Environmental News

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Ōi at Bream Head | Hochstetter's frogs on Aotea | The importance of Aotea's Marine Environment | Pekapeka Survey | Pāteke Update

Aotea Great Barrier
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EDITORIAL: A Time to Act

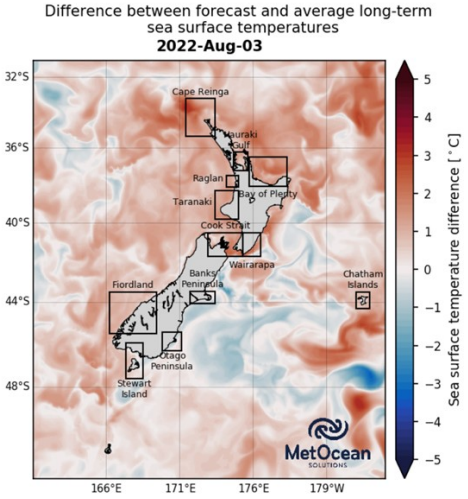
KATE WATERHOUSE (Chair Aotea Great Barrier Environmental Trust)

Humans can be slow to get the message until a change forces itself into our lives and will no longer be denied. As I write, warming of the global climate is manifesting in wildfires and heat waves in Western Europe. Talk of oceanic tipping points being reached has made me feel ill, and I'd pushed such thoughts away, but now NIWA are forecasting another La Niña. While it's good for the fire risk on Aotea after a couple of very dry summers, now the water tables are past full and I look up at the scars of that 2014 weather event on Hirakimatā and hope we don't get another one like that.

But the chances are that we will get more of these bigger storms – a lesser-known fact about increasing global temperatures is that for every 1 degree rise, storms can hold 7% more water and the "tropical" climate zone is slowly heading our way. This La Niña means more prevailing northeast winds, bringing warm air down from the tropics, with a wetter summer and a corresponding lack of southerlies. More bad news for the fading Whangapoua bar, but it's warming seas that are the real disaster.

The increase in temperatures in the Gulf is worrying. The Moana Project was set up three years ago to help NZ prepare for rapid oceanic warming. It is using advanced models to predict when and where marine heatwaves will affect coastal and oceanic waters. You can jump on their site and see the forecast sea surface temperatures for the next seven days. It's not good.

The warmer the Gulf gets, the more starving seabirds we can expect. These birds are bound to their chicks in burrows on our islands. There are thirteen species breeding on the islands between the Poor Knights, Aotea and the mainland. This is Te Moananui a Toi, the domain of Ngātiwai people, whose knowledge of bird populations and bird health goes back 30 or more generations. The ōi or grey-faced petrels are, I'm told, skinny and not in good health, and they are not being harvested for that reason. Why are birds starving? As the water warms, the food (small fish) moves into deeper water and seabirds must follow. And there is less of it, thanks to decades of decimation of small schooling fish like pilchards throughout the Hauraki Gulf Marine Park. We've all seen the increase in undernourished penguins, but diving petrels, shearwaters and small petrels have to spend more time flying to find food and fly back to the burrow with it, and they are lighter and less able to rear a chick as a result.



Difference between forecasted sea surface temperatures and the long term average for this time of year. Red shading indicates that the ocean is currently warmer than normal, blue that it is colder.

There's a few bits of good news— if you're wondering why there seem to be more snapper around, yes there are. Some species thrive in warmer waters and snapper is one of them. Gannets are going great guns on Mahuki, where more than 6,000 birds are now thought to breed. One school of thought is that it's because they too are following the fish to the cooler outer Gulf.

Cover: .Adult pāteke on Okiwi station pond. Photo: Sarah Dwyer

Back cover: Pied shags. Photo: Barry Scott.

Several years ago I asked black petrel guru Biz Bell about the low survival rates of juvenile black petrels – only one in ten of which return here by the age of three. To sum it up, birds are smaller and lighter than when she began her research in the 1990s. La Niña years weren't good she felt, although she wasn't yet sure why. But a hungry black petrel is more likely to go for readily available food – like squid baits, streaming out behind a long-line fishing boat. That is one reason tākoketai, black petrels, are so at risk from interactions with the fishing fleet.

Photo: Rohan MacMahon

Kate Waterhouse beside riparian plantings – established and new – Okiwi river, July 2022

But what have seabirds got to offer in helping us cope with climate warming? You might have heard burrowing seabirds like petrels and shearwaters described as "ecosystem engineers". Sadly, they are missing in action throughout most of Aotea's forests. No seabirds in burrows means no nutrients entering the forest soils from the sea via seabird droppings, helping them to regenerate and resist fire and rain events. No nutrients flowing out into the coastal zone, feeding those waters. Seaweed growth is heightened around islands where seabirds still breed, with knock on effects for the close-shore ecosystem. The trouble is, few of us have any memory of seabirds, yet Aotea is the biggest seabird island of any in the Gulf and it is down to us to make it safe for them to return.

It seems to me that doing right by Aotea comes down to the same basic actions.

Help the forests regenerate by eradicating the rodents that eat seeds and predate birds, and feral cats that do the same; attract burrowing seabirds back to feed the soil again; and plant natives – especially along streams, into wetlands and the areas of lost kahikatea and pūriri forests.

Help the seas regenerate by supporting a cessation of commercial fishing in coastal waters and any other measures that promote marine restoration – not just around Aotea, but for the whole Hauraki Gulf Marine Park – because we are affected by it.

On the Barrier we like to think we are sustainable. Some even like to think this is an unspoiled paradise, and perhaps, by virtue of living here that we're somehow less responsible for what is happening to te taiao, the natural world. *"Please keep doing what you're doing, it's wonderful."* is the sentiment we hear from our readers and members, and it's welcome feedback. But it somehow shifts a weight of responsibility onto the volunteers that give their time to this trust's work. There is no passing off responsibility for the whenua or the moana that sustains this community.

At the airport last Sunday I met two local environmentalists who knew my late sister Emma Waterhouse, former trustee and editor of this publication. She was so knowledgeable, they said, being from science backgrounds themselves. Emma was working within the international development and climate response system to lead change, but she ran out of time. Unlike her, I'm no scientist— I have a BCom/BA and a Masters in Creative Writing, and in 2023 I'll begin a Graduate Diploma in Psychology. These aren't the usual credentials for conservation leadership. But having spent a large part of my life in nature, in all its perfect detail, and in business and governance (which are somewhat less perfect). I am beginning to understand the value of whenua and moana, ki uta ki tai. Slow learner, I know.

