain the flying skills required around land to successfully raise a chick of their own. In time, they will find a suitable mate and be added to the ranks of breeding adults, continuing the legacy of hundreds of Northern Royal albatross that call Taiaroa Head/Pukekura home.

Questions

What other ways could you determine where albatross go once they leave the nest? Scientists knew that Northern Royal albatross flew far and wide before GPS technology was used to track individual birds. How do you think they determined where the birds went?

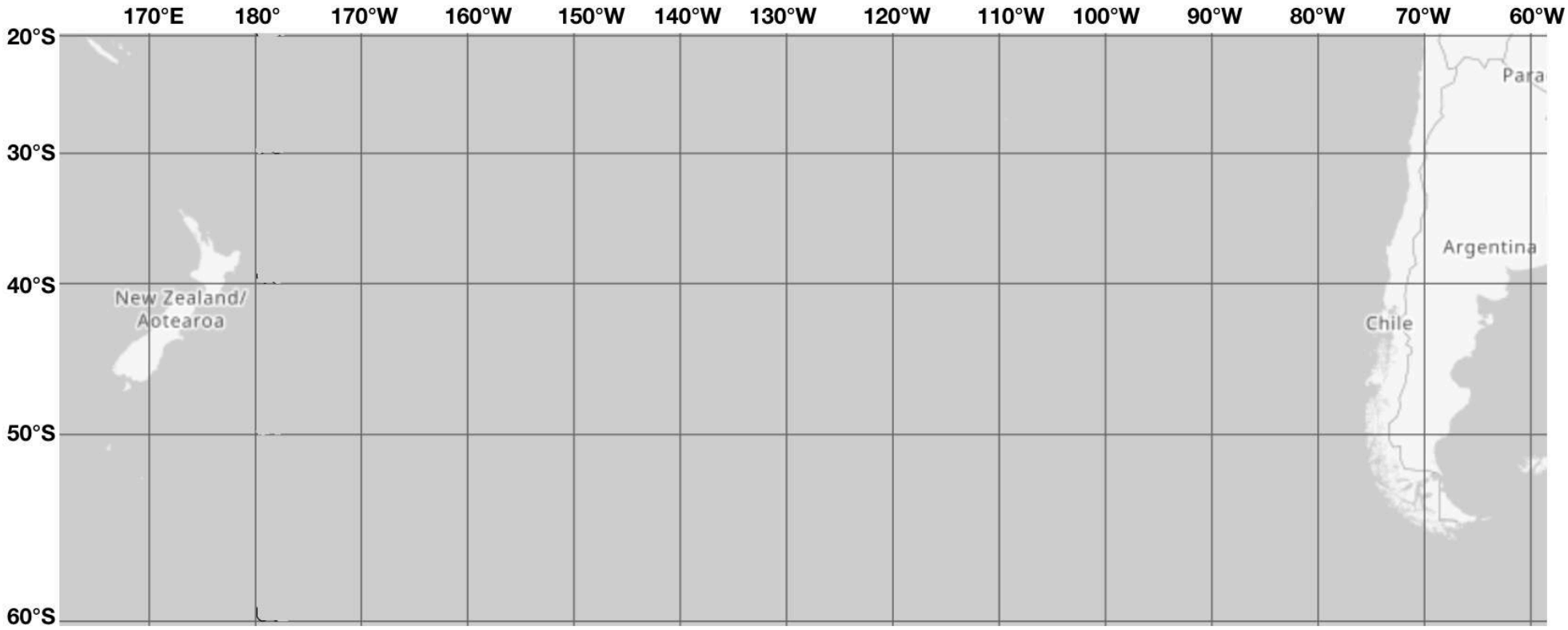
On the map on the next page, plot the following GPS locations of a newly-fledged Northern Royal albatross.

