Taonga of an island nation:

Saving New Zealand's birds

May 2017

Parliamentary Commissioner
for the Environment
Te Kaitiaki Taiao a Te Whare Pāremata

EMBARGOED until 2.30pm Wednesday 31 May 2017

Acknowledgements

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Photography

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Overview

This report begins with a vision – the restoration of abundant, resilient, and diverse birdlife on the New Zealand mainland. People who know me know that I am not generally given to visions. This one crept up on me during our investigation into New Zealand's native birds.

Our birds are indeed a great treasure – they are a taonga of this island nation. The kiwi deserves its iconic status – it is one of the very few birds left in the world that is only a step away from the dinosaurs. But we also have parrots and penguins, gannets and gulls, shearwaters and shags, ducks and dotterels, and many others.

There are 168 different species of native birds in New Zealand. Of these, 93 are especially precious because they are found in no other country.

But they are far from safe. Only 20% – one in every five – is in good shape. And one in every three is not far off from following the moa and many others into extinction. The situation is desperate.

Our native birds need three things – safety from predators, suitable habitat, and enough genetic diversity for long-term resilience.

Undoubtedly, the first – safety from predators – is the most urgent. Possums, rats, stoats, and other introduced animals kill millions of birds every year. And it is not just birds – they also devour lizards and frogs and insects.

Last year the Government announced the goal of making the country free of predators by 2050. While some might criticise this goal as unrealistic, it does something very important – it focuses our attention on the predators that are devastating our native fauna.

In the future, breakthrough genetic technologies may make it possible to eradicate some predators altogether. But for the foreseeable future, the name of the game is predator suppression.

Accordingly, I am greatly encouraged by the wave of innovation underway experimenting with new ways of luring, trapping, and poisoning predators. A range of creative ideas are on the table, and it is vital that this continues.

It is also vital to recognise that aerial application of the toxin 1080 remains essential for the foreseeable future. An aerial 1080 drop will effectively (and cost-effectively) knock down populations of possums, rats, and stoats to low levels over large areas, even when these areas are rugged and difficult to access. It is also the only way we have of preventing the devastation of mast years, when rat and stoat numbers soar in response to an abundance of food.

Possums, rats, and stoats are not the only predators. During this investigation, I have become increasingly concerned about the feral cats that now almost certainly number in the millions in the countryside and along forest margins. They are major killers of precious wading birds like the wrybill – the only bird in the world with a beak that curves to the side.

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Birds also need suitable habitat – somewhere to live. A population of birds might be safe from predators, but will not thrive without enough food and somewhere to nest. The honey-eaters – tūī and bellbirds – will not proliferate in a beech forest where wasps are eating all the honeydew.

The habitat for New Zealand's native birds is not just forest, and it is not all within national parks and other reserves. Restoring abundant, resilient and diverse birdlife back on the mainland will involve bringing birds back to farmland, coasts, riverbeds, and cities.

There is no shortage of interest. The QEII National Trust struggles to keep up with the demand for covenants that place permanent protection on areas of habitat on farmland. Similarly, Ngā Whenua Rāhui is engaged with placing kawenata on Māori land. And the number of eco-sanctuaries continues to grow, with many on private land.

Finally, birds need a measure of genetic diversity.

A great success of New Zealand conservation has been the eradication of predators on offshore islands, enabling them to be used as sanctuaries for birds. On the mainland also, some birds are effectively trapped in remnants of habitat.

But small isolated bird populations can become inbred, and struggle to produce healthy chicks. On Tiritiri Matangi in the Hauraki Gulf, a kokako named Bandit is consorting with his grandmother. This may be a happy relationship, but it is unlikely to be a healthy one. We must guard against our birds drifting to the shallow end of the gene pool.

In the last chapter of this report, I have made seven recommendations to Government Ministers.

The first three recommendations are concerned with the most important and pressing thing birds need – safety from predators.

The first recommendation is for the development of a plan for Predator Free 2050 – a living document that is revised and added to over time. All the disparate efforts currently underway will not just magically come together. There is a Far Side cartoon that captures this perfectly. It shows a group of cowboys and horses piled up in a heap outside the Sheriff's office. The Sheriff is saying "And so you just threw everything together?... Mathews, a posse is something you have to *organize*".

The first element of such a plan needs to be the preparation of a portfolio of areas for sustained predator control. Like Taranaki Mounga, these areas need to be large, so they can support bigger populations of birds and reduce the risk of inbreeding, and slow the rate of predator reinvasion.

The second recommendation highlights some areas of research that should be given a high priority. One of these is about optimising the effectiveness of 1080 drops. Another is about the urgent need to tackle the problem of feral cats effectively and humanely. In Australia, feral cats are widely recognised by the public as a great threat to their native species – we need the same cultural change to occur here.

While the quest for scientific breakthroughs that could completely eradicate at least one predator is underway, we cannot afford to wait. We may eventually succeed in building a wonderful high tech hospital, but in the meantime the patient may

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die. We may succeed in developing a breakthrough genetic technique, but in the meantime, many of our bird species may disappear altogether. Recall that only 20% are in good shape. Doing better with current ways of controlling predators is critical.

The third recommendation addresses the need for early engagement with the public over research into breakthrough genetic techniques. One of these techniques known as gene drive could potentially drive infertility through a population of predators. Approaches like this that rely on genetic modification are likely to encounter strong opposition from some. Kevin Estvelt, a world leader in gene drive research, argues that we need to share ideas and information with the public to *"permit open assessment and critique before experiments begin."* I agree.

The fourth recommendation is about some aspects of habitat protection and restoration. Without food to eat and places to nest, birds cannot thrive. I am asking Ministers to ensure some particular aspects of habitat restoration are explicitly considered during the development of environmental and conservation policies.

One of these aspects is the weeds that have invaded a particularly special bird habitat – the braided riverbeds of the eastern South Island where oystercatchers and other wading birds lay their eggs. Not only do these weeds crowd out nesting sites, they provide perfect cover for stalking predators.

Another of these aspects is the idea that indigenous species should be maintained and restored only within their natural range. In some instances, this may be the best thing to do, but in others it may not. Since kauri dieback disease is threatening the continued existence of these magnificent trees, does it not make sense to plant some far away from their natural range?

The fifth recommendation is concerned with genetic diversity. When a population of birds becomes too alike, it lacks resilience. If one bird is susceptible to a disease, it is likely that all will be.

One of our most treasured birds is the kākāpō. Once common across New Zealand, it is the heaviest parrot in the world and the only one that cannot fly. Despite the tremendous efforts put into the kākāpō, the effects of inbreeding are becoming apparent. To say we have brought the kākāpō back from the brink of extinction is not correct; rather it continues to teeter on the brink of extinction. The long-term survival of the kākāpō may well depend on genetically engineering the birds themselves. We must work to prevent other birds from slipping into this state.

During this investigation, it has become apparent that there are strong disagreements about managing bird genetics. What some see as genetic pollution, others see as hybrid vigour. This must be sorted through open discussion and the elucidation of clear principles.

Saving our birds will require a great deal more money to be invested in conservation. My sixth recommendation is concerned with potential sources of new money, including requiring visitors to the country to pay a Nature border levy. Tourists do not come to New Zealand to shop; they come because they have seen photographs of stunningly beautiful national parks.

The Government has recently announced more funding for the tracks, bridges, toilets, carparks, and other infrastructure that supports the visitor experience. But the flora and fauna that draw visitors need much more help too. It is not just birds – lizards, frogs, insects and other native fauna are also in trouble. And now myrtle rust has blown across from Australia, threatening pōhutukawa, rātā, and mānuka.

My last recommendation is concerned with the need for support for, and coordination of, conservation community groups – the thousands of people across the country who are giving so much to suppress predators, and protect and restore habitat. My staff and I have had the privilege of visiting some of these groups over the course of this investigation.

My memories of a trip to Northland are clear and warm. I remember the hospitality of the Rawhiti marae and Rana calling to the toutouwai – the robins – on Urupukapuka Island. I remember the difficulty of even asking a question during the enthusiastic babble of a meeting with Backyard Kiwi at Whangarei Heads.

I have enjoyed this investigation immensely. With no particular prior knowledge about our native birds, I have loved learning about them. But beyond the birds themselves, this investigation has opened a window into some of the big questions about conservation.

What, for instance, do we seek to achieve? Taking the country back to a prehuman state is not possible or desirable – we are here now. And when we have decided what it is we seek to achieve, how do we go about getting there?

It is my view that one of the things we should seek to achieve is the restoration of abundant, resilient, and diverse birdlife on the New Zealand mainland. Let us aim for much more than bird 'museums' on offshore islands that few can ever visit.

Nearly 50 years ago, like many young people at that time, I was a moderately serious tramper. More accurately, I trailed in the wake of moderately serious trampers doing my best to keep up. I clearly remember the joy of the dawn chorus on the Wangapeka Track. Can we not bring this experience back for young New Zealanders?

Ko te reoreo a kea ki uta,

ko te whakataki mai a toroa ki tai,

he kōtuku ki te raki,

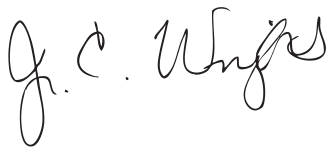
he kākāpō ki te whenua.

The voice of the kea is heard inland,

the cry of the albatross is heard at sea,

a white heron in the sky,

a kākāpō on the ground.



Dr Jan Wright

Parliamentary Commissioner for the Environment

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Tirohanga Whānui

Ka tīmata tēnei pūrongo ki te moemoeā – te whakarauoratanga o te taupori manu kia makuru, kia manawaroa, kia kanorau anō hoki ki te tūwhenua. Mēnā e mōhio ana koe ki a au, ka mōhio ehara au i te tangata whai moemoeā. I tūpono whakaninihi mai tēnei moemoeā i a tātou e rangahau ana i ngā manu ake o Aotearoa.

He tino taonga ā tatou manu – he taonga nō te motu nei. Ka tika rā kua hau te rongo o te kiwi – koia tētahi o ngā toenga manu ruarua nei, huri noa te ao, he whanaunga tata rawa ki te mokonui. Engari, kei konei hoki ngā kākā, ngā hoiho, ngā pokotiwha, ngā tākapu, ngā tītī, ngā kawau, ngā rakiraki, ngā tūturiwhatu, me te maha noa atu.

Kotahi rau ono tekau mā waru ngā tūmomo manu i Aotearoa. E iwa tekau mā toru o ēnei nō Aotearoa anake.

Kāore i te haumarutia ngā manu nei. Rua tekau ōrau anake – kotahi haurima – e pai ana. Ā, kotahi hautoru e tata ana ki te mate ā-moa. He raru nui kei te haere.

E toru ngā mea e tika ana mō ā tātou manu nō Aotearoa ake – kia aukatia ngā konihi, he nōhanga tika, ā, he ira kanorau kia manawaroa ai mō āke tonu atu.

Kāore e kore, ko te mea tuatahi – te aukati i te konihi – te mea kōhukihuki. He miriona ngā manu e whakamatea ai e ngā paihamu, kiore nui, toiura me ētahi atu kararehe kua tatū mai. Ā, ehara i te manu anake e whakamatea ana – ka horomitia hoki ngā ngārara, ngā peketua me te aitanga pepeke.

I tērā tau i whāki te Kawanatanga i te whāinga kia whakakorea ngā konihi kia tae ki te tau 2050. Tērā ētahi e whakahē ana me te kī e kore e tutukihia te whāinga nei. Engari, he kaupapa nui tō te whāinga nei – ka āta whakaarohia ngā konihi e whakamōtī ana i ngāi kīrehe nō Aotearoa ake.

Ā tōna wā, ka puta mai ngā hangarau ira hou e whakakore rawatia ai ētahi konihi. Engari, i te wāheke e mōhiotia ana, ko te tino kaupapa ko te pēhanga o te konihi.

Nā reira, e harikoa ana au i te maha o ngā auahatanga e whakahaeretia ana, e whakamātau ana i ngā huarahi hou ki te tīmori, ki te tārore, ki te paihana i ngā konihi. He maha ngā whakaaro auaha kua toko ake, ā, me haere tonu te mahi nei.

Kia mōhio mai tātou me haere tonu te whakamakere i te paitini 1080 i te rangi mō te wāheke e mōhiotia ana. Mā te whakamakere 1080 e whakaitia ai ngā taupori paihamu, kiore nui, toiura hoki kia itiiti noa ki ngā wāhi whānui. Ka pēnei ahakoa he wāhi uaua, ā, he uaua ki te tomo mai. Koia hoki te huarahi anake e aukatia ai te whakamōtītanga i ngā tau he huhua ngā pua o ngā rākau, ā e nekeneke mai ai te tini me te mano o ngā kiore nui me ngā toiura i te huhua o te kai.

Ehara te paihamu, te kiore nui me te toiura anake i te konihi. I roto i te rangahau nei, kua tino maharahara au mō ngā ngeru kūwao. Kāore e kore kua eke ki ngā miriona te taupori ki te taiwhenua me te taha o ngā ngahere. He kaha ēnei ki te whakamate i ngā manu kautū tongarewa pērā i te ngutu pare – te manu anake o te ao e kōpiko ana ngā ngutu ki te taha.

He mea nui mō te manu ko te nōhanga tika – tētahi wāhi hei noho. Ka aukatia te konihi i te taupori manu pea, engari kāore e tōnui ki te kore he kai, he wāhi ki te hanga kōhanga hoki. Ko ngā manu kai mīere – ngā tūī me ngā korimako – kāore e whakaranea i roto i te ngahere tawai e kāinga ana te tōmairangi mīere.

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Ehara i te mea ko te nōhanga o ngā manu ake o Aotearoa kei ngā wāhi pēnei i te ngahere, i te papa rēhia ā-motu, i ngā whenua rāhui anake. Ki te whakaoratia ai ngā manu ki te tūwhenua kia makuru, kia manawaroa, kia kanorau me whakahoki mai ngā manu ki ngā pāmu, ki ngā takutai, ki ngā whaiawa, ki ngā tāone nui anō hoki.

He tokomaha ngā kaitautoko.

He uaua kia whakatutukihia e te QEII National Trust ngā tono mō ngā kawenata e rāhui tuturu ai ngā wāhi nōhanga manu ki ngā pāmu. Waihoki, ka whakaritea ngā kawenata e Ngā Whenua Rāhui ki ngā whenua Māori. Ā, kei te piki tonu te maha o ngā whakahaumarutanga hauropi, ā, tērā ētahi kei ngā whenua tumataiti.

Ko te ira kanorau te kaupapa whakamutunga e tika ana mā ngā manu.

Kua angitu te whāomoomo i Aotearoa i te whakakorenga o ngā konihi ki ngā motu ririki i waho atu o te motu whānui. Kua noho ērā hei whakahaumarutanga mā ngā manu. Kei te tūwhenua, tērā ētahi manu kua whakamaua ki ngā toenga nōhanga.

Engari, ki ngā taupori manu mōriroriro, iti nei, ka moe tahi ngā manu whanaunga tata, ā, he uaua te whakaputa i ngā pī ora. I Tiritiri Mātangi i Tīkapa Moana, tērā tētahi kōkako, a Bandit, e moepuku ana i tana kuia. He whakapiringa whakakoakoa pea, engari kāore i te pai. Kei tere atu ā tātou manu ki te pito pāpaku o te hōpua ira.