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Bringing back the Grey-Faced Petrel/Ōi to Bream Head

BARRY SCOTT with Adam Willetts and Cathy Mitchell (Bream Head/Te Whara Conservation Trust)

The flight of nine recently fledged grey faced petrels/ōi from Bream Head/Te Whara Scenic Reserve in January of this year marked the third successful breeding season since re-establishment of a breeding colony on the Heads in 2015. This successful outcome was the result of an intensive predator control programme across the reserve and ongoing monitoring of the birds and their chicks throughout the breeding season. As discussions with project manager Adam Willetts and seabird expert Cathy Mitchell revealed, getting breeding success at Bream Head has been very challenging. Increased rodent control around the colony from 2015 onwards quickly led to success with survival of eggs in the 2016 and 2017 seasons but the hatched chicks did not survive because of stoat predation. Further predator control measures led to two seasons of success in 2018 and 2019 but then the presence of one rogue stoat led to a major setback in 2020 with all 10 chicks that were present in burrows on the eastern head being wiped out[1]. Restoring a breeding population at Bream Head, one of only a few known mainland breeding sites for these birds[2], is a high priority for The Trust, which was established in 2002.

Photo: Barry Scott

Bream Head showing grey faced petrel breeding site on ridge this side of the Old Woman.

In July 2015 Adam discovered eight active burrows on the eastern head (Old Woman peninsula) of the reserve while hanging off a pohutakawa tree to scout a new trap line! This discovery led to more intensive trapping of predators around this site. The sign of old burrows here and at other sites suggested that birds had been visiting the Head for many years but because of predation this mainland colony was on the edge of extinction. To assist successful breeding the Trust decided to designate the eastern head, comprising a network of 20 burrows at three locations in close proximity to one another, as a study site. These sites were used to monitor breeding success of the grey-faced petrels in response to various predator control regimes and to use the results of this research as a guide to improve predator control across the Reserve as a whole.

To protect the grey faced petrels from predation by stoats, feral cats and rats, an intensive predator control programme was established around the study site. To target the stoats, double DOC200 traps, baited with fresh salted rabbit, are placed in close proximity to each of the burrows. These are serviced monthly from February through to May and then with the arrival of the birds, fortnightly from June through to January. Rodents are controlled by a combination of toxin (Pindone) feed stations (Philproof) and traps baited with peanut butter. Adam says “it is crucial the bait feeding stations never run out of bait otherwise the knock down of rats will be less effective”. In addition, a network of Steve Allen SA2 traps baited with fresh rabbit are used to target feral cats and stoats. These are checked weekly and reset with fresh bait.

To record the success of these predator control measures the Trust: (i) monitors the presence of predators at the breeding sites with trail cameras, (ii) measures the breeding success of the grey-faced petrels, and (iii) records the

The Grey-faced petrel is an all-dark oceanic bird with a short-hooked beak, long narrow wings with a wingspan of c. one metre. The body is black-brown but the area around the bill and throat is grey, hence its name. At sea it is fast and graceful and around colonies is usually very active on stormy nights. From studies of colonies on islands in the Hauraki Gulf and the West Coast (Bethell's Beach), we know that the birds return to their breeding sites around April/May, where they re-establish pair bonds, prepare burrows and mate; the so- called prospecting time. They often engage in spectacular aerial displays before mating. After mating both birds depart the site to feed up at sea before returning to the burrow for egg laying, which occurs around June/July. The male usually returns first followed later by the female who lays a single large white egg and then departs soon after back out to sea to feed. The pair then take turns to incubate the egg in shifts of 2-3 weeks. After the egg hatches in August the young chick is brooded by an adult for several hours to a few days and is then left alone in the burrow while both parents forage for food at sea. At this time the young chicks are highly vulnerable to predation. The chick is fed on average every 4 days but at times is not fed for up to 14 days, corresponding to the two patterns of feeding by the adults; short trip rotations of 1-3 days and long trip rotations of up to two weeks. When the chick is fed the parent may remain in the burrow for several hours but more commonly departs within 30 minutes, especially later in the season. Chicks fledge after 108-110 days corresponding to late December to mid-January. As the chicks mature they lose their down and start emerging from their burrows where they exercise their wings to build up strength for flying. This is thought to be an important time for them to bond to the site and thus return to breed 5 or more years after they depart. By late January the colonies are deserted.

presence and breeding of other seabirds at Bream Head. Monitoring of predators is carried out using a combination of tracking tunnels and trail cameras and the results determine what additional measures need to be taken to protect the birds. The breeding success of the grey-faced petrels is monitored throughout the breeding season and includes determining the number of active burrows, the total number of eggs laid and hatched, and the number of chicks that fledge. Many of the burrows are long, so to access them study lids have been installed on a selection of these to record the status of the burrow. To minimize disturbance of breeding birds, endoscope cameras with a blue tooth connection to a cell phone are used to monitor egg laying and the early stages of development. The only time the birds are handled is when the chicks are banded late November before they fledge; an activity carried out by Cathy who has 'level three' bird handler qualifications and a permit from DOC for these activities. To monitor the presence of other seabirds around the reserve acoustic monitors are set up at specific times of the year to determine the presence of Cook's petrels/tītī (*Pterodroma cookii*; Sept-Nov), common diving petrels/kuaka (*Pelecanoides urinatrix*; Aug-Oct) and fluttering shearwaters/pakahā (*Puffinus gavia*; Aug-Oct). The first recordings were completed in 2021 and a report on the results is currently in preparation.

Photo: Cathy Mitchell

Adam Willetts with grey faced petrel chick.

However, predator control is not limited to the study site. A network of traps that target mustelids, rodents, brush-tailed possums and feral cats has been established across the entire 800 Ha reserve. Trapping lines have been set up 100 m apart and parallel to the sea. Some of these lines are along very steep and rugged terrain, necessitating the need for well

Photo: Neil Fitzgerald (neilfitzgeraldphoto.co.nz)

Grey faced petrel adult in flight.

trained and experienced staff to service them. Traps for stoats (DOC200) and possums (a mix of Steve Allan SA2 and Sentinel) are set at 200 m intervals. In addition, there are 1300 mini toxin feeding stations (Philproof) at 50 m intervals on the trapping lines, across the reserve. The first generation toxin, Pindone, is generally used as it has a very low risk of secondary toxicity and does not accumulate in the environment. However, this toxin is switched out every two years for either Double Tap or 1080 to target trap shy stoats and rodents. All traps and bait stations are designed to be inaccessible to the resident North Island brown kiwi population of around 150. A team of 3 contract rangers and 60 volunteers operate from the Trust base in Peach Road servicing all these traps as well as collecting the SD cards from the cameras, and chew and tracking cards. Servicing and monitoring such a large trap network by rangers and volunteers is a major logistical exercise that is managed by Adam. It also needs to be flexible as detection of predators such as feral cats or stoats requires an immediate response. Consequently, Adam is frequently out in the field auditing and checking everything is running smoothly.