Chick #55028 - Toroa	Fledged from Taiaroa Head/Pukekura on 23 Sept 2007	
Date	Latitude	Longitude
19 Sept 2007	46S	171E
1 Oct 2007	44S	172E
18 Oct 2007	46S	153E
29 Oct 2007	39S	73W
7 Jan 2008	35S	73W
22 Feb 2008	54S	62W
22 Apr 2008	43S	73W
21 Jul 2008	46S	76W
24 Sept 2008	54S	74W

How long did it take Toroa to fly across the Pacific to the coast of Chilé?

Why did Bindi only track a few birds? What do you think were some limitations of this research?

What other questions do you have? How could you find the answers?


170°E
180°
170°W
160°W
150°W
140°W
130°W
120°W
110°W
100°W
90°W
80°W
70°W
60°W
20°S
30°S
40°S
50°S
60°S
New Zealand/
Aotearoa
Chile
Argentina
Para

4. Adapted for the Ocean

Image: Aaron Heimann

Food for Thought:

Imagine you are a sailor of old, traveling in the South Pacific. The wind stops blowing and your ship ceases to sail across the ocean toward your destination. It is calm for days. For weeks. You and your shipmates drift on the ocean currents, waiting for the wind to pick up. While you wait, the limited water you have brought with you runs low, you are rationed to a few glasses a day. Yet, water is all around you. You hear it splash lazily against the hull of the ship as you lay in your bunk below decks.

Water, water, every where,
And all the boards did shrink;
Water, water, every where,
Nor any drop to drink.

Has everyone been in the ocean? Have you ever tasted the seawater? What does that taste like? Would you want to drink a glass if you were thirsty? Why or why not?

Albatross and other seabirds need to drink water, too. How can they survive doing this at sea where there is no fresh water available?

Note to Educators:

Alternately, read Samuel Taylor Coleridge's poem Rime of the Ancient Mariner in class and reflect on the plight of the thirsty, becalmed sailors and the significance and symbolism of the albatross in the poem.

Reading

The recently-fledged albatross chick revels in its newfound ability - *flying*.

As it soars away from Taiaroa Head/Pukekura, it will need to figure out how to survive on its own. Its parents raised it well, but they did not teach the youngster how to fend for itself at sea.

Human parents might call it independence – the stuff that "builds character." Scientists would say that's instinct, and an albatross is born with everything it needs to survive. Once fledged, an albatross is perfectly adapted to life at sea.

The young albatross will now need to use all of the evolved adaptations its body has to offer in order to live the life of a pelagic bird. It has begun its life as a solitary bird of the open ocean.

The fledgling has plenty of time to master the art of flying and foraging - it will not approach land again for at least 3 years. But let's not get ahead of ourselves. Right now, all this flying practice has made the chick quite *thirsty*.

It banks to the right, flying into the wind to slow down.

Starting its decent, an inexperienced quiver in the fledgling's wings causes some turbulence and the young Northern Royal albatross makes a less-than-stellar landing.

SPLASH!

Thankfully, the liquid crash-landing is forgiving and the bird is quickly floating upright, finally home. Without hesitation, the big bird bends forward and scoops up a full bill of the seawater. To swallow, it tilts its whole head back, letting gravity do the work.

A few more drinks and it is time to fly once again. It has been days since its last meal from Mum and so the fledgling runs on the surface, flapping its wings to get airborne. Now to try its luck foraging its first meal – and something smells promising offshore.

Albatross and their close relatives all suffer from a near-constant runny nose. These pelagic birds of the fresh, open ocean air do not have colds, however, but an adaptation that allows them to survive in their saline environment.

Northern Royal albatross spend most of their lives gliding over the ocean or bobbing on its surface. They rest and feed on the surface of the water - these are true ocean birds. If albatross were able to lay their eggs at

sea, they probably would. They only tentatively approach land when they get that urge to breed.

Besides sleeping and eating on the surface of the seas around the world, albatross also need to drink. When thirsty, they lean down *and drink the salt water*.

Albatross, and their cousins the petrels and shearwaters, can all drink from the big blue. To be fair, we humans can drink salt water, too. What we cannot do as effectively is process out the salt from our bodies once it is in there. As humans, our kidneys cannot successfully filter out all the salt found in seawater without us also diluting it by guzzling lots of fresh water. Albatross are specially adapted to life at sea and can quench their thirst at will. Their kidneys have help, though, from special glands perched in cavities on their skulls just above their eyes.