I te ūpoko whakamutunga o te pūrongo nei, e whitu aku tūtohunga ki ngā Minita Kāwanatanga.

Ko ngā tūtohunga tuatahi takitoru nei mō te kaupapa tino nui mō ināianei tonu – te aukati i ngā konihi.

Ko te tūtohunga tuatahi e pā ana ki te whakawhanake i te mahere mō te Konihi Kore 2050 – he tuhinga mataora e whakahoungia, ā, ka tāpiritia ētahi atu kōrero i ētahi wā. Kāore i te pai ki te kī ko te whakapau kaha a tēnā, a tēnā ka tūhonohono ai ā tōna wā. Tērā te pakiwaituhi Far Side e whakaatu pai ana i tēnei. Tērā te haupūtanga o ngā kaupoai me ngā hōiho i waho i te tari o te Pirihimana. E pēnei ana te kī a te Pirihimana "And so you just threw everything together?... Mathews, a posse is something you have to *organize*".

Ko te wāhanga tuatahi o te mahere nei ko te whakarite i te kohinga wāhi mō te whakahaere konihi e haere tonu ana. Ōrite ana ki Taranaki Mounga, me whānui ngā wāhi nei, kia tautoko ai i ngā taupori manu e whakaputa pī ana. Ā, kia kaua e moe tahi he whanaunga tata, ā, kia whakapōturi i te hokinga mai o ngā konihi.

Ka tīpako te tūtohunga tuarua i ngā wāhanga o te rangahau kia whakanuia rawatia. Ko tētahi o ēnei ko te whakakaha i te whakaaweawe i te whakamakere 1080. Ko tētahi atu ko te tūmanako kia whakatikatikahia paitia te raru e pā ana ki ngā ngeru kūwao. Me whakaaweawe, me whai aroha te whakatikatika. I Ahitereiria, e mōhiotia rawatia e te iwi whānui he whakawehi nui ngā ngeru kūwao ki ngā kararehe nō Ahitereiria ake – me huri kia pērā te whakaaro i konei.

Ahakoa e haere ana te rapu mō ngā kitenga hou ā-pūtaiao e whakakorengia rawatia ai tētahi konihi, kāore e taea e tātou te tatari. Ā tōna wā pea, ka hangaia te hōhipera hangarau mīharo, engari kua mate noa atu te tūroro. Ka tutuki i a tātou te kitenga hou mō te tikanga ira, engari, i mua i tēnā, kua mate noa atu ētahi o ngā tūmomo manu. Kaua e wareware e whā haurima ngā tūmomo manu – 80% - kua raru ināianei. Me pai ake ngā tukanga whakamate konihi o te wā nei.

Ko te tūtohunga tuatoru e pā ana ki te kōrerorero ki te hunga tūmatanui mō te rangahau kitenga hou mō te tikanga ira. Ko tētahi o ēnei tikanga, ko te whakahaere ira, ka whakahaere i te pukupā ki ngā taupori konihi. Ko ngā tukanga pēnei, i, hangaia i runga i te raweke ira, ka whakahēngia rawatia e ētahi. E ai ki a Kevin Estvelt, tētahi o ngā mātanga whakahaere ira, me tuku i ngā whakaaro me te pārongo ki te hunga tūmatanui kia *"permit open assessment and critique before experiments begin."* E whakaae ana au.

Ko te tūtohunga tuawhā mō ētahi āhuatanga e pā ana ki te haumarutanga me te whakaoranga o te nōhanga. Mēnā kāore he wāhi ki te kai, ki te hanga kōhanga, e kore ngā manu e tōnui. E akiaki ana au ki ngā Minita kia āta whakaarohia ētahi āhuatanga e pā ana ki te whakaora nōhanga i te wā e whakawhanakehia ngā kaupapa here mō te taiao, me te whāomoomo.

Ko tētahi o ēnei āhuatanga ko ngā taru kua urutomo i tētahi nōhanga motuhake manu – ko ngā whaiawa tūhonohono i te taha whakaterāwhiti o Te Waipounamu e whakaputa ai te tōrea me ēra atu manu kautū i ngā huamanu. Ka tāmuimuia ngā wāhi kōhanga, ā, ka hunaia ngā konihi whakamokamoka.

Ko tētahi atu āhuatanga ko te whakaaro me pupuri, me whakaora rānei i ngā kararehe nō Aotearoa ake ki ngā wāhi anake i noho ai ēnei kararehe i ngā wā o mua. I ētahi wā, e tika ana tēnei, engari i ētahi e hē ana. Nā te mea, kua whakatuma te mate kauri i te rākau mīharo nei, te kauri, kāore e kore me whakatō i ētahi ki ngā wāhi tawhiti atu i ngā wāhi i noho ai ēnei i ngā wā o mua.

Ko te tūtohunga tuarima e pā ana ki te kanorau ira. Mēnā ka ōrite te āhua o te taupori manu, ka ngoikore, kāore e manawaroa. Mēnā ka patua tētahi manu e tētahi mate, ko te whakaaro ka patua te katoa e taua mate.

Ko tētahi o ā tātou tino manu ko te kākāpō. I mua he tino maha rawa te taupori, ā, ko te manu nei te kākā taumaha o te ao, me te kākā anake kāore e taea te rere. Ahakoa te whakapau kaha ki te tautoko i te kākāpō, e kitea ana ngā whakaaweawe o te moe tahi o ngā whanaunga tata. Kāore i te tika ki te kī kua whakahokia te kākāpō i te mate ā-moa; engari e tata ana te mate ā-moa. Ka ora tonu te kākāpō mēnā ka rawekehia te ira o ngā manu nei. Me whakapau kaha tātou kia kaua e pēnā ai ētahi atu manu.

I roto i te rangahau nei, kua mārama he nui ngā taupatupatu e pā ana ki te whakahaere i te ira manu. Ki ētahi he takakino ira, ki ētahi he uekaha momorua. Me whakatau tēnei mā te kōrerorero tūmatanui me te whakahua i ngā mātāpono mārama.

Ki te whakarauora i ā tātou manu, me nui ake te pūtea e utua ai mō te whāomoomo. Ko taku tūtohunga tuaono, e pā ana ki ngā pūtea hou, ko tētahi, me utu ngā tāpoi ki te motu nei i te utu aukati Taiao. Kāore e haere mai ngā tāpoi ki Aotearoa ki te hoko mea; ka haere mai nā te mea kua kite rātou i ngā whakaahua o ngā papa rēhia ā-motu ātaahua.

Inā tata nei, kua whakapaoho te Kāwanatanga i te pūtea mō ngā huarahi, arawhata, wharepaku, papawaka, me ērā atu kaupapa e tautoko ai i te urunga mai o ngā manuhiri nei. Engari me tiaki i ngā tipu me ngāi kīrehe e tōtō mai ai i aua manuhiri. Ehara i te manu anake – ko ngā ngārara, ngā peketua, te aitanga pepeke me ēra atu kararehe nō Aotearoa ake kua raru. Ā, ināianei, kua pūhia mai te 'myrtle rust' i Ahitereiria. Kua whakatumahia te pōhutukawa, te rātā me te mānuka.

Ko taku tūtohunga whakamutunga e pā ana ki te tautoko me te ruruku i ngā rōpū whāomoomo hapori. Ko te tini me te mano o ngā tāngata, huri noa i te motu, e whakapau kaha ana ki te pēhi i ngā konihi. Ā, ki te haumaru, ki te whakaora anō i te nōhanga. Kua waimarie mātou ko aku kaimahi ki te toro atu ki ēnei rōpū i a mātou e rangahau ana.

He mārama, he mahana taku maumahara i tētahi haerenga ki Te Tai Tokerau. Ka maumahara au ki te manaakitanga o te marae o Te Rāwhiti me Rana e pepe ana ki ngā toutouwai i te motu o Urupukapuka. Ka maumahara hoki au i te uauatanga ki te tuku pātai i te papā waha uekaha me Backyard Kiwi i te matakūrae o Whāngārei.

Kua harikoa au i roto i te rangahau nei. Kāore au i tino matatau mō ngā manu ake o Aotearoa i mua, ā, kua harikoa au ki te ako. Engari, atu i ngā manu, kua whakatairanga te rangahau nei i ētahi pātai nunui e pā ana ki te whāomoomo.

Hei tauira, he aha te tino whāinga? Kāore e taea, kāore i te hiahiatia hoki kia hoki ki te wā i mua i te tangata. Kei konei tātou. Ā, ki te whakatau mātou, he aha tā mātou e rapu nei, mā te aha e tae atu ki reira?

Ki taku nei titiro, ko tētahi o ngā kaupapa ko te whakaora i te taupori manu kia makuru, kia manawaroa, kia kanorau anō hoki i runga i te tūwhenua o Aotearoa. Me kaua e pēnei te whāinga: te whare taonga manu i runga i ngā motu ririki kāore e kitea e te nuinga.

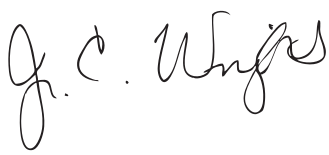
Nui ake i te 50 tau i mua, e pērā ana ki ngā rangatahi o taua wā, he āhua kaha au ki te takahitanga. Ko te tikanga kē pea, i te whai au i ngā kaihōkai, me te whakapau kaha kei mahue au ki muri. Ka mārama taku maumahara i te kōrihi o te manu, i te tākiritanga mai o te ata ki te huarahi o Wangapeka. Ka whakahokia mai anō pea ināianei tēnei āhuatanga mā ngā rangatahi o Aotearoa?

Ko te reoreo a kea ki uta,

ko te whakataki mai a toroa ki tai,

he kōtuku ki te raki,

he kākāpō ki te whenua.



Dr Jan Wright.

Te Kaitiaki Taiao a Te Whare Pāremata

1 Introduction

Before dinosaurs became extinct and before mammals flourished, New Zealand drifted apart from the ancient supercontinent of Gondwanaland. This set New Zealand on a different evolutionary path to the rest of the world.

Before the arrival of humans, New Zealand was a land of birds. Instead of mice, tiny flightless wrens scampered around the forest floor. Instead of badgers, kiwi rustled through the undergrowth probing for worms and insects. Instead of deer, tall moa browsed the forest. Instead of squirrels, kōkako ranged along tree branches searching for food. Instead of lions and wolves, the top predator was the giant Haast's eagle with a wingspan of three metres.

The forests, rivers, and shores teemed with birds. The beating of kererū wings reverberated over the forest. Along the coast at dusk the sky was dark with millions of seabirds.

Ngā manu – birds – were woven into many aspects of everyday Māori life. Moa, geese, kererū, and tītī were a ready source of protein. Kūmara planting started with the first calls of migratory pīpīwharauroa (shining cuckoo) as they returned from the tropics.

Kiwi bones were used to apply tā moko. The white-tipped tail feathers of the huia were worn in the hair by people of high rank. Tūī were sometimes taught to talk by tohunga. Great singers and speakers were compared to the korimako.

Although a number of bird species went extinct after the arrival of Māori, New Zealand was still a land of many birds when Europeans arrived. While the Endeavour was anchored in Queen Charlotte Sound, botanist Joseph Banks wrote, *"This morn I was awakd by the singing of birds … their voices were certainly the most melodious musick I had ever heard."*[1] A century later, explorer Charles Douglas recorded shaking kākāpō out of a tutu bush like apples out of a tree.[2]

New Zealand remains home to over 150 species of native birds, and many of these are found in no other country – they are endemic to New Zealand. Four out of every five are in trouble – and some sit on the brink of extinction.

Across the country, many New Zealanders are working hard to save our natural heritage. The Government has set a goal for kiwi to shift from an annual decline of 2% to an annual increase of 2%. But many other precious birds are in similar or greater trouble.

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This investigation is focused on a vision – a vision of restoring abundant, resilient, and diverse native birdlife on the mainland. Realising this vision will require using the knowledge, ingenuity, and passion of many New Zealanders.

1.1 Purpose of this report

The Parliamentary Commissioner for the Environment is an independent Officer of Parliament, with functions and powers granted through the Environment Act 1986. Her role allows a unique opportunity to provide Members of Parliament with independent advice in their consideration of matters that may have impacts on the environment.

This investigation is aimed at shining a light on the state of New Zealand's native bird populations, the challenges they face, and what it might take to restore them in large numbers back on to the mainland.

There is, of course, much more to protecting our natural heritage than saving the birds that sit at the top level of our ecosystems. But if we can restore our bird populations, much else will also benefit.

The possums, rats, and mice that eat eggs and chicks also devour foliage, seeds, snails, and insects. The stoats, ferrets, weasels, and cats that so skilfully hunt birds also eat lizards and insects. Together these introduced animals degrade the mauri of the forest.

Birds eat and disperse seeds, maintaining forest diversity – the spread of karaka trees is heavily dependent on the presence of kererū. The flowers of the pikirangi (mistletoe), which has become so rare, are pollinated by the honey-eaters – tūī, korimako, and hihi. Although much depleted in numbers, the birds that feed at sea and return to the land to sleep and nest fertilise the land with their phosphorus-rich guano.

Sometime after this investigation had begun, the Government launched a major initiative aimed at eradicating possums, rats, and stoats on the mainland by 2050. Introduced predators are now the main cause of declining bird populations, so the goals of ridding the country of predators and of restoring native bird populations have much in common.

Accordingly, both share some major challenges. There is still some opposition to the use of the pesticide 1080, and concerns about the development of new gene technologies. Ways of dealing with predators will need to be both effective and cost-effective, given the nature of the task and the inevitable limits on resources.

This report has been produced pursuant to subsections 16(1)(a) to (c) of the Environment Act 1986.

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Source: Kererū Discovery

Figure 1.1 The kererū (kūkupa as it is known in Northland and on the West Coast) is very important for dispersing the seed of large-fruited trees like the karaka.

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1.2 What comes next?

The remainder of this report is structured as follows.

Chapter 2 tells the story of what has happened to New Zealand's birds over time. It begins with showing how their evolution in isolation from the rest of the world has made them vulnerable as well as unique. A short account of the impact of the arrival of humans is followed by a description of the rise of a conservation ethic in the 20th century. The final section covers some of the developments in conservation since 1990.

Chapter 3 is about the 168 species of native birds that still exist today. It shows which are thriving, which are in difficulty, and which are just hanging on.

Chapter 4 explores two fundamental issues about the nature of species – the 'currency of biology'. First, dividing Nature into species is far from clear-cut. Second, it is often assumed to be self-evident that all species are equally valuable – this is discussed with reference to New Zealand's native birds.

Chapters 5 to 8 deal with the most critical requirements for birds to thrive on the mainland – safety from predators and suitable habitat.

Chapter 5 is about the big three predators – possums, rats, and stoats. These three are the primary target of Predator Free 2050. It covers some current innovations in trapping and poisoning, and shows why the pesticide 1080 is still a vital weapon in the war against these predators.

Chapter 6 covers other predators of native birds – mice, ferrets, weasels, hedgehogs, cats, and dogs. It finishes with a section on humans as unintentional predators – the bycatch of seabirds from fishing.

Chapter 7 is a short description of three areas of scientific research that may lead to radically new ways of controlling, and possibly eradicating, predators.

Chapter 8 deals with what birds need to thrive after predators have been suppressed – habitat. It describes how a number of introduced animals and plants degrade bird habitat. The last section is about protecting and restoring habitat on private land.