The intensity of the trapping has led to a reduction of the rat trapping index from ~65% in 2002 to less than 1% from 2015 onwards, which was sufficiently low to allow the re-introduction of birds previously extinct from the reserve, such as the toutouwai/North Island robin (*Petroica longipes*) and popokatea/whitehead (*Mohoua albicilla*), and has facilitated the self-reintroduction of kākā (*Nestor meridionalis*), korimako/bellbird (*Anthornis melanura*), occasional kākāriki/red crowned parakeets (*Cyanoramphus novaezelandiae*), and some seabirds around the coast. Possum numbers have fallen from an initial index of 85% (in 2010) to a current index of 0.6% (one possum caught every two months). Removal of possums has had a huge impact on the regeneration of the forest which prior to 2002 was in places very sparse. Suppression of predators has also greatly assisted the breeding and survival of many invertebrates including the Bream Head Skink (*Oligosoma kaerakau*)[3] and flax snail/pupurangi (*Placostylus* spp.). In addition to tracking tunnels and chew cards, a network of 33 infrared trail cameras (Browning Dark Ops and Bushnell DS No Glow) paired with automatic lure dispensers (*ZIP motolure* – with *Best Foods* mayonnaise), corresponding to one every 25 Ha, has been set up across the reserve to monitor for the presence of feral cats, stoats and possums as part of the *Predator Free Whangārei* possum eradication project. The use of the trail cameras is an essential component of the control measures so the team know what predators are present and how to respond. From monitoring in the first quarter of 2022 they know that at least six stoats are currently present in the reserve but have failed to engage with any of the traps. With that knowledge the team can introduce more targeted approaches to remove these remaining predators. To further protect the reserve a buffer zone of trapping that extends

Photo: Shannon Courtney

Cathy Mitchell with grey faced petrel chick.

back to Paua Bay was established in 2021 by *Predator Free Whangārei*. Trail cameras have been installed across this area as well. This has enabled a 'detect and respond' approach to control predators in this buffer zone. Stoats remain the biggest predator challenge for the reserve as they are very difficult to catch, as highlighted by the recent incursions at Motutapu island and Shakespeare Regional Park[3]. More promising methods such as the use of toxin-laced rat carcass[4] or toxin laced mayonnaise are being trialled by Zero Invasive Predator (ZIP) together with AI, and may be used in the near future.

"Understanding predator behaviour is absolutely key to achieving high levels of pest suppression" says Adam. The dramatic decrease in possum numbers was achieved without using any toxins as possums are attracted to visual cues such as white fabric, which they can detect from 100 m or more. They then switch to olfaction for the final few metres that lead them to the baited trap. Trail cameras showed that Norwegian rats, in contrast to Ship rats, do not climb ropes at heights greater than 100 cm from the ground leading to traps, necessitating a change in catch strategy. Observations of rat feeding showed that Norwegian rats prefer meat to cereal baits. Other observations showed that stoats are very weary of any man-made devices in the environment such as traps, and are highly driven by olfaction and learned habits in targeting their prey. These observations and others inform the trapping strategies employed in the reserve.

The work being undertaken by the Bream Head/Te Whara Conservation Trust is an excellent model of the benefits of community working with the Department of Conservation to restore and maintain an important ecological reserve. The involvement of the 60 plus volunteers together with the *Predator Free Whangārei* group has established a core group of conservation advocates within the greater Whangārei region. That strong community advocacy has a spillover benefit for conservation in the wider region. As outlined above the maintenance of a mainland area relatively free of predators is hugely challenging and requires considerable people and equipment resources. A key part of the success of this Trust has been the power of observation and follow up trials to better inform their predator control measures. They are ever watchful of new technologies and the need for testing them at their site. Hopefully, as new technologies evolve that make it easier to control predators like stoats, the task will get easier, but meanwhile The Bream Head Trust is very dependent on ongoing funding and support from their strong network of volunteers and supporters. Please support them.

Photo: Shannon Courtney

Cathy Mitchell returning from grey faced petrel colony on Bream Head.

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Hochstetter's frogs hanging in there on Aotea

JUDY GILBERT (Windy Hill Sanctuary)

*The Aotea Great Barrier Hochstetter's frogs/ pepeketua (*Leiopelma hochstetteri*), which are genetically distinct from mainland populations[1,2,] represent the only island population for this primitive native species – they are unique to us. These frogs are nocturnal and seek refuge during the day in damp spaces underneath rocks, logs, and leaf litter. In dry weather they are typically found around stream beds and banks, although they can also be found away from streams under bush canopies. Unlike the introduced Australian Bell frogs (Ranoidea aurea), Hochstetter's frogs are acoustically silent. Native frogs are in decline in New Zealand principally through habitat destruction and predation by introduced mammalian species. The global chytrid fungus epidemic is also thought to have impacted on New Zealand native frog populations.*

The last population on Aotea resides in Te Paparahi but until relatively recently no scientific surveys had been carried out to find out how many were there and whether they were successfully breeding. This situation changed in November 2012 and May 2015 when the area where the frogs had been seen was surveyed[3,4]. Fifteen 100 metre transect lines in stream beds were surveyed by a team consisting of herpetologists and Windy Hill Sanctuary field staff. The Windy Hill Rosalie Bay Catchment Trust, with support from Lotteries Environment and Ngāti Rehua Ngāti Wai ki Aotea, spearheaded this investigation following a full frog and lizard survey of the Windy Hill area in 20105, where no frogs were found in what is suitable habitat for them. The idea was that if there was a sufficiently healthy population in Te Paparahi a request could be made for translocation of some of these frogs back to Windy Hill so they could be re-established in a large forest area where pests have been suppressed to very low levels. Hence, a long term survey of the frogs would establish whether the population was high enough for some of the frogs to be relocated without endangering the population at Te Paparahi.

One problem with monitoring Hochstetter's frogs is it is very difficult to estimate actual population size because it is difficult to distinguish one individual from another, they are cryptic, and they also move between different streams over longer timeframes. Most monitoring therefore relies on an index rather than an actual estimate of abundance.

In April 2021 the third Hochstetter's frog survey took place[6]. The Windy Hill Rosalie Bay Catchment Trust, with support from Ngāti Rehua Ngāti Wai ki Aotea, received funding from Auckland Council and the Aotea DOC to survey the same transects in the Te Paparahi Park Area that were previously surveyed in 2012 and 2015[3,4]. The aim of the 2021 Hochstetter's frog survey Island was to check out the current health of the Te Paparahi Hochstetter's frog population by collecting more data to add to

Photo: Windy Hill and Rosalie Bay Catchment Trust Photo Collection

Hochstetter's frog ((Leiopelma hochstetteri).

Photo: Windy Hill and Rosalie Bay Catchment Trust Photo Collection

Volunteers counting Hochstetter's frogs..

the nine-year monitoring programme to determine whether this population was increasing, stable, or declining. Special care was taken to prevent or spread any diseases by the survey team.

These little native frogs are about the size of your thumb nail (30-50 mm) and incredibly camouflaged so finding them is painstaking work. A total of 428 observations of Hochstetter's frogs were made during the 2021 survey with frogs detected on 13 of the 15 transects - 87%. Of the total frog sightings, 17% were juvenile frogs. The presence of juvenile frogs indicates successful breeding or that subadult immigration is occurring. Based on the three surveys the population appears stable.

Recently, a further exploratory survey by Virginia Morena found two more Hochstetters' frog sites in the north-western area of Te Paparahi and at much lower altitudes. Knowing that the frogs are found at low altitudes on Aotea means that Windy Hill would be a suitable site for a possible translocation and the data indicates there are sufficient numbers to source some for Windy Hill.

In terms of protection for these little critters, the recently funded Tū Mai Taonga project, which takes in the area where the frogs are found, will, in time, further protect this unique Aotea population of frogs, but ongoing monitoring will be crucial to the conservation management of this unique and vulnerable population of Hochstetter's frogs.

