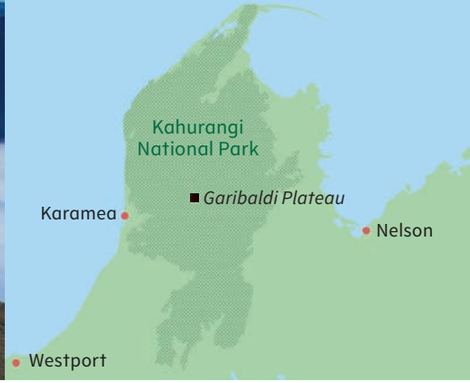
The Coprolite Hunters

by Neil Silverwood

Ancient fossilised poo. It's not the most obvious thing to study – but people do. A few years ago, I was in the Euphrates cave, near Karamea, on the west coast of the South Island, photographing a team of scientists from Manaaki Whenua – Landcare Research. They were hunting for coprolites. These treasures from the past, which range in size from a grain of rice to a box of matches, are as scarce as gold. That's why the scientists I was with were willing to go almost anywhere to find them ...



Beneath a Plateau

The Euphrates cave is part of a tunnel network that runs beneath the Garibaldi Plateau in the Kahurangi National Park. It's a remote place. Getting there on foot takes three days, so we've flown in by helicopter. The plateau is covered in tussock and ringed by limestone cliffs – a reminder that we're in **karst** country. Hundreds of shafts drop down to the tunnels below, which stretch for almost 3 kilometres like the tangled arms of an octopus. I'm glad we know exactly where we're headed.

A strong cold wind blows through the Euphrates, but it's dry. The cave would have been the perfect place for birds to nest, safe from aerial predators like the pouākai/Haast's eagle. Alex Boast, the team leader, is the first to make a find: a small pile of coprolites hidden beneath a rock. He changes into protective gear to avoid contaminating the samples, and with help, slowly places each piece into a specimen container.

karst: a barren area, usually with a lot of caves, sinkholes, and underground rivers

Alex thinks the coprolites are from a kākāpō. He's happy about this. "We know a huge amount about moa," he says, "but much less about our critically endangered native parrot. We don't know where they lived on the mainland or even how many there were." The coprolites can help to answer these questions because they contain the bird's **DNA**. Finding this genetic material is like finding an important piece in a puzzle.

The coprolites also have traces of plant DNA. This will help with another question: what did kākāpō eat before introduced species began eating plants and changing the landscape? Scientists like Alex can use this information to decide whether an area could support kākāpō again. In 2017, the takahē was reintroduced in another part of the national park; maybe one day, the kākāpō could return to the Garibaldi Plateau.

A further search reveals more treasure: the skull of a takahē and what's probably a moa feather. Both have been there for hundreds – even thousands – of years. Back at camp, Alex tells me about the plateau. "This place was once home to all kinds of birds," he says, "but many are now extinct. Others survive in small populations on off-shore islands, and their future is uncertain. We need to keep learning so we can protect them."

I look around the broad sweep of the plateau. It's easy to imagine this peaceful place teeming with birds, their chorus like nothing we've ever heard.

DNA: the genetic material that contains all the information for how a living thing will look and function

High-country Station

After the Garibaldi Plateau trip, I head out on a second expedition with scientists from Manaaki Whenua – Landcare Research. This time, we're off to a remote, high-country station near Lake Wakatipu in Otago. The team is led by Janet Wilmshurst and Jamie Wood. Instead of looking for coprolites in caves, we're searching for them under rock overhangs. These overhangs were carved out of the **schist** by water millions of years ago, when the level of the lake was a lot higher.

We camp in a woolshed near the lake. On our first day, Jamie squeezes through a hole at the back of an overhang. It's tight. The passage is no wider than a coathanger. Jamie has a tiny camera that he pushes in front so he can see what the space might contain. He's back after a few minutes with a precious find: a tiny fragment of bone.

schist: a hard rock that has many layers

The bone is from a Polynesian rat (*Rattus exulans*), also known as kiore. "Kiore came here around eight hundred years ago," Jamie says, "and they spread through the country quickly." Although small, the invasive species hunted birds. New Zealand's flightless species were especially vulnerable. With few ways to protect themselves, their populations were decimated. "Birds were also hunted by people, but kiore played a big role in their extinction. The rats could travel anywhere, including into small holes like the one I just squeezed through!"

Janet makes the next discovery when she digs through a thin layer of dirt and pulls out a moa coprolite. "It's in perfect condition," she exclaims. She takes a closer look at the coprolite, then puts it in a small plastic bag that won't be opened until it reaches the ancient DNA lab near Christchurch.

When Birds Ruled

Before the arrival of people, the land mass known as Zealandia (the whole of New Zealand, including the undersea portion and our off-shore islands) contained almost two hundred species of birds. With no mammals other than bats, birds were at the top of the food chain. Each species evolved in different ways, resulting in diverse shapes and sizes – with some unique results.

Some birds lost the ability to fly, like the moa. One moa species, the South Island giant moa (*Dinornis robustus*), weighed up to 230 kilograms (one of the heaviest birds in the world). It could reach tree branches 3.6 metres off the ground. And can you imagine a predatory bird with talons like tiger claws and wings that spanned almost 3 metres? This was the enormous Haast's eagle, which Māori in the South Island called pouākai (Māori in the North Island used other names, including hōkioi). They told stories about the giant bird and drew its image on cave walls.

In 1871, Julius von Haast, an explorer and geologist, named the creature *Harpagornis moorei* after the Greek word "harpax", meaning "grappling hook". Almost three decades later, Charlie Douglas, another famous explorer, recorded an encounter with what was probably a Haast's eagle. Charlie lived in Westland, where he mapped the region's vast river valleys. On one trip, he shot "two raptors of immense size". The largest bird had a wingspan of 2.54 metres. Charlie had no idea what he'd shot, but he wasn't the type to exaggerate. Some **palaeontologists** believe the unlucky birds may have been the last of their kind.

palaeontologist: a person who studies fossils to learn the history of life on Earth

A pouākai/Haast's eagle hunting moa

Pouākai/Haast's eagle bones

A curator with Canterbury Museum's moa bone collection

Back at the Lab

Back at the lab, the next step is extracting the DNA from the coprolites. Because of the risk of contamination, I'm the first non-scientist to go into this carefully guarded place. We kit up outside: paper overalls, face mask, gloves. Then we enter a small room behind airtight doors. Here we take off the gloves and put on a new pair. We pass through a second airtight door, and we're finally in the laboratory.

Jamie opens a freezer. It's filled with coloured containers, all holding biological material from many of New Zealand's extinct and endangered species. There are thousands of coprolite samples. Jamie says that studying DNA has taught scientists far more about the history of our bird populations than ever before. "It paints an accurate picture of what life looked like for New Zealand's birds before people arrived. And it helps us learn why their populations have declined."

Behind Jamie, another scientist uses a slender tube called a pipette to extract DNA from a sample. The process can take days. DNA is so small it can only be seen under a powerful microscope, and it's very difficult to extract. But for these scientists, the results make it all worthwhile. They provide a window to a time when the land was vastly different from what it is today.

Before I leave, Jamie tells me about his next adventure: He's heading to Antarctica to search for penguin coprolites. "DNA preserves well in cold climates, so what better place to look for it! We hope to learn how climate change in the past affected the diet of Adélie penguins in the Ross Sea."

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