Chapter 9 is about the resilience of New Zealand's native birds in the long term. Some, like the much-loved kākāpō, are highly inbred, and others are likely to be heading that way. The four forces of evolution are explained – an understanding of these is critical for deciding whether birds should be moved from one population to another.

Chapter 10 contains conclusions and recommendations from the Commissioner.

At the end of the report, the Appendix contains a detailed list of all New Zealand's native birds. It shows which are endemic; that is, found in no other country. It also gives the current threat classification (at a high level) of all bird taxa.

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2

A brief history of New Zealand's native birds

This chapter tells the story of the native birds of New Zealand – their distinctiveness, the impact of human settlement, and the changing response to their decline.

There are four sections in the chapter.

The first section describes how the long isolation of New Zealand and the absence of mammals led to the evolution of many unusual birds.

The second section describes the impact of the arrival of humans and the animals they brought with them. The features that made many birds so distinctive left them vulnerable to these new arrivals. Many European settlers saw the decline of native species as inevitable due to the 'superiority' of European plants and animals.

The third section describes the concern about the decline of native plants and animals that began to develop towards the end of the 19th century. The growing conservation ethic was increasingly accompanied by initiatives aimed at protecting what remained of the country's natural heritage. Efforts to protect birds were focused on the creation of island sanctuaries.

The fourth section brings the New Zealand bird story into the present day. The most recent development occurred in 2016 – the setting of a target aimed at ridding the country of the most damaging introduced predators by 2050.

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2.1 A land of distinctive birds

Safe from predation by mammals, many New Zealand birds evolved in unusual ways.

With no need to evade ground-dwelling predators, flying was a waste of energy, so many birds lost the ability.[3] Many, like moa and adzebill, are now extinct, but some, including kiwi, kākāpō, takahē, and weka, still survive.

The ground was a safe place to live and nest. Kakī and wrybill lay their eggs on open riverbeds with the eggs camouflaged to look like stones. Fairy terns lay their eggs in sandy hollows on beaches. Takahē make rudimentary nests under tussock. Mohua, kākā, and hihi nest in holes in trees.

Some New Zealand birds evolved to lay fewer eggs than birds in other countries.[4] In the years of plenty when trees 'masted', some bred more prolifically.

Although there were no mammalian predators on the ground, there were predators in the air. The giant Haast's eagle has long been extinct, but the speedy New Zealand falcon (kārearea) survives. Such airborne predators locate their prey by using their keen eyes to detect movement, so many New Zealand birds evolved to freeze in the presence of danger. Nothing could make them more vulnerable to mammalian predators with an acute sense of smell.[5]

It is not surprising that many of New Zealand's birds evolved to be exceptional – particularly the 'deep endemics' that adapted to local conditions over many millions of years.

The Haast's eagle was the largest eagle known to have ever existed. The South Island giant moa was the tallest bird ever to exist. The takahē is the world's largest rail. The kea is the world's only alpine parrot, and the kākāpō is the only parrot that cannot fly. Three of New Zealand's penguins nest in forests, and Hutton's shearwater is the only seabird that lays its eggs high above the bushline.

The kiwi is so odd that it is sometimes referred to as an 'honorary mammal'. Its bones are filled with marrow, not air like most birds. Kiwi have two functioning ovaries whereas most birds only have one. Their eggs are six times as big as those of birds of similar size. Kiwi even have whiskers rather like cats.

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Source: Wikimedia/ PLoS Biology CC BY 2.5

Figure 2.1 A Haast's eagle hunting moa. Both species are now extinct.

Source: Wikimedia

Figure 2.2 The huia was regarded by Māori as tapu, and the distinctive tail feathers were worn by those of high rank. The beak of the male was short and robust, while the beak of the female was a long, fine, downward-curving arc. The last official sighting of a huia was in 1907.

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2.2 The arrival of humans

About 50 native bird species have become extinct since humans arrived in New Zealand.[6]

The first mammalian predator was the kiore – the Polynesian rat – which arrived in the ancestral waka of Māori. To the kiore, New Zealand was a food paradise, and the vulnerability of some birds would have made them easy pickings. At least four species of flightless birds succumbed to kiore (see Figure 2.3).

Māori also brought kurī (dogs) with them, using them for companionship, for food, and for hunting birds. All nine species of moa had been hunted to extinction by the 16th century. With the loss of its main food source, the Haast's eagle also disappeared.[7]

Large areas of rich lowland forest – the home for many birds – were burned following the arrival of Māori. Fire was used for various purposes, including clearing land for easier travel.[8] It is likely that larger areas of forest were cleared than intended when fires got out of control.

When Europeans arrived, they brought a whole host of predatory mammals. Some were stowaways, like rats and mice. Kiore were almost completely displaced by mice, Norway rats, and the particularly destructive ship rats.

Possums were brought over from Australia to establish a fur trade. Hedgehogs were brought in by acclimatisation societies to make New Zealand more like England. When rabbit populations boomed following their introduction for food and sport, mustelids – weasels, stoats, and ferrets – were brought in to control them.[9]

Between 1880 and 1920, 15 bird species were lost. The last few birds of seven species were killed by cats that had been put on islands to suppress rabbits.[10]

Other animals changed the nature of the forest. Goats and pigs arrived with the first European explorers.[11] Game animals – deer, chamois, and thar – were carefully imported and released for hunting. These animals browsed selectively on the more palatable plants, altering the composition and density of the forest, thus reducing food available for birds.[12]

European settlers felled large areas of forest. After the first refrigerated ship sailed for England in 1882 laden with thousands of frozen lamb carcasses, the value of pasture for grazing sheep soared, and the rate of forest clearance accelerated. In the last decade of the 19th century alone, over a quarter of the remaining native forest was felled or burned.[13] Wetlands were also drained to create new farmland, greatly reducing the habitat of bitterns, fernbirds, and teal.

Few Europeans were concerned by the decline of birdlife in New Zealand. The dominant view of 19th century scientists was that indigenous species would inevitably die out in the face of introduced species – displacement theory. The duty of the scientists was to record the past by killing and stuffing these 'doomed' birds for display in museums.[14]

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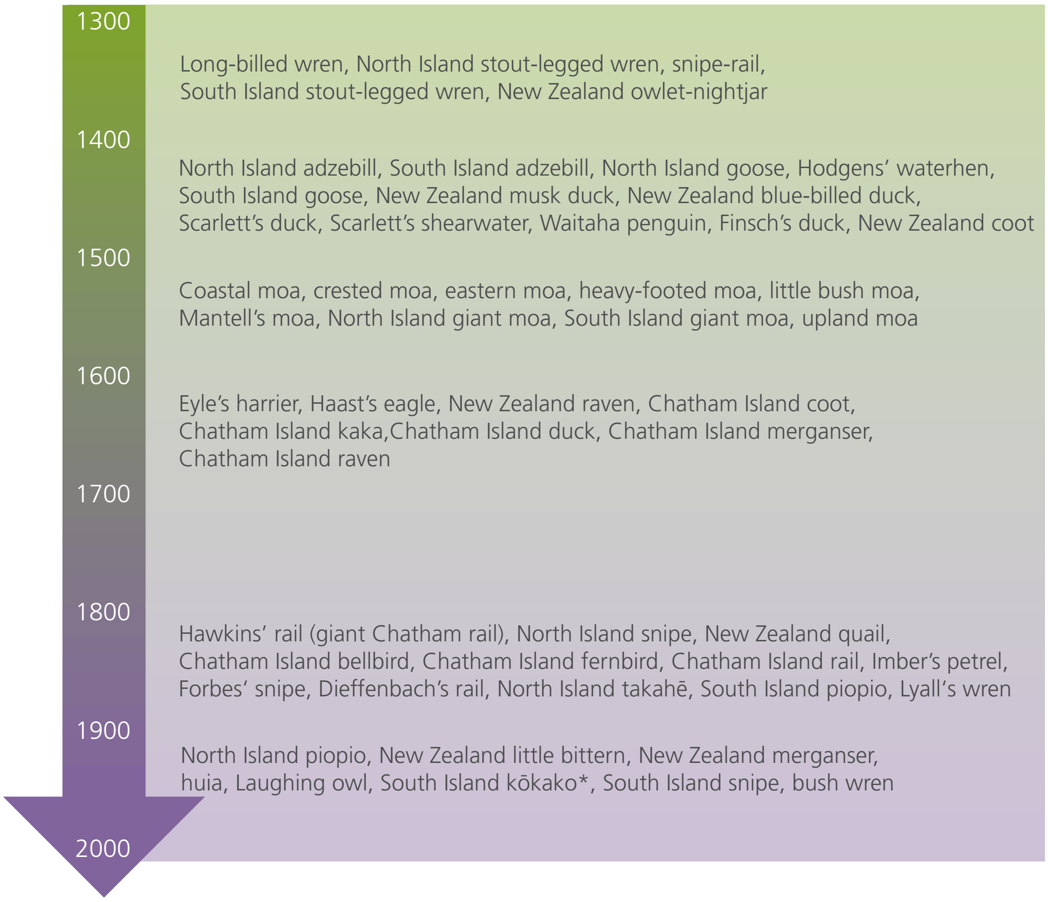

Figure 2.3 A timeline showing when New Zealand birds are believed to have become extinct or were last sighted. It is based primarily on information taken from Holdaway (1989). *The South Island kōkako is classified as 'data deficient', but is almost certainly extinct.

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2.3 The growth of a conservation ethic

In the second half of the 19th century, attitudes towards native species began to change. Europeans born in New Zealand started to identify with their local landmarks, scenery, and wildlife.[15]

One early conservationist was Thomas Potts, who saw the native flora and fauna as valuable in their own right, saying, *"It will not redound to our credit if we suffer the indigenous fauna to be exterminated without some further efforts for its preservation."*[16]

Potts proposed the setting aside of large areas of land as national domains *"held under tapu as to dog and gun"*, and suggested Resolution Island in Dusky Sound as a candidate. In 1891 Resolution Island was made a reserve. Richard Henry was appointed as curator, and sailed his dinghy around Dusky Sound capturing and relocating birds from the mainland. But after Richard Henry saw a stoat on Resolution Island, he realised that protection from *"dog and gun"* was not enough.[17]

Another key figure was scientist Sir Walter Buller, famous for his painstaking documentation of New Zealand's birds. Although Buller subscribed to displacement theory, he advocated delaying the extinction of native birds by moving remnant populations on to offshore islands and keeping these islands pest-free. Little Barrier Island and Kapiti Island followed Resolution Island by becoming 'island sanctuaries' in 1897.

For the first half of the 20th century, the focus of conservationists turned to the loss of forests and the preservation of scenery.[18] But in 1948, Geoffrey Orbell's discovery of the takahē – long thought extinct – in a remote part of Fiordland caused great excitement and helped ignite further efforts to conserve native birds.[19]

Until the middle of the 20th century, there were five national parks in New Zealand, primarily managed for recreation and tourism. This changed in 1952 when the National Parks Act required that native plants and animals be preserved *"as far as possible"* in all parks.[20] The following year the Wildlife Act granted full protection to most indigenous birds.[21]

There are now 13 national parks, and together with other reserves about a third of New Zealand lies within the conservation estate. But placing an area within a national park or reserve does not guarantee protection for the diverse life within – the animals that eat birds and plants are oblivious to lines on maps.

The network of island sanctuaries has also grown over the years. In the early 1960s, a modest programme to supress rodents on tiny Maria Island in the Hauraki Gulf was unexpectedly successful when it was discovered that the entire rat population had been eradicated. This triggered a series of ever-bolder predator eradications on larger and larger islands.[22]

In 1987, the importance of conserving New Zealand's natural heritage was given a new status with the creation of the Department of Conservation. In 1991, the Resource Management Act made the protection of *"significant habitats of indigenous fauna"* a matter of national importance, although not the fauna themselves.[23] Twelve years later an amendment to the Act charged councils with *"maintaining indigenous biological diversity"*.

Source: Parliamentary Commissioner for the Environment archives

Figure 2.4 The remains of a pen Richard Henry built to keep flightless birds in can still be seen on an island in Dusky Sound.

Source: Karen Baird

Figure 2.5 The late John Kendrick recording bird calls in the 1970s that were used for many years to signal the beginning of the morning news on Radio New Zealand.

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2.4 Recent developments

Over the last few decades, a number of changes in the management of New Zealand's natural heritage have influenced the protection of native birds. This section describes some of these, but is not comprehensive.

The mid-1990s saw the expansion of 'island sanctuaries' on to the mainland, with some enclosed within predator-proof fences. There are now over 30 fenced sanctuaries, enclosing several thousand hectares.[24] Some have now been surrounded by 'halos', where people work to suppress predators over larger areas.

The mid-1990s also saw the development of a deeper understanding of 'masting' – the mass seeding of trees that occurs in some years and the plagues of rodents and stoats that follow. This leads to the devastation of populations of native birds and other animals. It was not until 2004 that the pesticide 1080 was first used to kill the populations of rats and stoats that soar during a mast.[25]

In 1991 six claimants, each representing a different iwi, lodged with the Waitangi Tribunal what became known as the 'Wai 262 claim' or the 'indigenous flora and fauna claim'.[26] A major aspect of the claim was the ownership and control over taonga plants and animals. In 2011, the Tribunal concluded that *"… partnership and shared decision-making between the department and kaitiaki must be the default approach to conservation management."*[27] A number of agreements between iwi and the Department of Conservation have now been established, including for Te Urewera.[28]

For a long time, interest in and concern about New Zealand birds has been focused on forest birds – largely because some of them are so very different from birds in other countries. That New Zealand is the 'Seabird Capital of the World' is only now being appreciated – about 10% of all the seabird species in the world breed in no other country.[29] Widespread awareness that most of these are in trouble has yet to develop.[30]

In recent years there has been a growing realisation that conservation of natural heritage is, and must be, much wider than the activities of the Department of Conservation and councils.

Community groups and iwi involved in conservation now number in the thousands. Some conservation projects are funded by private money. Project Janszoon, which aims to *"restore the ecology"* of the Abel Tasman National Park over 30 years, is one of the largest of these.

In 2015, concern about the falling population of New Zealand's most iconic bird, the kiwi, resulted in the Government announcing its intent to turn a 2% annual decrease into a 2% annual increase in population.[31]

The following year, the Government adopted a new conservation initiative – the aim of making New Zealand 'predator-free' by 2050.[32] This idea was given impetus in 2012 by the late Sir Paul Callaghan in his last lecture. Sir Paul spoke of the devastating effect of introduced mammals on New Zealand's natural heritage, describing the state of our forests as catastrophic. He finished with a 'crazy' idea. *"Let's get rid of the lot. Let's get rid of all the damn mustelids, all the rats, all the possums, from the mainland islands of New Zealand."*[33]

Predator Free 2050

Predator Free 2050 has the goal of ridding New Zealand of possums, rats, and stoats by 2050.

The Cabinet Minute of the Predator Free 2050 decision describes this ambitious goal as credible because of four changes that are underway in New Zealand.[34]

- The interest shown by some philanthropists in supporting large-scale conservation projects.
- The development of innovative ways of controlling predators.
- The rapid progress being made in genetic sciences.
- The growth in the number of community groups controlling predators.

Four interim goals have been set for 2025.

- Increase the area of the mainland where possums, rats, and stoats are suppressed by one million hectares – about 4% of the country.
- Eradicate possums, rats, and stoats from areas of 20,000 hectares on the mainland without fences.
- Eradicate all mammal predators (not just possums, rats, and stoats) from offshore island nature reserves.
- Develop a break through science solution that could eradicate at least one small mammal predator from the mainland.