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The importance of the Aotea marine environment to the Gulf's marine megafauna community

OLIVIA HAMILTON (recent PhD graduate, University of Auckland)

The Hauraki Gulf—Tīkapa Moana Te Moananui-ā-Toi— is a world-renowned biodiversity hotspot supporting a diverse marine megafauna community. The Gulf is famous for the Bryde's whale and the more commonly encountered dolphin species. Yet, our only national marine park is home to one-fifth of seabird species, one-fifth of whales and dolphin species, various large shark and ray species, large migratory fishes, turtles, and seals. The Gulf's long coastline and offshore islands, strong currents, and high primary productivity provide the ocean's giants with critical habitat seasonally or year-round.

The positioning of Aotea/Great Barrier Island in the outer Gulf – the region beyond Cape Rodney and Cape Colville, as the crow flies – puts it at the centre stage of the large-scale oceanographic processes that primarily influence the productivity of the Gulf. The productive waters support an abundance of zooplankton, fish, and squid, which support communities of seabirds, cetaceans, large predatory fishes and sharks, and rays[1,2,3,4,5,6,7,8]. Aotea is also at the heart of the circulation of these productive waters as it forms one side of the Cradock and Colville Channels and is directly influenced by oceanic water flowing through the Jellicoe Channel. The interaction between Aotea and surrounding landmasses such as Te Hauturu-ō-Toi/Little Barrier Island and the Coromandel peninsula, winds and currents, and persistent inputs of nutrient-rich water from the Firth of Thames creates productivity hotspots in the outer Gulf. While marine megafauna species have specific diets, they congregate in regions where food is abundant[9]. A recent study identified an overlap between large marine predators and their prey, providing evidence that the Gulf is a critical feeding ground for sharks and cetaceans[10]. This is what we see in the outer regions of the Gulf throughout the year, albeit changes to the assemblages of marine megafauna depending on the seasonal changes in food availability and prey type and ecology of species.

Explaining the presence and prevalence of marine megafauna species throughout the year requires an understanding of the climatic and oceanographic processes that drive food availability in the Gulf. During winter and spring, westerly winds promote the upwelling of nutrient-rich waters from the deeper areas onto the shelf[6,8,11]. The combination of wind-driven mixing and upwelling essentially fertilises the top layer of the water with nutrients that promote the growth of phytoplankton – tiny marine plants

Photo: Olivia Hamilton

Olivia Hamilton carrying out an aerial survey of marine animals in the Hauraki Gulf.

that form the basis of the entire food chain in the open waters of the Hauraki Gulf. The Gulf is core habitat to four populations of cetacean

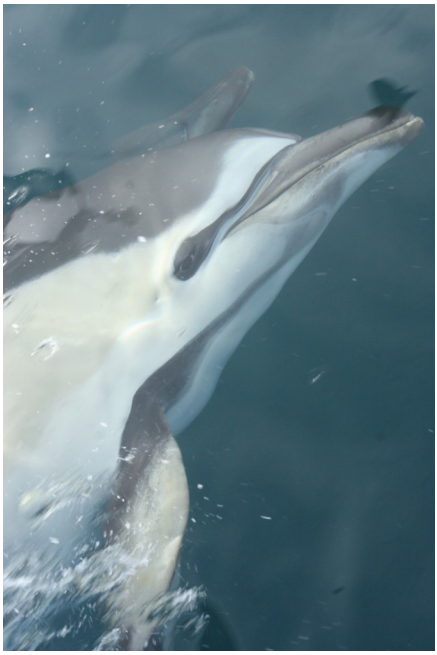

Photo: Olivia Hamilton

Common dolphin cruising in the Hauraki Gulf.

species – orca/kera wera (*Orcinus orca*), the 'nationally critical' Bryde's whale (*Balaenoptera edeni brydei*), the 'nationally endangered' bottlenose dolphin/terehu (*Tursiops truncatus*)[23], and the common dolphin/popokanua (*Delphinus delphis*)[23] – the latter three commonly seen in the waters around Aotea year-round[12,13]. Habitat modelling indicates that we are likely to see these cetacean species more frequently with the onset of the period of intense upwelling and primary productivity[10]. While bottlenose dolphins around the coast of Aotea will be a familiar sight to residents, Aotea has recently been identified as a hotspot for the North Island population[14]. The Bay of Islands was once a stronghold of the North Island bottlenose dolphin population, but the numbers have dwindled over the last 20 years due to human pressures[24,25], namely due to intense tourism[26,27]. As a result, the discovery that Aotea is a core feeding and breeding habitat for bottlenose dolphins will be vital to the conservation and management of this species due to its importance in sustaining the declining population.

In summer, the marine environment in the outer Gulf is strongly influenced by the East Auckland Current (EAUC), an extension of the sub-tropical East Australian Current, which flows southeast down the northeast of the North Island, causing a sharp increase in the sea temperature. The presence of the EAUC brings with it a new assemblage of zooplankton and fish species as additional prey sources to large predators[15]. High densities of fish were found on the east coast of Aotea in the warmer months during aerial surveys, including small planktivorous fish, such as jack mackerel/ haature (*Trachurus novaezelandiae*) and pilchard/mohimohi (*Sardinops sagax*), and larger predatory fish, such as yellowtail kingfish/haku (*Seriola lalandi*), skipjack tuna (*Katsuwonus pelamis*), and kahawai/kōukauka (*Arripis trutta*)[16]. Densities of zooplankton aggregations were also notably high from the Cradock Channel through to Colville Channel[13]. The warmer months and periods of abundant food result in a seasonal influx of different species – one may be lucky enough to encounter whale sharks (*Rhincodon typus*) and devil rays (*Mobula japonica*) on the east coast of Aotea[17,18,19].

Several other cetacean species pass through the waters around the outer Gulf. Blue whales (*B. musculus intermedia*), fin whales (*B. physalus*), sei whales (*B. borealis*), minke whales/pakake (*B. bonarensis and B. acutorostrata*), beaked whales (Ziphiidae), humpback whales/paikea (*Megaptera novaeangliae*), southern right whales/tohorā (*Eubalaena australis*), long-finned pilot whales/ ūpokohue *(Globicephala melas)*, and false killer whales (*Pseudorca crassidens)*, occasionally use this area either as part of their migration corridor or part of their overall range[4]. The Gulf is also a seabird hotspot, with 20% of migratory and residential global seabird species occupying the numerous islands within the embayment[2,5]. Twenty-seven seabird species breed in the HGMP, mainly on offshore islands. Aotea and

Te Hauturu-ō-Toi are the regionally endemic black petrel/tāiko (*Procellaria parkinsoni*) breeding sites – meaning that the entire global population breeds on these two islands. In addition, many of the surrounding islands and island groups in the outer Gulf support most of the breeding seabirds, such as the Mokohinau Islands, which are home to one of the richest seabird breeding communities in Aotearoa. The outer Gulf is, therefore, an important feeding ground for breeding seabirds, which are often constricted to foraging close to their breeding colonies. At-sea distribution maps of seabirds indicate that the waters around Aotea are core habitat for a range of seabirds, including the flesh-footed shearwater/toanui (*Puffinus carneipes*) and the Buller's shearwater/rako (*Puffinus bulleri*), Australasian gannet/tākapu (*Morus serrator*), New Zealand storm petrel/takahikare (*Fregetta maoriana*), and the white-fronted tern/tara (*Sterna striata*)[28]. Fish-eating seabirds, such as petrels and gannets, and plankton-eating shearwaters are often seen as part of multi-species feeding aggregations with Bryde's whales and common dolphins, with the species composition dependent on the prey being schooling fish or zooplankton[29]. The *Pulse of the Gulf* project, led by Professor Rochelle Constantine from the *University of Auckland*, is leveraging the power of drones and artificial intelligence to learn more about the dynamics of these feeding aggregations to inform conservation and management decisions.