These salt glands give albatross kidneys a break by removing salt from the bloodstream. A tangle of blood vessels in the glands bring salt-laden blood close to special cells that help salt molecules diffuse out of the blood. Getting the salt out of the bloodstream requires a bit of energy. This energy powers what is known as active transport, which moves the salt molecules between cells and keeps the salt concentration down in the bird's blood without needing fresh water.

So, with a bit of cellular energy spent and the right gland, extra salt from the blood can make it to the secretion duct and ultimately out of the bird's body. A small price to pay for life-sustaining water!

Tubes as noses and grooves on albatross bills then channel the saline solution, dripping innocuously back into the sea. Instead of needing fresh water to dilute ingested salt as we humans do, these seabirds simply desalinate.

Questions

What other adaptations can you think of that enable albatross to live out at sea? Make a list below.

Now compare lists with your neighbour. In a different colour, add any adaptation your partner had that you had not thought of.

Be prepared to share an albatross adaptation with the class. In a third colour, add any adaptations shared in class that you do not yet have on your list.

How do other marine animals regulate the salt they ingest? Pick two animals other than seabirds and research the answer.

What other questions do you have? How could you find the answers?

References and Resource Links

General references

New Zealand Department of Conservation ‘Royal Cam’
http://www.doc.govt.nz/royalcam

‘Royal Cam’ Highlights Youtube channel
https://www.youtube.com/playlist?list=PLL6KEl0oZPfu6SK4wCJjthF8blTmrXo2h

N.Z. Department of Conservation: Observing the ‘Royal Cam’ - classroom activity
http://www.doc.govt.nz/get-involved/conservation-education/resources/observing-a-royal-albatross-toroa/

N.Z. Department of Conservation: ‘Northern Royal albatross’
http://www.doc.govt.nz/nature/native-animals/birds/birds-a-z/albatrosses/royal-albatross-toroa/

N.Z. Department of Conservation: ‘Stories about albatross’
http://www.doc.govt.nz/nature/native-animals/birds/birds-a-z/albatrosses/stories/

Otago Peninsula Trust: Royal Albatross Centre
http://www.albatross.org.nz/

New Zealand Marine Studies Centre
http://www.otago.ac.nz/marine-studies/index.html

New Zealand Curriculum
http://nzcurriculum.tki.org.nz/

1. Chick on the Nest

Sugishita, J., McKenzie, M., Torres, L. G., & Seddon, P. J. (2017). Automated techniques for measuring meal size in great albatrosses. New Zealand Journal of Ecology, 41(1), 120-125.

‘Royal Cam’ Highlight video: Chick being fed at the nest
https://www.youtube.com/watch?v=Y0qSx5eQvDI&list=PLL6KEl0oZPfu6SK4wCJjthF8blTmrXo2h&index=38

2. Adult Foraging at Sea

Sugishita, J., Torres, L. G., & Seddon, P. J. (2015). A new approach to study of seabird-fishery overlap: Connecting chick feeding with parental foraging and overlap with fishing vessels. Global Ecology and Conservation, 4(Supplement C), 632-644.

3. Chick Leaves the Nest

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'Royal Cam' Highlight video: Chick practicing flight
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4. Adapted for the Ocean

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p.5 Junichi Sugishita: Chick on the nest with scale beneath

p.6 Adapted from New Zealand Department of Conservation 'Royal Cam' footage

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p.9 Adapted from New Zealand Department of Conservation 'Royal Cam' footage

p.11 Junichi Sugishita: Adult N. Royal albatross with GPS tracker

p.15 Junichi Sugishita: With help of Lyndon Perriman, DOC Ranger, Jun attaches GPS

p.19 Bindi Robertson: Chick Toroa at his nest before fledging. GPS attached.

p.21 Bindi Robertson: Attaching Toroa's GPS

p.24 Map adapted from map.openseamap.org Creative Commons Attribution - ShareAlike2.0

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