A new Crown entity – Predator Free 2050 Ltd – has been created to help realise this ambitious objective.[35]

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3

How safe are our birds?

Today New Zealand remains home to 168 species of native birds, many of which are found in no other country.[36] How secure are they? How likely are they to follow the moa, the huia, and many others into oblivion?

This chapter is focused on the state of New Zealand's native birds – which species are in good shape, which are in difficulty, and which are just hanging on.

There are four sections in this chapter.

The first section introduces the system used to assess the conservation status of native plants and animals. Under this system, every bird species is assigned a threat ranking.

In the next three sections, the threat rankings of groups of native birds are shown. The birds have been grouped in a way intended to show the great diversity of bird species in New Zealand.

The second section is concerned with the native birds that live in forests.

The third section is concerned with the native birds that live in open country, in rivers and lakes, and along the coast. These habitats have been grouped together because some birds move between them. For instance, some oystercatchers nest in fields, feed in riverbeds, and spend their winters on the coast.

The fourth section is concerned with seabirds.

The Appendix contains the threat rankings of all native bird species, subspecies, and isolated populations.

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3.1 Assigning threat rankings

Figure 3.1 shows the structure of the classification system used for assessing the conservation status of native plants and animals. This report is concerned with the native birds that live and breed in New Zealand; that is, they fall within the dotted line in the figure.[37],[38]

The Department of Conservation's audits of the status of New Zealand birds assign threat rankings to all bird taxa – not just to species, but also to subspecies and to some isolated populations. The table and figures in this chapter present threat ranking at the species level only.[39]

As can be seen in Figure 3.1, native bird species living and breeding in New Zealand are assigned one of four high-level threat rankings.

- Extinct
- Threatened
- At risk
- Not threatened

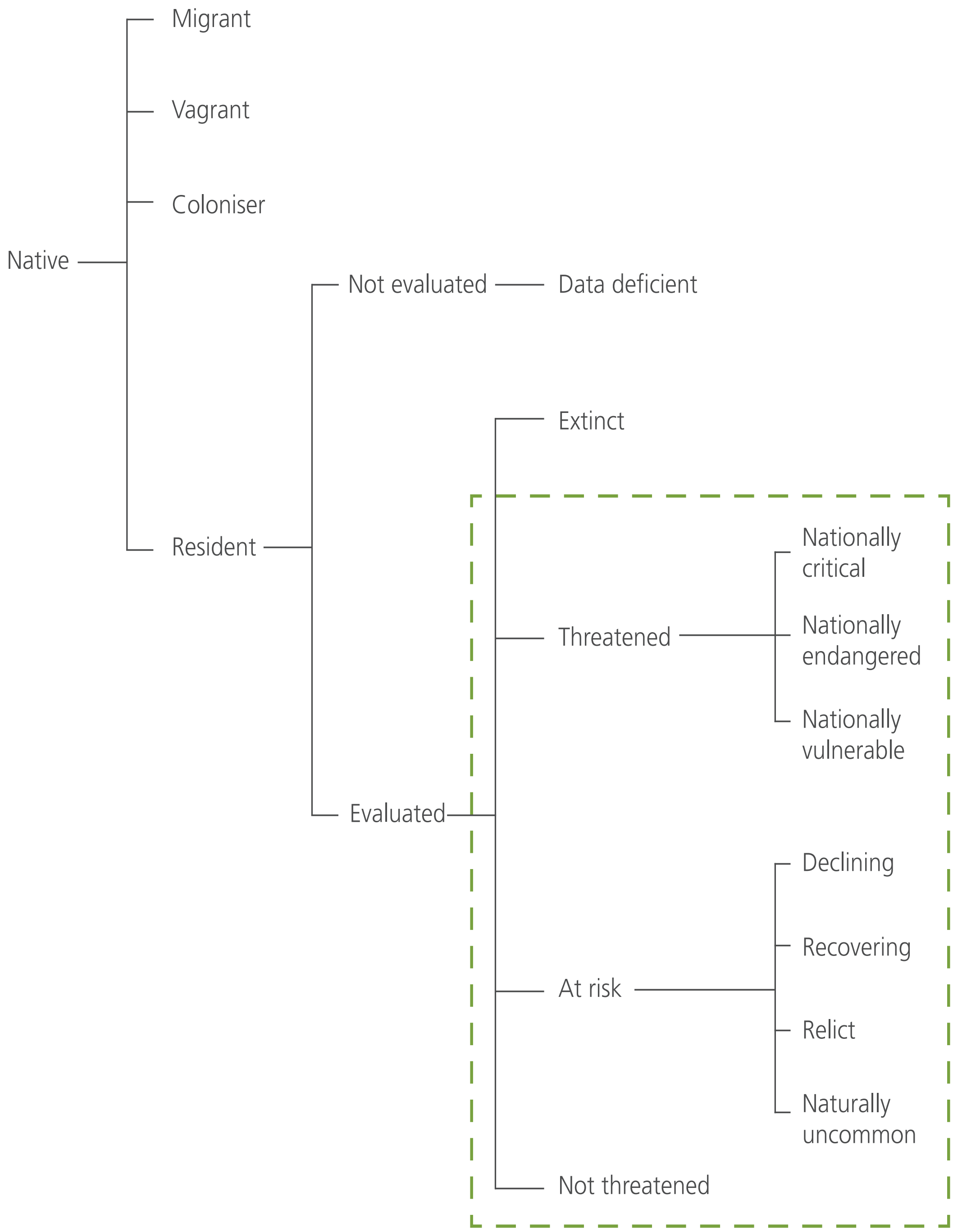
The meaning of these terms is confusing for the uninitiated.[40] Therefore, the threat rankings in this report have been renamed as follows:

- Extinct
- In serious trouble
- In some trouble
- Doing OK

In summary, only a fifth of New Zealand's 168 native bird species are doing OK, and a third are in serious trouble.

	Number of species	Percentage of species
In serious trouble	54	32%
In some trouble	81	48%
Doing OK	33	20%
Total	**168**	

Table 3.1 The conservation status of New Zealand's 168 species of native birds.



Source: Department of Conservation

Figure 3.1 The structure of the New Zealand Threat Classification System used for assessing the threat status of flora and fauna.[41] This report is concerned with the native bird species that live and breed in New Zealand; that is, they fall within the dotted line in the figure.

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3.2 Forest birds

Forest birds can be put into six groups – perching birds, parrots, kiwi, pigeons, cuckoos, and ducks.

The conservation status of each of these groups is shown in Figure 3.2, and much more detail is given in the Appendix.

Perching birds

There are 22 different species of perching birds in New Zealand forests. Technically, these birds are called passerines – all perch with three toes pointing forward and one back. All except the rifleman and the rock wren are songbirds. Tūī, bellbirds, and fantails are all songbirds well known to New Zealanders.

The hihi (stitchbird), the rock wren, and the black robin are the most endangered. The kōkako and the tīeke (saddleback) belong to the same family as the extinct huia, and both are in some trouble, but classified as recovering.

Parrots

Three native parrot species – the kākāpō, kea, and kākā – are like no other parrots in the world. The kākāpō is particularly odd – it is exceptionally large, nocturnal, and cannot fly – and is classified as nationally critical.

There are six different species of kākāriki. Of the three that live on the mainland, the orange-fronted kākāriki is the most endangered.

Kiwi

There are five different species of New Zealand's most iconic bird, with the North Island brown kiwi by far the most common. The rowi and tokoeka are now confined to small pockets of the South Island, and both are in serious trouble.

Pigeons

There are two native pigeon species in New Zealand – the kererū or kūkupa, and the now rare Chatham Island parea.

Cuckoos

The long-tailed cuckoo is naturally uncommon and breeds only in New Zealand. The much more numerous shining cuckoo (pīpīwharauroa) is in good shape. Both lay their eggs in the nests of other birds.

Ducks

The whio (blue duck) is an unusual duck because it prefers to live in fast-flowing rivers in the forest. It is the white-water kayaker of the bird world.

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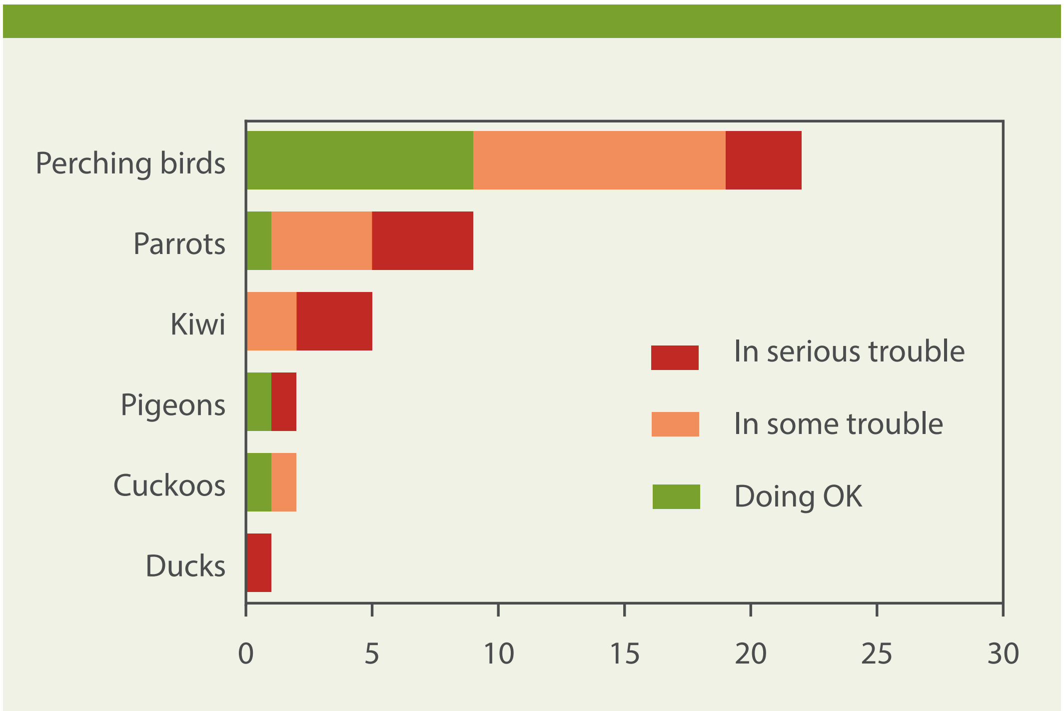

Data: Department of Conservation

Figure 3.2 The conservation status of the six groups of forest birds.

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3.3 Field, river, and coast birds

Birds that live in open country, in rivers and lakes, and along coasts can be placed into 10 groups – birds of prey; rails; ducks and swans; grebes; herons, bitterns, and spoonbills; kingfishers; shags; waders; gulls and skuas; and terns.

The conservation status of each of these groups is shown in Figure 3.3, and much more detail is given in the Appendix.

Birds of prey

New Zealand has three remaining birds of prey. The ruru (morepork) and the kāhu are both in better shape than the kārearea.[42]

Rails

Rails are small to medium-sized birds that live largely in or around wetlands. Takahē, weka, and pūkeko are the most well-known of the eight rails. The takahē and the pūkeko stand in direct contrast, although both belong to the same family – the takahē has been nursed back from the brink of extinction, while the irascible pūkeko is thriving.

Ducks and swans

There are eight native duck species living in rivers and lakes, and one recently arrived swan species from Australia. The two duck species on subantarctic islands are endangered. On the mainland, the pāteke (brown teal) is in some trouble.

Grebes

Grebes are freshwater diving birds. There are two species in New Zealand – the endemic weweia (dabchick) is faring better than the pūteketeke.

Herons, bitterns, and spoonbills

New Zealand is home to three species of herons, one bittern, and one spoonbill. The exceptionally beautiful kōtuku (white heron) has always been rare in New Zealand, but is common in some other countries. Only the matuku moana (white-faced heron) is doing OK.

Kingfishers

The kōtare (sacred kingfisher) is the only native kingfisher. The population is widespread and in good shape.

Shags

There are 13 species of shags or cormorants in New Zealand, and nine of these are endemic. Three live primarily in rivers and estuaries, and the remainder live primarily on the coast. All but one of the marine shag species are endemic, and only one – the spotted shag (kawau tikitiki) is doing OK.

Waders

Oystercatchers, dotterels, snipes, stilts, and some others can be put into a group of 16 mostly endemic wading birds that range across the coast, wetlands, and riverbeds where many nest. All are vulnerable except two – the poaka (pied stilt)

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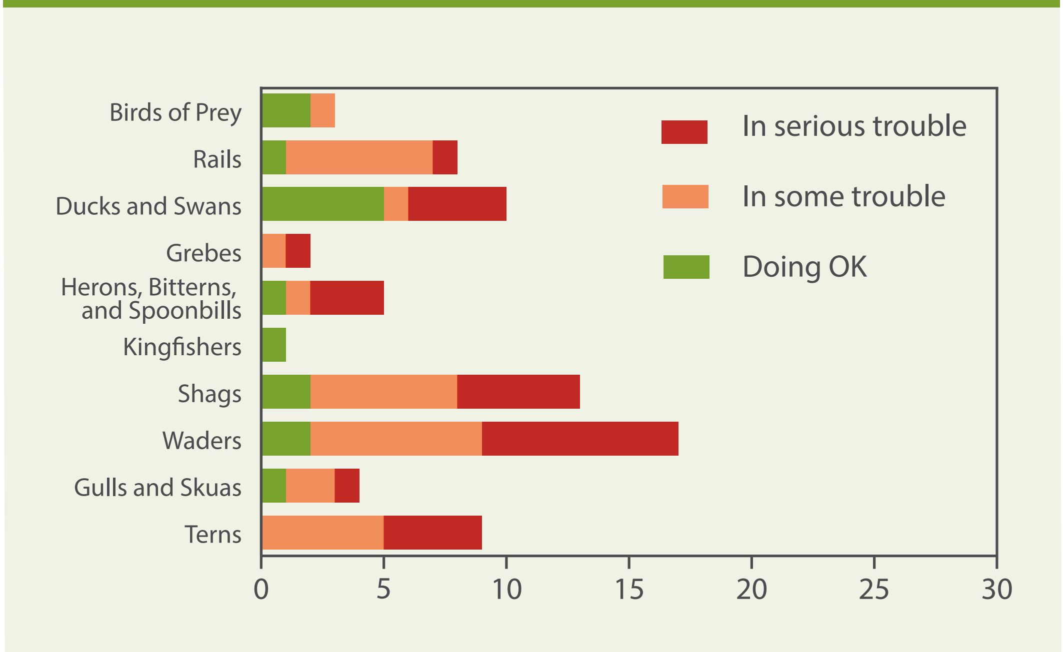
and the recently arrived spur-winged plover. The kakī (black stilt) is regarded as a taonga species by Māori, and is nationally critical.

Gulls and skuas

There are three gull and one skua species in New Zealand. While the large and aggressive black-backed gull (karoro) is in good shape, the much smaller endemic black-billed gull (tarāpuka) is the most threatened gull in the world.

Terns

The eight tern species and one species of noddy in New Zealand are all vulnerable. Only one – the black-fronted tern (tarapirohe) – is endemic, and it is in serious trouble.



Data: Department of Conservation

Figure 3.3 The conservation status of the ten groups of field, river, and coast birds.