Aotea and Te Hauturu-ō-Toi are the regionally endemic black petrel/ tāiko breeding sites – meaning that the entire global population breeds on these two islands.

While most megafauna research has focused on the more commonly sighted cetacean species in the inner Gulf, we are seeing more megafauna research in the outer Gulf and around Aotea. For example, the oceanic manta ray (*Mobula birostris*) was previously considered an occasional visitor to the Gulf. However, the data suggest a more significant and persistent population than previously thought, thanks to the wonderful work of the Manta Watch Aotearoa New Zealand (MWANZ). A combination of dedicated surveys and citizen science input has revealed a foraging hotspot on the Pacific side of Te Hauturu-ō-Toi and Aotea and the regular occurrence of individuals in 'cruising mode' along the northern coast of Aotea. Furthermore, large-scale aerial surveys of the inner and outer Hauraki Gulf identified offshore regions of Aotea as crucial seasonal

Photo: Jochen Zaeschmar

False killer whale breaching off Aotea.

Photo: Edy Setyawan

Oceanic manta ray.

habitats for the highly migratory mako shark/mako (*Isurus oxyrinchus*) and blue shark/taha pounamu (*Prionace glauca*)[10]. The same study pinpointed the coastal waters of Aotea as important habitat for the smooth hammerhead shark/mangōpare (*Sphyrna zygaena*) and bronze whaler shark/horopekapeka (*Carcharhinus brachyurus*), who move into the Gulf to feed and pup over summer. In addition, the Far-Out Ocean Research Collective is making strides in our understanding of oceanic and more elusive species, such as the false killer whale, who frequent the Gulf in warmer months and form large feeding aggregations with oceanic bottlenose[20] and may be sighted both seaward and landward of Aotea (Jochen Zaeschmar, pers comm).

While the Gulf is classified as a marine megafauna hotspot, there has been a marked reduction in biodiversity since human settlement. There has been a 94% decline in the biomass of marine mammals[21]. For example, although once abundant in the Gulf, fur seals were almost entirely extirpated from the Gulf by 1800. The development of commercial fisheries from 1950 to the present day has resulted in a substantial reduction in the biomass of sharks and fish and caused changes to the food web structure[22]. While marine mammals and seabirds are protected species, there are currently no designated protected areas for these species in the Gulf. There is virtually no safeguard to the large migratory sharks that frequent the Gulf during the warmer months, such as the smooth hammerhead and mako shark – both listed in Appendix II of the Convention on International Trade in Endangered Species (CITES).

Activities such as farming, construction, and urban development, have caused substantial changes to the catchments of the Gulf, and many fish stocks have been depleted through commercial fisheries[1,30]. Due to the wide-ranging nature of marine megafauna species and the diversity of habitats they occupy, the ocean's giants are vulnerable to a wide array of land and sea-borne human pressures. As a result, an ecosystem-based management approach that considers food-chain links, species interactions, and the cumulative impact of human pressures is crucial for protecting the megafauna community. Marine megafauna are important ocean predators and are vital components of all ecosystems, and any hope of maintaining a viable pelagic ecosystem in the Gulf depends on their persistence.

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Pekapeka Survey Aotea/Great Barrier Island

ANNAMARIE CLOUGH (Auckland Council) with Patrick Stewart (Red Admiral Ecology)

*In December 2021 Soundcounts, under contract to Auckland Council, carried out an autonomous ultrasonic survey of pekapeka/ New Zealand long tailed bat (*Chalinolobus tuberculatus*) across Aotea/Great Barrier Island. A taonga species on Aotea, the North Island long tailed bat is presently classified as "Nationally critical", the highest threat level for native species before extinction in New Zealand[1].*

In December 2021 Soundcounts, under contract to Auckland Council, carried out an autonomous ultrasonic survey of pekapeka/New Zealand long tailed bat (*Chalinolobus tuberculatus*) across Aotea/Great Barrier Island. A taonga species on Aotea, the North Island long tailed bat is presently classified as "Nationally critical", the highest threat level for native species before extinction in New Zealand[1].

Photo: Colin O'Donnell

Pekapeka/long-tailed bat .

Northern Catchments

Analysis of hourly time/location data indicated that bats were roosting within the upper reaches of the Kaiaraara catchment, behind Port Fitzroy with the latest activity 45 minutes prior to sunrise. Indications were that bats were not roosting within the Okiwi catchment, the latest activity being 75 minutes prior to sunrise. Bat activity on the road saddle between the Fitzroy and Okiwi catchments was limited to the middle of the night and indicative of them using the road to commute between the Fitzroy and Okiwi catchments.

Southern Catchments

Low levels of sparse activity were detected in the southern catchments of Aotea. Analysis of hourly time/location data indicated that a communal/maternal roost was unlikely to be within any of the southern catchments during the short survey period. It is possible that bats will utilise more habitat in the southern catchments as pups are weaned if the population disperses across the landscape.

Dark Sky Sanctuary

Aotea is accredited as a Dark Sky Sanctuary and there is little lighting on the islands roads, which pekepeka utilise to commute between catchments. Roadside lighting is believed to increase prey for bat species but may turn them away from their normal commuting route. The dark skies of the motu may well be advantageous to pekapeka[2].

The survey will not detect all bats, as it utilises patterns of activity across the landscape to make generalised inferences. Also this survey did not include any DOC managed land. The main finding was that bats are more active in the north of Aotea. In future, further surveys and more input from the community should provide a clearer picture of bat activity across the motu. A handheld bat detector will be available through Aotea's Ecology Vision program to loan to community groups wishing to undertake their own localised surveys, contact ecologyvisiongbi@gmail.com

To view the full survey report, visit https://ecologyvision.co.nz/2022/02/08/aotea-autonomous-pekapeka-survey-2021/.