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3.4 Seabirds

'True' seabirds get virtually all their food from the open sea. In this section, they are put into six groups. The first three are all tubenoses – they have prominent tube-shaped nostrils that drain away excess salt. Here they have been grouped on the basis of size – albatrosses and mollymawks; petrels and shearwaters; and storm petrels and prions. The other three groups are gannets and boobies; penguins; and tropicbirds.

The conservation status of each of these groups is shown in Figure 3.4, and much more detail is given in the Appendix.

Albatrosses and mollymawks

There are four albatross and six mollymawk species in New Zealand. (Mollymawk, meaning 'foolish gull', is a historical name for the smaller species of albatross.) These are large birds – the toroa (southern royal albatross) has a wingspan as wide as that of the extinct Haast's eagle. None of the species in this group are doing OK, and four are in serious trouble.

Petrels and shearwaters

The 19 petrel and eight shearwater species are mid-sized tubenoses. The Chatham Island tāiko is one of the rarest seabirds in the world. In contrast, the tītī (sooty shearwater/ muttonbird) remains abundant on some islands, but the millions that once nested on the mainland are all but gone. Only five of the petrel and shearwater species are doing OK.

Storm petrels and prions

The six storm petrel and four prion species are vulnerable partly due to their small size. The tītī wainui (fairy prion) weighs little more than 100 grams. Only one – the black-bellied storm petrel – is in good shape. Two of the three storm petrel species that are in serious trouble are endemic.

Gannets and boobies

One gannet and one booby species live along New Zealand coasts. The tākapu (Australasian gannet) is faring well, but the masked booby is not.

Penguins

Of all the birds, penguins are the most accomplished swimmers and divers, with some species capable of reaching depths of 100 metres or more. Of the seven species that breed in New Zealand, three are in serious trouble, including the endemic yellow-eyed penguin (hoiho) and the Fiordland crested penguin (tawaki).

Tropicbirds

A single tropicbird – the amokura – breeds in the Kermadec Islands and has been classed as native to New Zealand.

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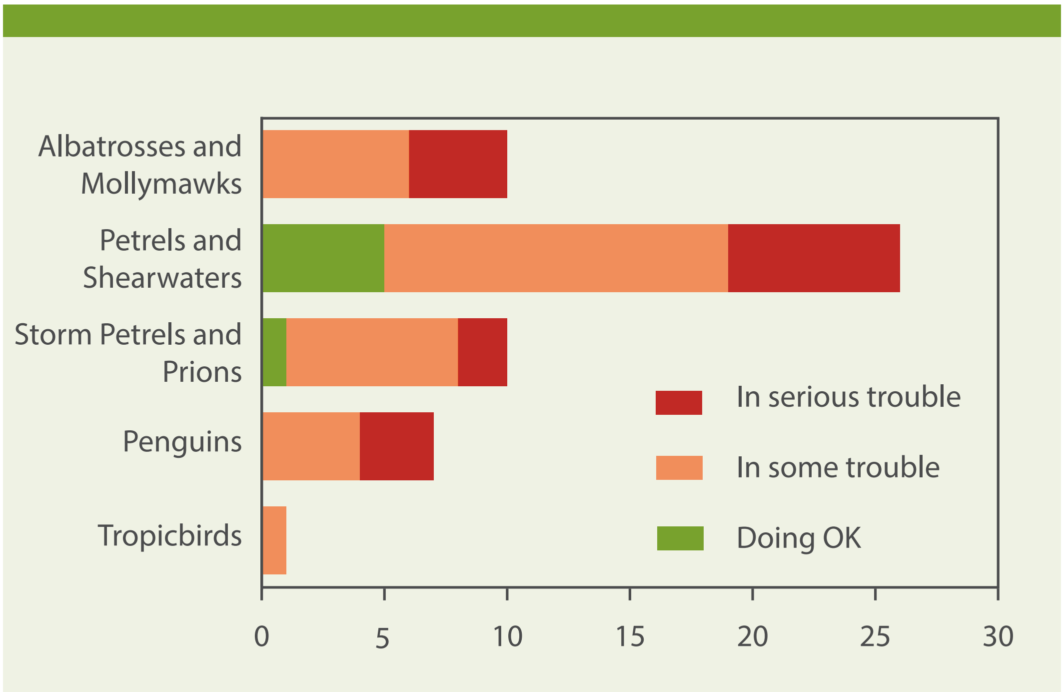

Data: Department of Conservation

Figure 3.4 The conservation status of the five groups of seabirds.

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4

Not all species are alike

An overview of the threat status of the 168 species of New Zealand native birds was given in Chapter 3. It showed that only a fifth are considered to be doing OK, and about a third are in serious trouble.

Such assessments are inevitably based on species – the "*currency of biology*".[43] But what is a species? And do all species merit the same conservation priority?

Is the pied stilt as valuable as the endemic black stilt? Are each of the six kākāriki species as valuable as the single kea species? How concerned should we be about a species such as the Caspian tern, which is endangered here but in good shape in other countries? Is a bird that is the sole occupant of an ecological niche especially valuable?

This chapter begins to explore such questions. It is divided into two sections.

The first section describes the difficulty of defining species and the two most common conceptual bases used by taxonomists. This matters because conservation actions are frequently expressed in terms of saving particular species.

The second section is focused on endemism. A high proportion of New Zealand's native birds are endemic – that is, they are found in no other country. This makes them particularly valuable because of their contribution to global biodiversity. But they are also especially vulnerable – many have spent millions of years adapting to an environment without mammals.

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4.1 What is a species?

The dividing of plants and animals into species is far from an exact science. In 1859, Charles Darwin wrote: *"I look at the term species as one arbitrarily given for the sake of convenience to a set of individuals closely resembling each other..."*[44]

A century and a half later, there is still no universally accepted way of defining a species. There are more than 20 definitions with no sign of convergence. Most are based on either the biological species concept or the phylogenetic species concept.

Under the *biological species concept*, individuals belong to the same species if they breed together and produce viable offspring.[45]

Under the *phylogenetic concept*, species are grouped together in a way that attempts to reconstruct their evolutionary history.[46] The development of techniques that enable the DNA of one individual to be readily compared with another has increased the use of this approach.

Different definitions of species result in different numbers of species. In general, using the phylogenetic concept leads to longer lists of species, often when subspecies are elevated to species. This has been dubbed 'taxonomic inflation'.[47,48]

When the number of species increases due to taxonomic 'splitting', the number of species classified as endangered will almost certainly increase.[49,50]

This matters because conservation action is largely directed towards saving species that are endangered. But lists of species not only change, they generally grow ever longer.

The difficulty over defining species raises questions about the purpose of conservation and about the prioritisation of conservation actions.

"… while current conservation measures are often biased toward charismatic taxa, diagnosing biodiversity by ***counting species errs in the other direction by insisting that all species are equally important****. A large number of species does correspond to general ecosystem stability, but the identification of a species as such does not say anything about its evolutionary distinctiveness or ecological importance."*[51] (Emphasis added)

This issue of the relative importance of species is not just fodder for academic wrangling. Resources for conservation will always be limited and priorities must be set.

How might this apply to New Zealand's native birds? If all our native birds are not equally important, which should we worry about the most? And which are of least importance? Some aspects of this challenging topic are explored in the next section.

Source: Diana Sudyka

Figure 4.1 Charles Darwin recognised the difficulty of defining species, seeing it positively as evidence of evolution. In 1857, he wrote in a letter to Joseph Hooker that *"… varieties are only small species – or species only strongly marked varieties"***. In the same letter, he refers to** *"hair-splitters and lumpers"* **(Darwin, 1887). These terms are still used today. Lumpers tend to classify varieties into single species; splitters tend to view varieties as separate species.**

4.2 Which birds are most precious?

Many of New Zealand's native plants and animals are endemic – that is, they are found in no other country. These endemic species are our greatest contribution to global biodiversity, and they are what makes our natural heritage so exceptional. Endemic birds are also likely to have evolved to play specialised roles within ecosystems.

Of the 168 species of native birds in New Zealand today, 93 are endemic. This makes them especially valuable. But are all endemic birds equally precious?

Taxonomists have placed all known species of birds into a hierarchical series of groups based on evolutionary heritage. Each species belongs to a genus, each genus belongs to a family, and each family belongs to an order. There are 23 orders of birds. A bird can be endemic at different levels of the taxonomic hierarchy – at the species level, at the genus level, at the family level, or at the order level (see Figure 4.2).

Kiwi stand out from the other endemic birds because they are endemic at the order level. They are the only living members of an order formed about 70 million years ago.[52,53]

Eleven of New Zealand's birds are endemic at the next highest level – the family level.

With the loss of the huia, the kōkako and the saddleback are the only remaining members of one family.

In this report, birds that are endemic at the order or family level are called 'deep endemics', because they originated in 'deep time' – more than 25 million years ago. These deep endemics are particularly precious because they have travelled such a long evolutionary path in New Zealand, making them different from birds elsewhere.

Are each of the six kākāriki species as valuable as the single kea species? The kea, the kākā, and the kākāpō are the only members of an ancient family and are therefore deep endemics. But the six kākāriki species are not – they are only endemic at the species level, and there are similar parakeets in other countries.

Further, each of the six kākāriki species – the red-crowned, the yellow-crowned, the orange-fronted, and the three island species – are closely related. *Genetic distance* is one measure of biodiversity.[54] The genetic distance between any two kākāriki species is much smaller than the genetic distance between any of the six kākāriki species and the kea.

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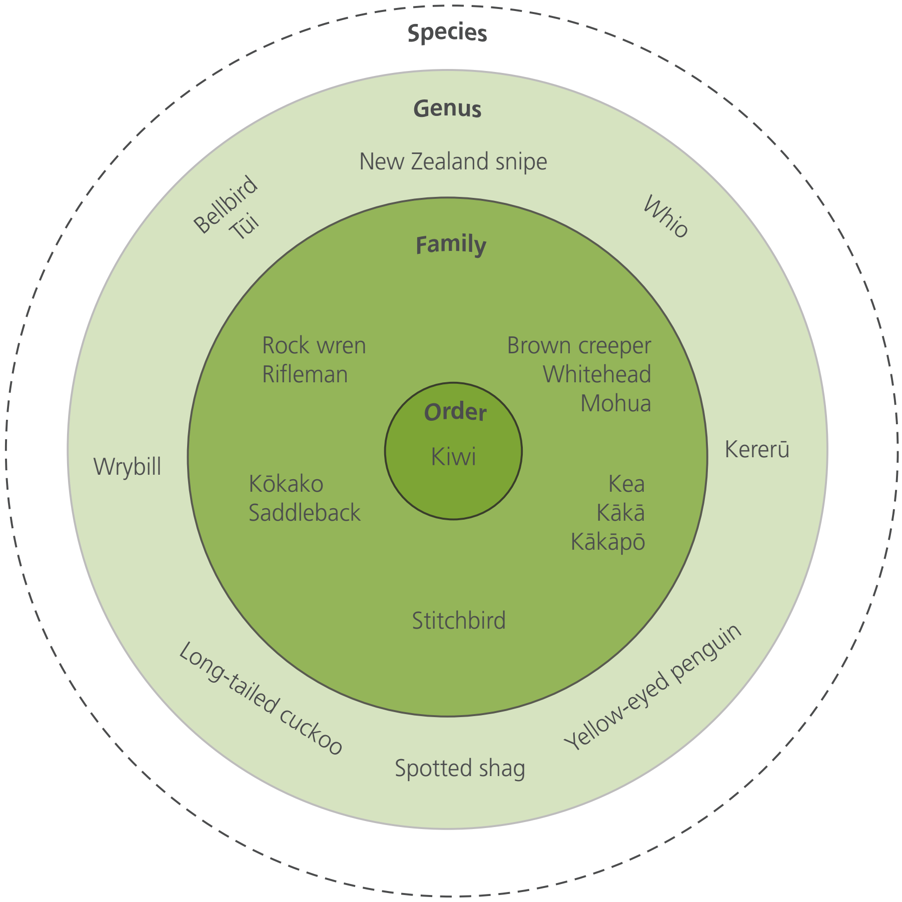

Figure 4.2 The ancestors of some endemic birds go back further in time than others. Kiwi (and the extinct moa) are endemic at the order level. Some birds are endemic at the *family* level – they belong to families found nowhere else in the world. Others are endemic at the *genus* level – they belong to genera found nowhere else in the world. The remainder are endemic at the species level.

Unsurprisingly, the endemic birds are generally in more difficulty than the other native birds. This is because they have spent millions of years adapting to an environment without humans and the animals they brought with them. Only 13% of the endemic birds are doing OK and 45% are in serious trouble.

Figure 4.3 shows how the range of four deep endemic birds – kōkako, mohua, kiwi, and kākā – has shrunk since the middle of the 19th century.[55]

However, it is not all bad news. Three endemic birds that have increased their ranges over the last few decades are the pīwakawaka (fantail), tūī, and the riroriro (grey warbler).[56]

The pīwakawaka is a prolific breeder, and appears to be just as happy hunting for insects on farms and shrubland as in podocarp forests. The feisty tūī will fly a long way to find its favourite flowering plants and can now be found in many gardens in the North Island. The tiny riroriro is not fussy about where it lives and has become the most widely distributed endemic bird.[57]

There are also ways to think about the relative value of native birds that are not endemic; that is, birds that are also found in other countries. Some of these are considered threatened in other countries, and others are considered secure in other countries.[58]

For instance, the white-chinned petrel is in good shape in New Zealand but threatened overseas, and the reef heron is in serious trouble here but secure overseas. A higher priority should be put on protecting the former than the latter, as conservation of a species that is internationally endangered is a greater contribution to global biodiversity.

Some birds also play very important, and sometimes irreplaceable, roles maintaining healthy ecosystems, such as pollinating plants and dispersing seeds.

Finally, non-scientific values cannot, and should not, be ignored. Tītī are not endemic to New Zealand and are secure overseas, but they are in some trouble here and of great cultural importance to Māori. The takahē is only 'shallowly' endemic, but will always be greatly valued because of its astonishing discovery in Fiordland in 1948. And it would be a brave person that said the magnificent kōtuku – the great white heron – is unimportant because it is abundant in Asia and Australia.

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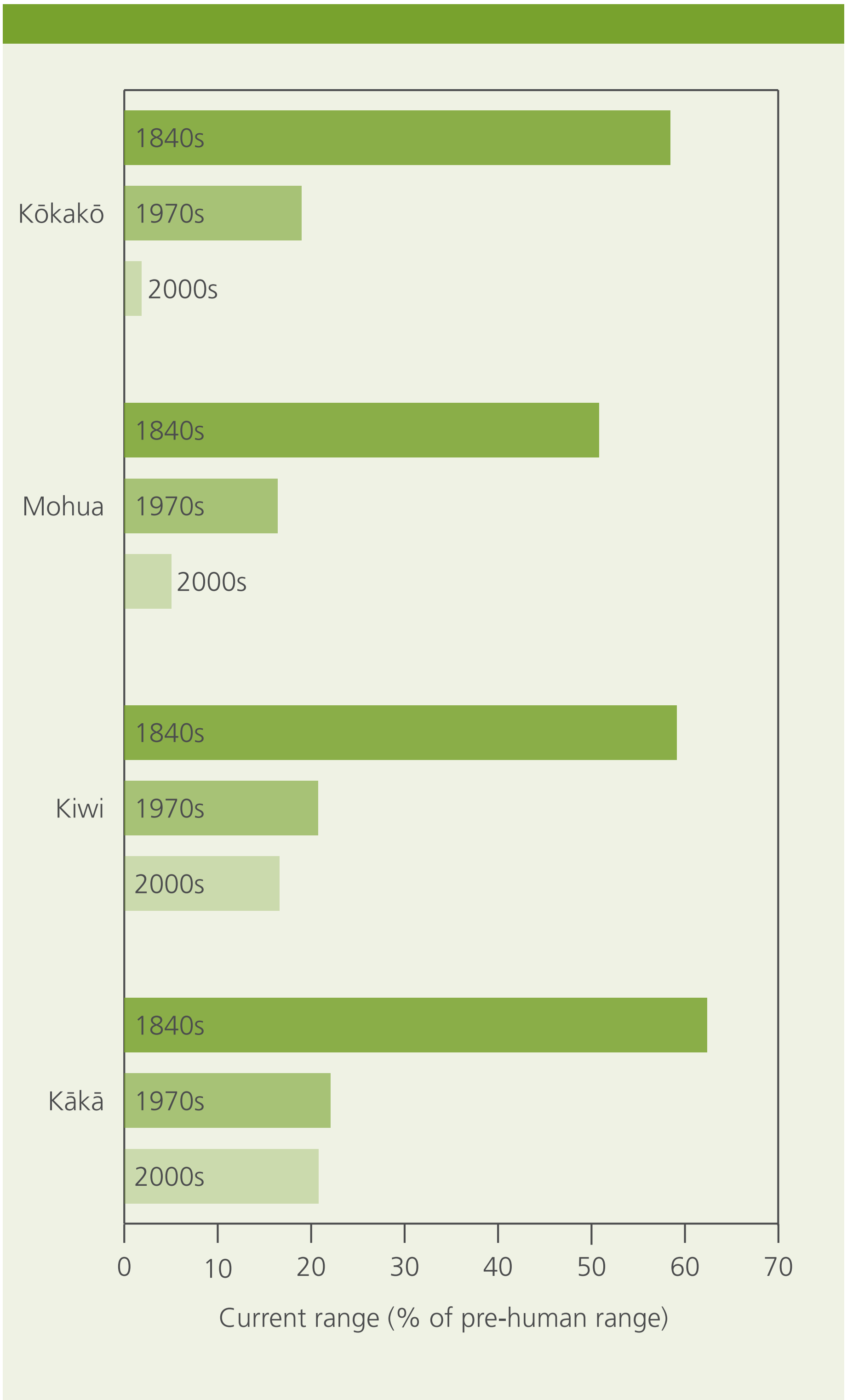

Data: Department of Conservation

Figure 4.3 The range of a species is the geographical area within which it can be found. Kōkako, mohua, kiwi, and kākā are all deep endemic birds that once roamed over much larger areas than they do now.

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5

The big three predators

For a long time the decline of native birds in New Zealand was driven by the loss of habitat. Today, it is clear that the most critical requirement for many native birds to thrive on the mainland is safety from predators. There are many animals that kill native birds, but there are three that consistently feature on the 'most wanted' list – possums, rats, and stoats. The target of Predator Free 2050 is to rid the country of these three predators by 2050.

This chapter is focused on these big three predators. It contains four sections.

The first section is a brief description of possums, rats, and stoats. Of these three, it is now understood that rats and stoats have the greatest impact on forest birds.

The second section is about the use of trapping and poisoning in suppressing populations of the big three predators.

In some years, forest trees flower prolifically and produce huge quantities of seeds. This phenomenon is known as masting. In mast years, the abundance of food leads to plagues of rodents and stoats, and thus to the death of millions of native birds. This is the subject of the third section.

The fourth section describes a number of important aspects of predator control that should remain, or become, the subject of research.

The big three predators that are the target of Predator Free New Zealand are the biggest killers of forest birds. But there are other predators that are major killers of the native birds that live in other habitats – in open country and in cities, in rivers and lakes, and along the coast and at sea. The next chapter is about these other predators.

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5.1 Possums, rats, and stoats

Possums

Brushtail possums were brought to New Zealand over 150 years ago from Australia to establish an export fur trade. In their native Australia, possums are legally protected in every state. Possums have flourished in New Zealand, and there are about 30 million today.[59]

In New Zealand, the damage possums do to native forests has long been recognised. They are the major cause of the decline of trees such as pōhutukawa, rewarewa, kāmahi, māhoe, tawa, and rātā.

Understanding of the direct impact of possums on native birds is more recent. They eat eggs, chicks, and occasionally adults of some birds, but ship rats and stoats are the major predators in the forest.[60]

Rats

Three species of rat have been introduced into New Zealand – the kiore, the Norway rat, and the ship rat. Kiore have been almost entirely displaced by the other bigger rats.

Norway rats tend to live around water – in estuaries, marshes, lakes, rivers, and streams. Rats seen in cities and on farms are likely to be Norway rats.

Ship rats are the most prevalent by far. They are skilled climbers and live much of the time in trees. They begin to breed when only three or four months old, and thereafter will produce a litter once a month if enough food is available. Their destructive impact on forest birds is well documented.

Rats (and mice) are also a major food source of the third big predator – the carnivorous stoat.

Stoats

Stoats were introduced to New Zealand to kill rabbits in the 1880s. Tragically, stoats had little effect on rabbits, but took to the bush where they mainly fed on rodents, but also proved to be adept killers of native birds.

Stoat populations can increase quickly. Female stoats breed once a year in the spring. Male stoats visit the nest soon after the young are born and mate with the tiny female babies as well as with the mother. The young females leave the nest in mid-summer already pregnant, although their own young will not develop until the following spring – and then only if there is enough food. If food is plentiful, a single female can produce as many as 12 kits.

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Source: Nga Manu Images

Figure 5.1 A ship rat destroying a pīwakawaka (fantail) nest.

Source: Graeme Taylor, Department of Conservation

Figure 5.2 A stoat larder – a cache of seven diving petrels and one grey-faced petrel found on an island off the west coast of Auckland.

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5.2 Dealing to the big three

Possums, rats, and stoats are killed in a variety of ways that involve either trapping or poisoning. Most of the poisons used are put in baits in ground 'stations'. Two – brodifacoum and sodium fluoroacetate (1080) – are registered for aerial use; that is, they can be dropped over large areas from helicopters.

Ground control, using bait stations and/or trapping, is generally used in places with easy access, such as bush reserves or riverbeds, and near densely populated areas. Traps are generally designed to catch a particular type of predator.

Standard methods of trapping and ground baiting are labour-intensive. Traps must be checked and reset regularly, and poison baits must be replenished. Innovative technologies are being developed to improve the effectiveness of trapping and ground poisoning, and to reduce the associated labour costs.

A major innovation in trapping is the development of traps that reset themselves. One model on the market has been designed to kill up to 12 possums or 24 rats or stoats before the trap needs checking.

The success of re-setting traps depends critically on the development of lures that are long-lived and attract predators. Such lures are available for rats, but the development of such a lure for stoats is much more challenging. Stoats are carnivores, so they are attracted by lures made of meat, but even when the meat is dried, it only lasts three or four weeks. A stoat lure that attracts stoats over a large area and only needs replacing every few months or so would be a great advance.

A major innovation in poisons is PAPP (para-aminopropiophenone). Carnivores – including stoats – are particularly susceptible to PAPP, and it is already being used in bait stations. It takes at least 20 times as much PAPP, weight for weight, to kill an omnivorous rat than it does to kill a carnivorous stoat.[61]

Work is underway to develop a re-setting device for PAPP that would kill stoats. When triggered by a stoat, the device would spray PAPP on to its fur. The stoat would then lick it off and lose consciousness in a few minutes. As for the re-setting traps, the development of an attractive long-lived stoat lure would be a game changer.

Many from both the public sector and private sector are involved in this unprecedented wave of innovation in trapping and ground poisoning of possums, rats, and stoats. These include universities, Landcare Research, the Department of Conservation, and a new company, Zero Invasive Predators Ltd (ZIP). A great range of creative ideas are on the table. For instance, the Cacophony Project has the goal of making a device that will lure, identify, and eliminate predators, and monitor birdsong to measure the impact.

Only two poisons are registered for aerial use – brodifacoum and sodium fluoroacetate (1080). Brodifacoum has been successfully dropped from the air on to some offshore islands, but it is not considered as suitable as 1080 for dropping on the mainland.[62]

Despite innovations in trapping and ground poisoning, aerial application of 1080 remains essential for the foreseeable future. There are two reasons for this.

The first reason is the ability to suppress possums, rats, and stoats over large areas cost-effectively, in a very short time period, even when these areas are rugged and difficult to access.

Predator control at a landscape scale is vital for restoring abundant and resilient birdlife across the mainland. The bigger the safe area, the greater the number of birds and the number of species that can thrive. While a fantail will happily live within a hectare of forest, a kākā needs to range over hundreds of hectares, and a kererū can fly 100 kilometres between feeding areas.[63]

Aerial 1080 is also cost-effective, at about $30 per hectare. This figure includes the costs of communication, consultation, and obtaining consents.[64]

The second reason why aerial 1080 is needed for the foreseeable future is because it is the only way of knocking down the populations of rodents and stoats that 'irrupt' in mast years. Masting is discussed in the next section of this chapter.

Source: Philip Gleeson

Figure 5.3 ***Gastrolobium*** **is a genus of flowering plants endemic to Western Australia that contain fluoroacetate (the active part of 1080). The native animals of Western Australia are able to eat these plants safely because they have evolved to co-exist with them.**

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5.3 Knocking down rat and stoat plagues during masts

When trees mast, they flower more prolifically and produce far more fruit and seeds than normal. This phenomenon is greatest in beech forests, but other trees such as rimu and kahikatea also undergo mast seeding.

Mast events provide abundant food for birds, and some species lay more eggs and successfully raise more chicks in mast years. But tragically, masts also provide abundant food for rats and mice.

With plenty to eat, populations of rats and mice 'irrupt' and their numbers soar. Stoats gorge themselves on the rodents and their numbers soar as well – plentiful food results in the birth and survival of many more young.[65]

Dropped at the right time, 1080 will knock down irrupting populations of rodents and stoats. Although the carnivorous stoats do not eat the baits themselves, they eat poisoned rats and mice and die through secondary poisoning.

In the spring of 2013, scientists observed that prolific flowering of beech trees was occurring across much of the country. Early in 2014, it became clear that a 'megamast' was underway, and the first Battle for Our Birds was launched.[66] Between August and December 2014, 1080 was dropped on 660,000 hectares of beech forest – only 16% of the total area of masting forest (Figure 5.4).

Analysis of the effectiveness of the 2014 Battle for Our Birds is taking place in stages.

The first stage is the measurement of the effect on predator populations. Monitoring of tracking rates at different sites before and after the 1080 drops show very big reductions in rat and stoat numbers, with a few exceptions.[67]

The second stage is the measurement of nesting success of birds. The time when birds are most vulnerable to predators is the nesting season. In spring, eggs, adult females sitting on eggs, and chicks are easy pickings. Substantial improvements in the nesting success of mohua, rifleman, rock wren, and South Island robin were found.[68,69]

The ultimate measure of effectiveness of predator control of any kind is the change in the number of birds in a population. Sometimes, despite successful knockdown of predators, other factors may prevent populations from increasing.[70]

In 2016, another major beech mast occurred, and a second Battle for Our Birds was fought.[71] The populations of rodents and stoats that soar during masts take an enormous toll on birds and other forest creatures. It is vital that such a battle is fought whenever a mast occurs.

Over recent decades, many endemic birds (especially the deep endemics) are left clinging on in remote forest refuges.

"New Zealand's colder forests, many of which are dominated by species of beech or rimu, are now its most important reservoirs of endemic forest bird populations."[72]

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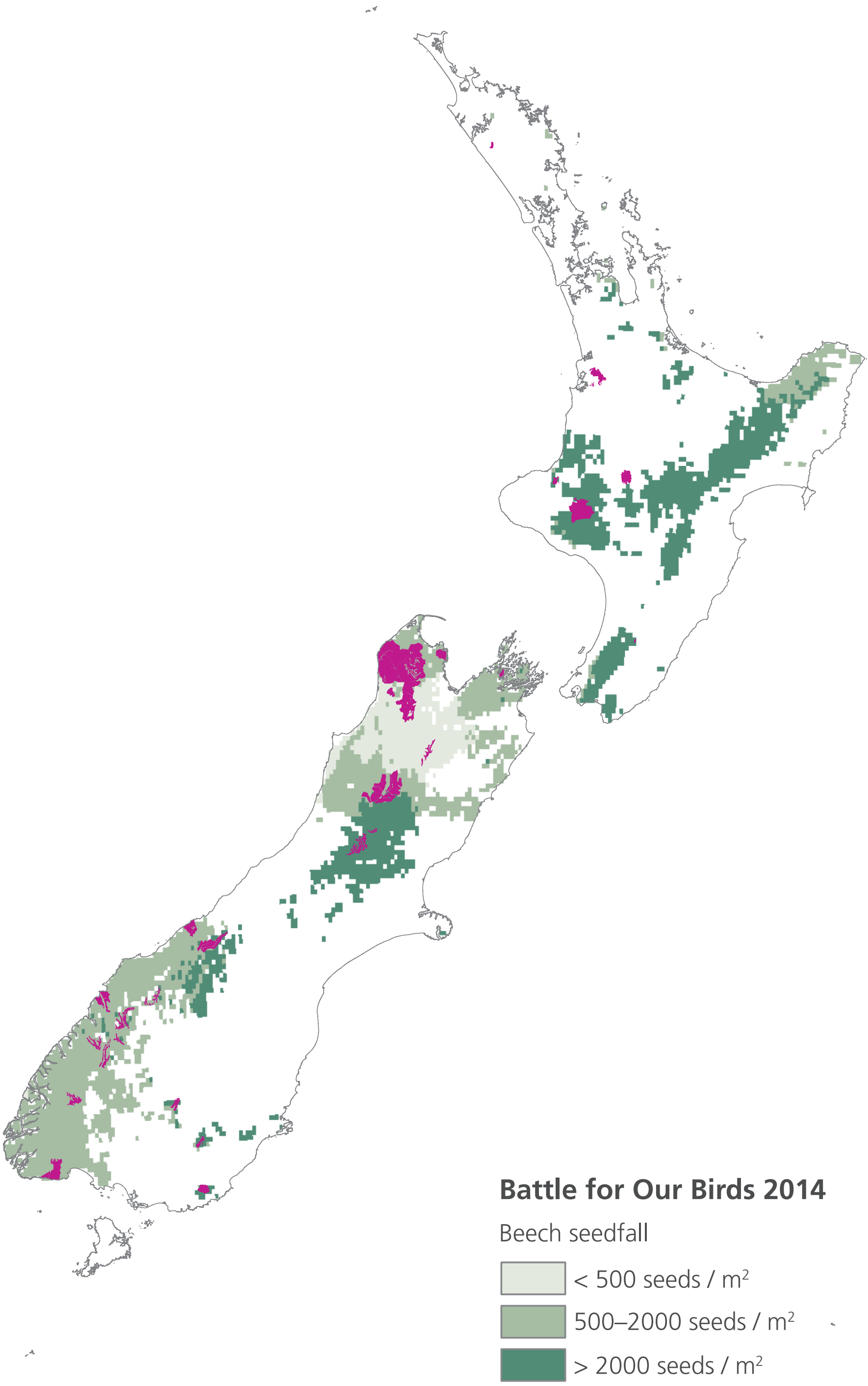

Data: Elliot and Kemp, 2016

Figure 5.4 The 2014 megamast. In the autumn of 2014, huge amounts of beech seed were produced in forests in the North Island as well as in the South Island, and on private land as well as within the conservation estate. The areas where the battle was fought (where 1080 was dropped) are shown in purple.