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Pāteke update on Aotea Great Barrier Island

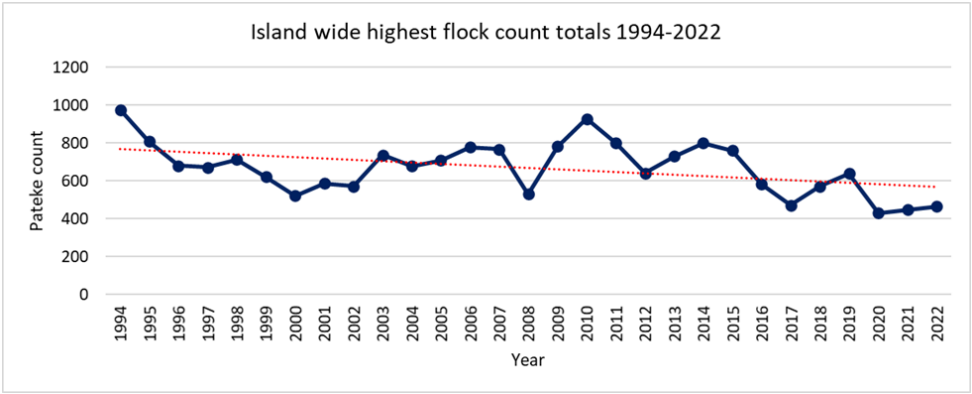
TESS van der WELL (Biodiversity Ranger), Dr. LEIGH JOYCE (Acting Senior Ranger Biodiversity), Dr. SARAH DWYER (Supervisor), Department of Conservation, Aotea Great Barrier Island

*Pāteke/brown teal (*Anas Chlorotis*) are an endemic dabbling duck that were once abundant and widely distributed throughout New Zealand[1] but are now classified as 'Threatened – nationally increasing' according to the New Zealand Threat Classification System[2]. Pāteke are most abundant on Aotea/ Great Barrier Island, Northland, and Coromandel, with an estimated total population of 1000-5000[2,3]. The threat classification has a qualifier of 'Conservation Dependent' meaning that pāteke need help for their population to recover[2].*

As omnivores, pāteke are known to feed on at least 78 taxa including vegetation, fungi, and various terrestrial and aquatic invertebrates[4]. Their varied diet means they can live in a range of habitats such as wetlands, ponds, lakes, estuaries, swamp forest, streams, and rivers. Adults are mainly nocturnal, usually staying hidden in the grass or overhanging vegetation during the day and coming out at night to forage. Young ducklings also feed during the daytime accompanied by the female parent, which makes them more vulnerable to predation. Given their varied habitat use and nocturnal behaviours, the summer months provide a good opportunity for population monitoring when the birds flock to find a mate and strengthen mating bonds[5]. The Department of Conservation (DOC) and local community have undertaken annual flock counts to monitor pāteke population trends on Aotea since 1994 (Flock count results are outlined in Annual Pāteke Reports[6]). The methodology follows the *National Guidelines for Monitoring Pāteke*[7] with all flock sites counted on a single day during February/March and repeated a further two times to obtain the best overall count. While the methodology is

Photo: Sarah Dwyer

Adult pāteke on Okiwi station pond.



Aotea annual island wide pāteke flock counts from 1994 to 2022[6].

known to have limitations, it provides a long-term data set to track general population trends. It should also be noted that a flock count is not a population estimate nor is it a count of the number of individual birds on the island.

During the 2022 annual flock count, pāteke were counted at 41 sites across Aotea[6]. The 2022 total flock count of 465 pāteke showed a slight increase, compared to 447 birds recorded in 2021 and 429 birds in 2020[6]. The overall trend since the 1990s indicates that the Aotea pāteke population has been declining, with a significant rate of decline between 1994 and 2000, fluctuating counts of between 530 and 927 from 2002 to 2010, and relatively low counts from 2016 onwards. The lowest count of 429 pāteke was recorded in 2020. Although the flock counts indicate an overall decline in pāteke numbers some of the variation may be due to pāteke moving to new sites, which could result in a full count not being recorded. For example, the Burrill's drain flock count declined from a maximum of 146 pāteke in 2019 to 8 birds in 2020, and although there is no clear explanation for this decrease, it may be partly due to birds flocking at new locations. Seasonal variation and environmental factors may also affect flock count numbers, and it is interesting to note that the Burrill's drain flock count increased in 2022, with a maximum of 129 birds recorded[8]. Pāteke are known to move sites, especially if old flock sites have less stable pond habitats prone to drying out during drought conditions. Northland flock sites had an "expansion" of range leading to pāteke population count increases (rather than increases at old established flock sites) so it is important to regularly search for new likely flock locations (Nigel Miller pers. comm). It will be interesting to see if the last 12 months of "damp" conditions is reflected in the 2023 annual flock counts (hopefully as a result of improved breeding success).

As for many native bird species that have experienced significant declines since the 1800s[9], there are numerous contributing factors to consider when trying to understand the reasons for the decline in pāteke numbers on Aotea. To help pāteke recovery on Aotea, DOC has primarily focused on feral cat trapping, pūkeko control, and pond and waterways restoration. However, as John Ogden notes in Issue 36 of Environmental News, the pāteke population has not recovered as would be expected with ongoing predator control at Whangapoua[10]. Predation by feral cats is probably a significant contributor to pāteke mortality, however the causes of decline are complex and most likely due to a combination of factors, including predation, habitat destruction, drought conditions, food availability and starvation. More research and monitoring is needed to determine what factors are having the greatest impact on pāteke survival and recruitment. Evidence and anecdotal observations identify predation by feral cats, pūkeko and harriers; and rats are known to prey upon eggs and compete for food. Other threats include habitat degradation, competition for resources by

To help pāteke recovery on Aotea, DOC has primarily focused on feral cat trapping, pūkeko control, and pond and waterways restoration.

Monthly flock counts November 2021 to January 2022 at main flocking sites.

Site	11-Nov-21	8-Dec-21	12-Jan-22	22-Feb-2022 (Annual count)
	Pāteke	Pāteke	Pāteke	Pāteke
Burrill's drain (Whangapoua)	52	120	210	126
River Reserve (Whangapoua)	98	45	0	21
Paddock 27 (Whangapoua)	91	106	48	62
Airport pond (Whangapoua)	2	5	13	5
Estuary (Whangapoua)	0	0	0	1
Awana	34	21	8	24
Pond 1 (Whangapoua)		9	22	10
Wairahi		111		26
Totals	277	417	301	275

paradise ducks and mallards; and predation by eels and ruru/morepork, however the most significant threat of predation is from introduced carnivorous mammals[7]. Climate change may have long-term implications for survival rates and changes in behaviour, with increasingly dry seasons and drought on Aotea affecting water quality, pond levels, wetland habitat and food availability, with juvenile pāteke dying of starvation. In 2021, the Department of Conservation established a dedicated pāteke Biodiversity Ranger role to try and gain a better understanding of the complex pressures affecting the pāteke population on Aotea, with a view to managing the most significant pressures.

Additional flock counts

In 2021, additional monthly flock counts were conducted throughout the flocking season (November to January) at the main flocking sites around Whangapoua and Harataonga to observe dispersal trends. Large variations were seen among counts across the different sites during the 2021-22 flocking season, warranting further consideration of pāteke movements around Aotea, the timing of annual flock counts, and potentially whether birds are moving off island.