5.4 Vital ongoing research

While major breakthroughs in predator control from cutting edge science may well occur, they will not occur soon. The importance of research into developing and refining current methods for dealing with the big three predators cannot be overstated.

Nor should the challenge that these predators pose be underestimated. Thorough field testing of the effectiveness and impacts of new innovative ways of killing predators is vital. Aerial 1080 has been much studied in response to controversy over its use, and is regulated under multiple laws. But it can be tempting to assume that all is well with other methods. A kea dying from eating 1080 is national news, but a kiwi caught in a possum trap is no news at all.

Three important research areas are discussed in this section, but there will be others.

Rat rebound

It is not yet possible for an area to be kept free of possums, rats, and stoats, unless it is an island or a fenced sanctuary. Even then constant vigilance is required. On the unfenced mainland, the aim is predator suppression – the longer the better.

After a control operation, predator populations bounce back in two ways – *survivors* breeding within the control area, and *invaders* from outside the control area moving in.

The greater the number of *survivors*, the faster the population will grow.[73] Very fertile podocarp forests can support large numbers of rats, so even a small percentage of survivors can start to repopulate a forest within six months.[74,75]

One fruitful area of research could involve exploring the use of combinations of different methods in some operations. For instance, rat populations are likely to be highest along fertile valley floors. The few rats that survive a 1080 drop are most likely to be in these areas, so lines of resetting traps or bait stations along valley floors may well be an effective way of keeping rat populations low for longer.[76]

The rate at which *invaders* come back into a control area depends on both the size and shape of the control area. In general, the smaller and narrower the control area, the faster the reinvasion will be. Rats can invade a kilometre into a control area within a year.[77]

The Department of Conservation often excludes some parts of a control area following consultation with landowners and communities. Medical officers of health also set buffer zones around tracks and rivers and lakes that are drinking water sources. Such 'holes' within a 1080 treatment area reduce the effectiveness of an operation because they increase both the number of *survivors* and the number of *invaders*, and thus speed up rat bounceback.

There are some options in the guidance document for protecting the public used by the medical officers of health. Predator control will be more effective if tracks are cleared and water intakes are closed for a short time, instead of setting buffer zones.[78]

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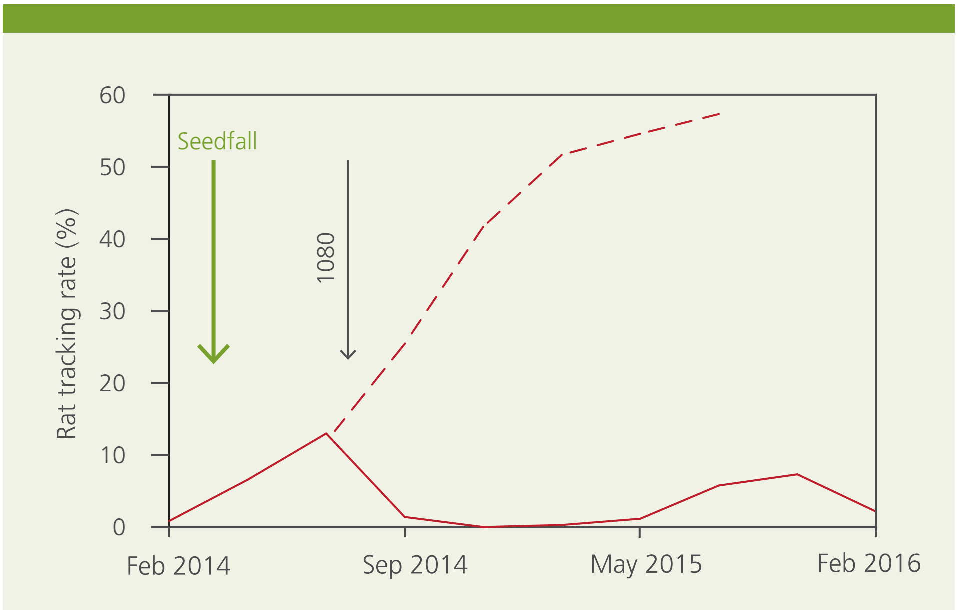

Data: Department of Conservation

Figure 5.5 Rat rebound after the drop of 1080 during the 2014 megamast in Dart Valley in Mount Aspiring National Park. The solid red line shows the rat population monitored by using tracking tunnels. The broken red line shows how the rat population would have continued to grow if the 1080 drop had not been done.

Source: Mark Dwyer

Figure 5.6 Tutahanga Tepu of Ngāti Rereahu blesses toutouwai (robins) before they are released on Mt Taranaki in April 2017. Following an aerial 1080 operation on the northern slopes of the mountain, more than 2,000 traps that reset themselves have been put in place to keep predator numbers as low as possible.

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Mice matter too

The interaction between populations of rats and populations of mice is another critically important area of research.

Mice can be predators in their own right, but the greater concern is the role they play, along with rats, in fuelling growth in stoat populations.

Rats compete with mice for food and can also prey on them. So fewer rats can lead to more mice. In some forests during a mast, mice are far more numerous than rats, and provide the primary food for stoats.[79]

Predator Free 2050 is focused on possums, rats, and stoats as the big three predators. But the tiny mouse is a fourth that cannot be ignored. The ideal is the simultaneous removal of all four predators – possums, rats, stoats, and mice.[80]

Both rat rebound and interaction between populations of predators are strongly affected by the type of forest. And in pure beech forests, the mouse–stoat dynamic is generally more important than the rat–stoat dynamic.[81]

Keeping vulnerable birds safe

Suppression of predators, rather than complete freedom from predators, is currently the name of the game. If native bird populations are to be restored on the mainland away from the safety of predator-free islands, a critical area of research is understanding how low levels of predators need to be for different birds to be safe.

Some birds are much more vulnerable to predators than others. These include mohua, tīeke, and kōkako – all precious deep endemics.

Cape Sanctuary is a 2,500 hectare area at Cape Kidnappers in Hawke's Bay, protected by a predator-proof fence that runs for just over 10 kilometres. The introduction of tīeke (saddleback) into Cape Sanctuary in 2013 illustrates the need for developing much more accurate ways of detecting the presence of predators.[82]

The current method for measuring the density of rats and some other predators is to use tracking tunnels. Rats run through these tunnels and leave behind their distinctive inky footprints on paper.

At Cape Sanctuary in 2013, the rat tracking level was found to be less than 1%. At that time, an area was considered 'safe' for tīeke if less than 5% of the tunnels contained rat tracks.[83] Subsequently, in April of that year, 120 tīeke were released into the sanctuary.

Two weeks later, nearly half of the tīeke had disappeared, and by October, less than 20 birds remained. The cause turned out to be a colony of Norway rats that had escaped detection. These were trapped and poisoned, and a small population of tīeke still exists in the sanctuary.[84]

This case illustrates the need for research into more accurate ways of detecting predators at low levels and identifying 'safe levels' for different birds.

Source: Duncan, Flickr CC BT-SA 2.0

Figure 5.7 Tīeke (saddleback) are particularly vulnerable endemic birds because they nest in cavities, and forage on the forest floor.

Source: Fiordland Wapiti Foundation

Figure 5.8 Since 2005, the Fiordland Wapiti Foundation has run a programme trapping stoats in five valleys near Milford Sound. The area is home to a population of whio (blue duck) – the torrent duck that is featured on the $10 note.

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6

It’s not just possums, rats, and stoats

The possums, rats, and stoats that are the target of Predator Free 2050 are the biggest killers of forest birds. But there are other creatures that prey on native birds, particularly on those that do not live in the forest, but live in open country and in cities, in rivers and lakes, and along the coast and at sea.

This chapter is about the most significant of these other predators. It has four sections.

The first section shows how native birds can face threats from a range of very different predators.

The next two sections contain descriptions of a number of these predators.

The second section begins with mice. It then covers ferrets and weasels – the animals which, along with stoats, belong to the family of carnivorous mammals known as mustelids. The last predator described in this section is the innocuous-looking hedgehog.

The third section deals with cats and dogs – much-loved companions to many New Zealanders. Although domestic cats and dogs do kill birds, the millions of aggressive feral cats that roam across much of the countryside are the greater problem by far.

The last section is about the unintentional killing of seabirds that can happen during fishing.

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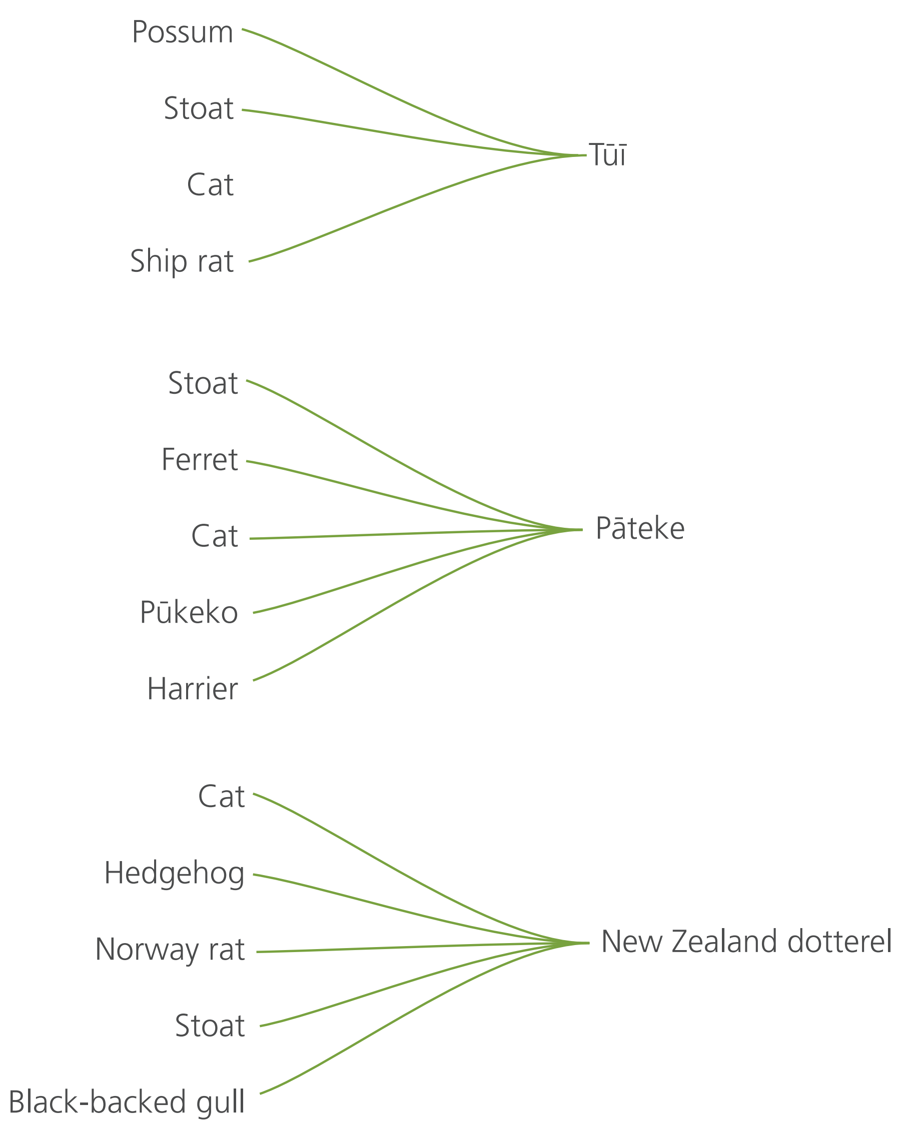
6.1 A range of predators

The animals that prey on native birds vary. In the stony riverbeds of the eastern South Island, feral cats, ferrets, and hedgehogs are big bird killers. In cities and towns, many domestic and stray cats are skilled bird hunters, though sometimes the birds make it easy for them by flying into windows and falling to the ground unconscious.

Figure 6.1 shows the major predators of three native birds in Hawke's Bay – the tūī, a forest bird; the pāteke, a waterbird; and the New Zealand dotterel, a shorebird. The predators include three native birds – the pūkeko, the harrier hawk, and the black-backed gull.



Source: adapted from Innes and Fitzgerald, 2016

Figure 6.1 The predators that are the main killers of three endemic birds in eastern Hawke's Bay. They are listed in order of their impact from the most damaging to the least damaging.[85]

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6.2 Mice, mustelids, and hedgehogs

Mice

In the absence of other predators, mice can sometimes attack surprisingly large prey. In 2001, mice on a small island in the South Atlantic Ocean were found to be nibbling on live albatross chicks nearly 300 times their size.[86]

On New Zealand's subantarctic islands, ground-nesting birds such as snipe, pipit, and kākāriki have been observed to be more abundant on islands free of all predators compared with islands that have only mice on them.[87] However, this is likely to be at least partly due to the mice competing with the birds for food. Similarly, mice have been found high up trees in a fenced sanctuary in Waikato, so may well be eating bird eggs and chicks. But their bigger impact is almost certainly depriving birds of food because they eat so many worms and other invertebrates.[88]

The major impact that mice are having on native birds is the way they, along with rats, fuel the growth of the stoat population. Stoats are carnivores, so the more rats and mice there are, the more food there is for stoats. And the more food a female stoat eats, the more young she will bear.

Ferrets and weasels - the other two mustelids

Of the three mustelids introduced to New Zealand in the 19th century, the stoat remains the most damaging by far. However, the larger ferrets and the smaller weasels also prey on native birds.

Ferrets are most common in open country, particularly where there are plenty of rabbits for food. They are significant killers of ground-nesting wading birds, but unlike stoats, are poor swimmers and climbers.[89] Ferrets are known to prey on yellow-eyed penguins, blue penguins, and tītī (muttonbirds).[90]

Weasels are only patchily distributed around the country, preferring overgrown areas with thick ground cover. Weasels can run, swim, and climb just as well as stoats, but there are far fewer of them. They are known to prey on small birds such as riflemen and tomtits.

Hedgehogs

Hedgehogs appear to have been first brought to New Zealand out of sentiment – to, in the words of the Animal Acclimatisation Act 1861, *"contribute to the pleasure and profit of the inhabitants"*.[91] While hedgehog numbers have rapidly fallen in Britain, here Mrs Tiggy-Winkle has thrived and been dubbed a 'serial killer'.[92]

Hedgehogs will eat the eggs and chicks of ground-nesting birds, but are a much larger threat to waders, terns, and gulls than they are to forest birds because they do not like wet bushy areas. Along with cats and ferrets, hedgehogs are playing a major role in the decline of the country's only endemic tern and only endemic stilt – the tarapirohe and the kakī.[93] Both are in serious trouble.

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6.3 Cats and dogs

Cats

Companion cats number more than a million – about half of New Zealand households have a pet cat. Philanthropist and businessman Gareth Morgan has weathered a storm of criticism for pointing out that even the most pampered domestic cat still retains its predatory instinct. The number of birds killed by domestic cats has been estimated at between 5 and 11 million a year, although many of these will not be native birds.[94]

Microchipping cats so they can be identified and returned to their owners has become much more common in recent years.[95] The Wellington City Council has made it compulsory for all cats in the city to be microchipped by 2018.