Camera monitoring

Pāteke nest in shrubby undergrowth near waterways as it keeps them hidden from predators and close to their foraging site[11]. Finding nests can be challenging, so a pāteke detection dog was used in July 2021 to locate nests and pathways found at Harataonga, Whangapoua and Awana, in order to monitor hatching success and duckling survival.

A total of eight nests were discovered with

Photo: Sarah Giblin, DOC Aotea

Pāteke nest monitoring. (a) pāteke nest found in punga skirt. (b) Rat captured visiting pāteke nest holding eggshell of hatched pāteke.

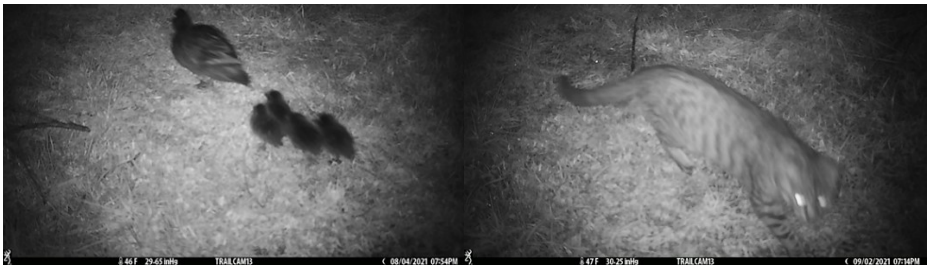


Photo: DOC Aotea

Pāteke pathway monitoring. (a) adult pāteke with 4 ducklings. (b) cat captured using the same pathway.

clutch size ranging from 4-7 eggs. Most nests were located within 20 metres of a water body. Five nests were found under punga skirts, two in kikuyu and one on a pōhutukawa tree hidden amongst epiphytic kiekie. Cameras were set up to monitor parent behaviour and hatching success. Unfortunately, not enough data was collected to conclude hatching success, however, the footage showed the parents leaving the nest and eggs left unattended for 30 -50 minutes every night. Rats were captured visiting the nest and playing with eggshells but there was no evidence of them preying on unhatched eggs.

Cameras were also set up along pāteke pathways which were found along fence lines and adjacent to creeks or roads. Pāteke use these tracks daily to commute between roosts and foraging sites[11]. Once eggs had hatched, adult ducks were seen taking their ducklings down these pathways to foraging sites. Soon after pāteke ducklings were observed on the pathways, paradise shelducks were seen using the tracks with clutches of up to 17 ducklings. Data from the 2021-22 monthly flock counts also showed high numbers of paradise shelducks (maximum of 163 at Burill's drain) using the same habitat as pāteke, with the highest numbers towards the end of the flocking season. High numbers of paradise ducks were also seen flocking on Awana Stream in January 2021 (approximately 70) and February 2022 (approximately 60) (Barry Scott pers. comm). The trail camera footage also showed that the pathways were shared with feral cats, rats, pūkeko and feral pigs.

Monitoring of feral cats and rats

Trap data records identify the number of feral cats captured in recent years, however there is no historical baseline data to estimate long-term feral cat population trends on Aotea. In 2021, DOC established a network of 32 baited trail cameras at set point locations along 8 transects around Whangapoua to monitor feral cats, following the same methodology used by Auckland Council across central regions of the island. Monitoring was undertaken for 21 nights in both May and October in 2021 and 2022, recording the presence of cats, harriers, rats, pigs, rabbits, pāteke, pūkeko, banded rail, paradise ducks, magpies, and shore-wing plovers (however some records may be recounts rather than discrete individuals).

An index for each species counted in the camera images was determined by the formula:

$$\text{Detections per 1000 CH} = \frac{\text{number of detections}}{\text{number of camera trap hours}} \times 1000$$

The 2021 results showed an increase in cat detections per 1000 camera hours in May (3.7) compared to October (1.1). Harrier detections were also higher in May (19.4) compared to October (5.7), while rat numbers were higher in October (107.6 compared to 65.4 detections per 1000 camera hours). These initial results indicate when pāteke may be most vulnerable to predation, however ongoing monitoring is required to identify long-term trends in feral cat numbers. This information will assist feral cat control, for the Tū Mai Taonga project, and pāteke management decisions.

Rodent monitoring was set up at Harataonga (4 lines) and Whangapoua (8 lines) in 2021. Each line consisted of 10 tunnels spaced at 50 metre intervals. Monitoring started in November 2021 and records were taken four times (in February, May, August, and November) to align with the existing island-wide rodent monitoring. Initial rat tracking index (RTI) results for November 2021 were 35% at Whangapoua and 28% at Harataonga.

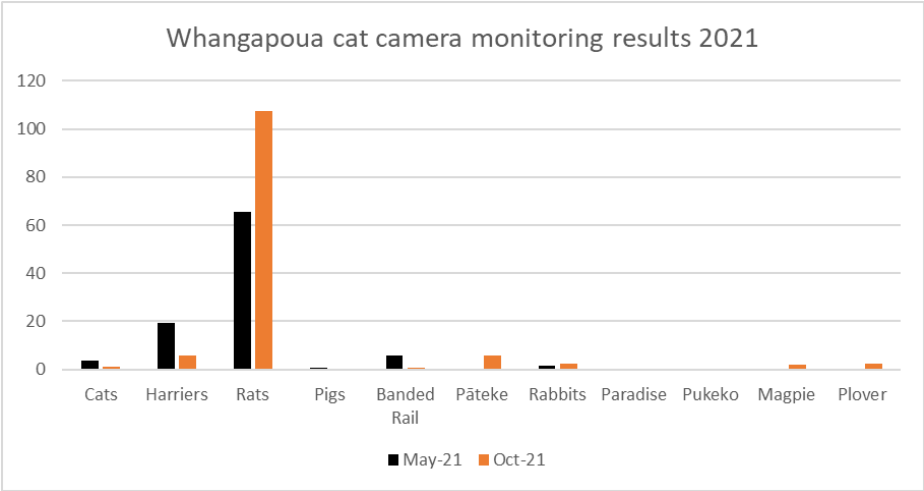


Photo: DOC Aotea

Predator control

Cat trapping efforts varied in terms of the number of months per year control was carried out in the Whangapoua basin. Feral cat control was only undertaken during April-September between 2013-2017. This increased to nine months of the year from 2018 onwards in response to the declining pāteke population, and then to year-round trapping in 2021. Conibear (quick-killing body-gripping traps) and live capture traps were set around Whangapoua basin along roads and near sand dunes. Following a review of the network in 2021, additional traps were added at the edge of the bushline.

Pūkeko are known to eat both ducklings and eggs and large numbers can have an impact on pāteke breeding success due to habitat competition[12]. Pūkeko control by shooting and cage trapping commenced in 2001 and continued until 2015 before it was reintroduced in 2017, with more intensified control during the pre-breeding season in 2021 and 2022.

Wetland Restoration

To increase pāteke foraging, breeding and roosting sites, DOC has managed ponds and wetlands around Whangapoua, including undertaking weed control and native planting. In 2021, roughly 2600 plants were planted near waterways and ponds around Okiwi to provide suitable habitat for pāteke. Mercer grass, Mexican devil, lotus major and kikuyu are known to grow into dense mats reducing areas of open water, choking waterways, and reducing the ability for pāteke to feed. Last year the Whangapoua wetland management plan was reviewed and updated, and a work plan was created to include both weed control and planting.

Conclusion

DOC is continuing existing predator control, habitat restoration and monitoring in partnership with the Aotea community and Auckland Council, and new monitoring initiatives will help identify where future efforts and resources should be directed. Pāteke will also benefit from feral cat and rat control undertaken by the DOC Jobs for Nature funded Ngāti Rehua Ngātiwai ki Aotea-led Tū Mai Taonga project. The pāteke programme is the main focus of acting Senior Ranger Biodiversity, Dr Leigh Joyce (who is on a 14-month secondment while Louise Mack is on maternity leave). The plan is to finish the draft Pāteke Literature review and gather information from existing scientific research, publications, reports and monitoring – to collate what we already know about pāteke on Aotea and identify areas where knowledge and data is lacking; to be able to prioritise further research and help determine ongoing management decisions so that we can prevent further decline and protect pāteke. In order to utilise resources effectively, we need to gain a better understanding of the complex factors threatening the pāteke population on Aotea. It is important to identify gaps in our knowledge,

including available information on nesting, duckling, juvenile and adult survival rates, recruitment, and causes of mortality, so that we can determine when pāteke are most vulnerable.

DOC is planning a community hui in September to discuss ideas and the possibility of setting up a community "citizen science" website specifically for pāteke on Aotea. There is a wealth of local knowledge in the Aotea community and observations about pāteke behaviour, threats, flock sites and long-term trends in numbers - and it would be fantastic to capture this knowledge and involve the community and schools in monitoring and recording current and historical information to help manage the pāteke population.

Acknowledgements

Thank you to all those in the Aotea community who have been trapping in their back yards, restoring wetlands and waterways, and participating in pāteke flock counts.

Photo: DOC Aotea

Auckland Council (blue) and DOC (green) cat trapping network.

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Beyond the Barrier

ENVIRONMENTAL NEWS FROM NEW ZEALAND & AROUND THE WORLD

Kāpiti Island now rat free for 25 years

It is now just over 25 years since rats were eradicated from Kāpiti Island but there was a last minute hiccup that caused great anxiety for architect of the project, Raewyn Empson, who at the time was a Threatened Species Officer for DOC's Wellington Conservancy[1]. Kapiti Island is 1965 Ha in size with dense bush and complex terrain. While there had been considerable success in removing rats from smaller islands no one, anywhere, had ever attempted to eradicate both kiore and Norway rats from an island this size. After considerable planning for the complex logistics this operation required, when the bags of bait were opened and checked they found all 30 tonnes of the brodifacoum was mouldy and could not be used. While winter is the best time for rodent control, when rats are hungry and their numbers are lowest, Raewyn and the team decided they would wait for fresh bait to be prepared and go for a later aerial drop. After years of work including two trials of non-toxic bait and putting in place special measures to protect non-target species – weka were temporarily transferred off the island and takahē and pāteke were put in special enclosures to keep them safe – two aerial drops proceeded in September and October of 1996. After these aerial drops a network of hundreds of tracking tunnels was set up across the island and monitored until 1998 but not a single rat print was found. In 1999, Conservation Minister Nick Smith declared Kāpiti Island to be rat-free. Thanks to that effort when you visit the Island today you are greeted with an astounding chorus of birds that is absent from most of mainland New Zealand.

Photo: Barry Scott

Kererū/New Zealand wood pigeon on Kapiti Island.

Feral cats roam far and high in the Southern Alps

Recent research by Manaki Whenua/Landcare Research field ecologist Ivor Yockney showed that feral cats not only roam far but also very high into the alpine zone of the Southern alps and even cross the Main Divide[2]. The motivation for the study was the observation that feral cats were killing adult kea in the alpine zone of the Southern Alps. Twenty feral cats were captured and fitted with GPS radio collars and 10 released in the upper Hope River (Lewis Pass) and 10 in the Hawdon River (Arthurs Pass) and their movements tracked to see exactly where they went. A huge amount of data has been collected but the analysis has only just got underway. One male cat had a home range in the Hope Valley of 23 km and though he spent most of his time on the river flats he also crossed the main divide to the headwaters of the Tutaekuri River on the West Coast. Another male cat was identified as an "alpine specialist" as he spent much of his time in the alpine zone above the Hawdon Valley. His range was a large circuit that always finished on the valley floor after his forays on the tops.

This study provides new insights into the behaviour of feral cats in the Southern Alps and should help devise strategies that protect our iconic alpine parrot from predation by these cunning animals.

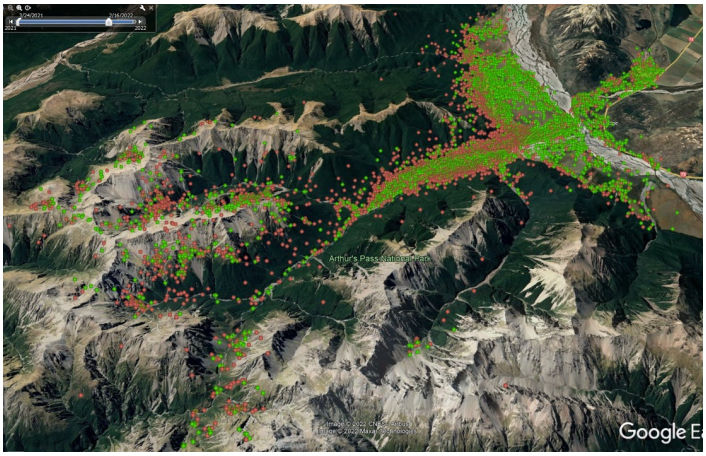

Photo: Ivor Yockney, Manaaki Whenua/LandCare Research

Location of fixes on feral cats tracked in the Hawdon Valley, Arthurs Pass.

Partnership to eradicate predators on Rakiura

In a recent announcement, Manaaki Whenua/ LandCare Research and Predator Free Rakiura have signed a research partnership agreement of $2.8 million dollars to make Rakiura/Stewart Island predator free[3]. The research project will run for four years to investigate ways to eradicate possums, rats, feral cats and hedgehogs from the island. Deer are currently excluded from the project because of the current economic benefits to the island from hunting[4]. This would be one of the biggest island predator eradication projects to date anywhere in the world. At around 180,000 Ha, Rakiura is the third largest island in New Zealand (cf. Aotea/Great Barrier Island at 28,500 Ha) with a permanent population of around 400 people centred in and around Oban. Campbell Leckie, Project Director Predator Free Rakiura, said the research agreement "would enable the team to carry out research on predator behaviour, predator distribution and density, and the social and economic impacts of a project this size and complexity." This research is essential to devise a management strategy to free Rakiura of these predators. Besides the ecological benefits for the main island itself, this project would also eliminate the ongoing risk of rat incursions onto Ulva Island[5], one of the gems in the conservation estate of New Zealand.

Photo: Te Rūnanga o Ngāi Tahu

Rakiura/Stewart Island looking north-east across Mason Bay.

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