Stray cats rely directly or indirectly on humans for much of their food, and sometimes form colonies in cities and towns. It has been estimated that there are nearly 200,000 stray cats across the country.[96] The draft New Zealand National Cat Management Strategy has the elimination of stray cats as one of its goals.

Feral cats are unowned and unsocialised. It is widely thought that there are now many millions of feral cats in New Zealand. They are formidable killers. Dr John McLennan, environmental adviser to the Cape Sanctuary in Hawke's Bay, describes them as *"the most intractable predator"*. Since 2007, more than 1,400 feral cats have been killed within the sanctuary fence.

Feral cats tend to live in open country and around the edges of forests. However, they can be found in other habitats, including deep within podocarp forest on Stewart Island. They roam over huge areas – one Stewart Island study found the range of female feral cats to be over a 1,000 hectares, and that of male feral cats to be almost twice as large.[97]

Feral cats can kill many different native birds. On one of the muttonbird islands, cats wiped out the populations of yellow-crowned kākāriki, robins, brown creeper, New Zealand snipe, banded rails, diving petrels, and broad-billed prions.[98] In 1981, cats killed over half of the radio-tagged kākāpō on Stewart Island. And cats are major killers of the wading birds (including the adults) that live in the braided riverbeds of the eastern South Island.[99]

In New Zealand, most regional councils list feral cats in their pest management strategies, but only four invest in widespread suppression of cat populations.[100]

Currently, rabbit populations are worryingly high in many parts of the country, and feral cats are living up large on a diet of fresh rabbit and multiplying rapidly. Otago Professor Phil Seddon comments, *"Cats don't control rabbits ... Rabbit numbers control cats. Rabbits are the drivers of the cat population."*[101]

The virus introduced to control rabbits in 1997 has largely run its course because many rabbits have developed immunity. It is likely another strain of the virus will be released soon.[102] But when this happens and rabbit numbers fall rapidly, the cats and other predators that feed on rabbits will eat whatever they can find, including birds and lizards. The birds will take a big hit, unless much greater efforts are made to kill feral cats.[103]

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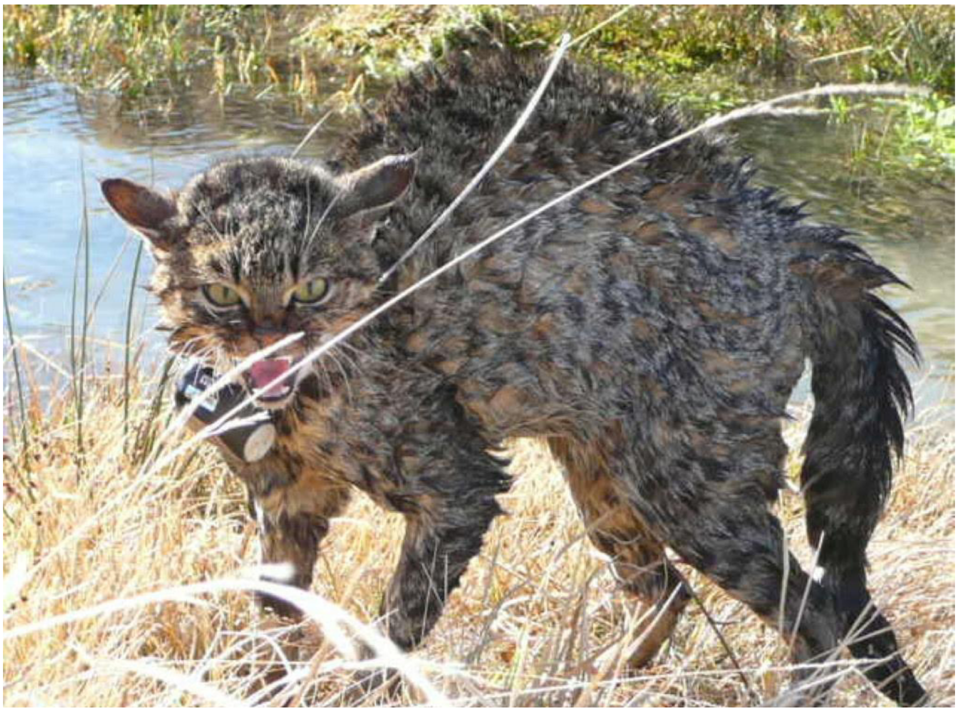

Source: Simon Stevenson / Department of Conservation

Figure 6.2 A feral cat fitted with a transmitter collar.

Source: Otago Daily Times

Figure 6.3 Plagues of rabbits are once again invading large areas of the country, providing abundant food for feral cats and other predators.

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Dogs

Dogs (off lead) are a particular danger to kiwi. To the sensitive nose of a dog, the smell of a kiwi is very powerful.

In 1987 a single German shepherd abandoned in a Northland forest was found to have killed at least 13 kiwi and likely many more.[104] But while not all dogs are deliberate killers of kiwi, any dog can accidentally crush them to death.

Kiwi are exceptionally vulnerable to dogs because of their unusual anatomy. Along with ostrich, emu, cassowary, rhea (and once the moa), kiwi belong to the ancient order of birds known as the ratites. A ratite does not have a keel attached to its sternum – other birds have a strong keel bone to which their flight muscles are attached.

This is why a curious and gentle dog can easily kill an adult kiwi just by picking it up in its mouth. A single rib snapping and piercing a lung is enough to kill a bird. In Northland, dogs are now the main killers of adult kiwi, and it is not just one or two breeds that are responsible.[105] Kiwi avoidance training can help reduce the likelihood of a dog being attracted by the smell of a kiwi, but there are no guarantees.[106]

Dogs left to run free on beaches and riverbeds during breeding season can frighten ground nesting birds such as dotterels and penguins, leaving eggs and chicks exposed. Any dog found to be 'at large' threatening protected wildlife can be seized or destroyed.[107]

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Source: Department of Conservation

Figure 6.4 Some dogs are conservation heroes. Here Jazz, a German wirehaired pointer, sniffs out a kakī chick so that it can be looked after. Other highly trained dogs are used to find stoats, feral cats, and rats.

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6.4 Humans as 'unintentional predators' of seabirds

Seabirds often flock around fishing boats looking for food. Unfortunately, in New Zealand waters alone, thousands end up drowned in nets, caught on hooks or mortally wounded from hitting steel cables. The most common casualties are shearwaters, petrels, and albatrosses. The black petrel is in the most danger – it is caught while scavenging around boats close to where it breeds in the Hauraki Gulf.[108]

The endemic Antipodean albatross is undergoing a particularly rapid decline. This great bird with its three-metre wingspan wanders across the southern ocean from the Tasman Sea across to the coast of Chile. Its recent decline is correlated with an increase in surface longline fishing on the high seas and a change in the foraging range of the birds.[109] In the New Zealand fishing industry, hundreds of seabirds, including several species of albatross, are caught on longline hooks each year.

There is a solution. International best practice involves adding weights to the lines so the hooks and bait sink quickly out of reach of the birds, setting lines at night, and using bird-scaring devices. Under an international agreement, New Zealand has an obligation to conserve albatrosses and petrels. The Government is currently considering a proposal to make line-weighting mandatory.[110]

In 2004, New Zealand adopted a plan to reduce the incidental bycatch of seabirds in fisheries, whether they are commercial, recreational, or customary. The plan was updated in 2013, and a further update is scheduled for 2018.[111]

Since 2004, there has been progress in some areas. For instance, deepwater trawlers are using devices such as bird-scaring lines and bafflers to keep birds at a distance. As a result, the number of albatrosses killed by flying into steel cables in the squid trawl fishery has halved. Almost all skippers on commercial bottom longline fishing boats in the Hauraki Gulf have completed training on how to avoid catching seabirds, and are now involved in a camera trial to see how effective their efforts are.[112]

But there is still more to do. In particular, the understanding of what is actually happening on fishing boats is based on data recorded by observers who cover only a small proportion of the commercial fishing fleet.

The Government has recently decided to require electronic monitoring of commercial fishing by using on-board video cameras. The primary purpose is to monitor the fishing effort and catch, including the bycatch of fish for which quota is not held.[113] These monitoring systems should be designed so that the bycatch of seabirds is also recorded.

Source: Kath Walker

Figure 6.5 The Antipodean wandering albatross is sometimes caught on surface longline hooks in New Zealand waters and on the high seas. They wander across the South Pacific from Australia as far as Chile.

Source: Sanford Ltd

Figure 6.6 On trawl vessels, bafflers create a 'fence' around the stern of a vessel, which keeps the seabirds at a distance so they are unlikely to crash into steel cables.

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7

Breakthrough genetic science to deal with predators

As discussed in Chapter 5, there is a wave of innovation in trapping and poisoning predators underway in New Zealand. This is likely to be accelerated by the Government's predator-free goal. Some of this innovation rests on novel applications of science. One example is the potential development of a stoat lure using synthesised pheromones.

One of the interim goals of Predator Free 2050 is to develop a *"breakthrough science solution that would be capable of eradicating at least one small mammal predator from the New Zealand mainland"*.[114] Achieving this would almost certainly require using genetic science techniques.

This chapter is about the quest for scientific 'breakthroughs' in predator control using the new tools of genetic science.

One tool of genetic science is 'genome mining' – analysing the DNA of predators in order to find weaknesses that can be exploited. Another is the system called CRISPR/Cas9, which can cut strands of DNA in a very precise, targeted fashion – much like a pair of scissors.

Three areas of current research that rely on genetic science to suppress and/or potentially eradicate mammal predators are described in this chapter.[115]

- The development of toxins that will kill only the target predator.
- The Trojan female, in which female predators pass on infertility to their sons.
- Gene drive, whereby all offspring of a predator inherit a particular trait.

These three research areas are not intended to be a complete description of the scientific effort underway. Rather, they are being used to illustrate some of the possibilities provided by the fast-evolving field of genetic science.

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7.1 Toxins that only kill particular predators

Species-specific toxins kill only one kind of predator, and do not harm any other animal. Research is underway at Landcare Research to find or create such toxins.[116]

One line of research is focused on a toxin that is known to be selectively toxic to rats.

Norbormide was developed as a rat poison in the 1960s, but its use stopped in the 1980s because rats did not find it palatable. Researchers are creating chemical variants based on Norbormide. In cage trials, one variant has been shown to kill 100% of Norway rats and 80% of ship rats, and field trials are being planned.[117]

That Norbormide happens to be fatal for only rats is a lucky discovery. The more general approach is to *develop* species-specific toxins. The process of developing such a toxin for possums is underway.

The first stage involves 'genome mining' – analysing the DNA of the possum to find gene sequences that are both unique to possums and associated with vital biological functions such as respiration. The second stage involves finding a toxin that closes down the biological function the gene controls, causing death.

To date, genome mining has led to the identification of some promising gene sequences that are unique to possums and wallabies. It is hoped that candidate toxins will be identified by 2019. It would then be several more years before any toxins would be ready for use.

A toxin that kills only rats or only possums would not hurt other animals. But to be effective at a landscape scale, large quantities would need to be dropped aerially. Thus, such a toxin would also need to be affordable and leave no harmful residues in the environment.

7.2 The Trojan female technique

Another new approach to predator control that is being investigated is known as the 'Trojan female'. It takes its name from the myth of the Trojan horse – a giant wooden horse containing armed men used by the Greek army to capture the city of Troy. In this approach to predator control, the female predator is the Trojan horse, and she carries inside her a gene that makes her sons infertile.

There are two kinds of DNA in animals.

- Most of the DNA sits inside the nuclei of the cells of the animal. Half of this DNA is inherited from the father and half from the mother.
- The remainder of the DNA sits in a different part of the cells known as the mitochondria. All of this DNA is inherited from the mother.

Thus, a female rat, for instance, will pass on her mitochondrial DNA to all her offspring – to her sons as well as her daughters. The oddly named 'mother's curse' in biology refers to sons inheriting harmful genes from their mothers, while the same genes do not have the same effect on the daughters.

The Trojan female approach would begin with screening rats to find healthy females that will bear sons with low fertility. Then these females would be bred up in captivity. Their female progeny could then be released to spread the mutation through wild populations.

As with any research, there are many questions to be resolved.

The first is: Do individual females carrying mutations like male infertility exist? Examples have been found in fruit flies, mice, and hares. This augurs well for finding similar mutations in rats and other predators.[118]

Another question is whether such natural mutations have a strong effect on male fertility without harming the reproductive functioning of the females. Again, this also seems likely. Mutations with these characteristics have been recently found in fruit flies.[119]

So could the Trojan female technique be used to suppress predators in New Zealand? Modelling has suggested that it should be feasible, although inevitably there would be practical difficulties.[120]

It is possible that Nature would find a way to fight back against the Trojan female and restore male fertility.[121]

7.3 Gene drive

The idea of driving a gene through a population of animals was first raised in 2003.[122] Bill Gates is advocating the use of gene drive to eliminate malaria by driving the inability to spread malaria through mosquito populations.

Baby rats, like the young of most animals, inherit half of their chromosomes from the father and half from the mother. If one parent has a gene for a specific characteristic and the other does not, every baby rat has a 50% chance that it will inherit that gene.

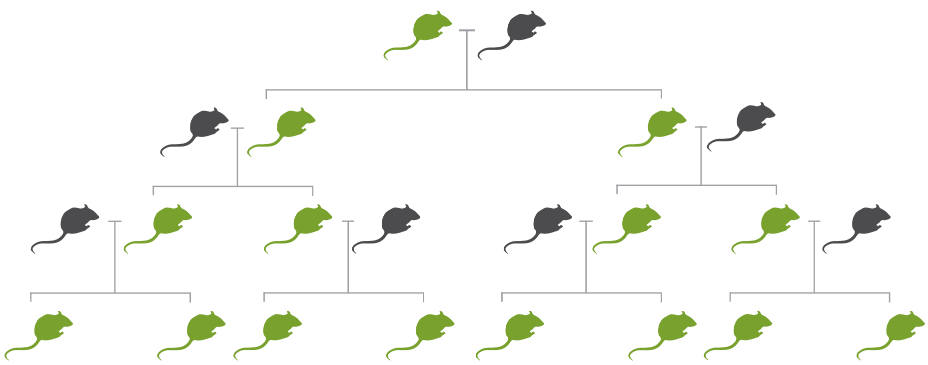
Gene drive technology can override this inheritance pattern, ensuring a desirable characteristic is inherited by virtually all the offspring. Moreover, the gene drive is inherited too, and so it continues for generation after generation.

A gene drive that only produces male offspring, for example, could be engineered into a rat using the CRISPR/Cas9 technique.[123] Thus, gene drive technology holds the potential for completely eradicating rats and other predators.

Gene drive is a technology with great potential. But it is also a high -risk technology because once released, it can spread by itself. Clearly, if gene drive is used to suppress or eradicate predators in New Zealand, safeguards will be all-important.[124]

One safeguard recommended by a group of leading researchers is:

"… all laboratories seeking to build standard gene drives capable of spreading through wild populations simultaneously create reversal drives able to restore the original phenotype."[125]



Source: adapted from Figure 1A in Esvelt, et al., 2014.

Figure 7.1 Gene drive overrides the normal inheritance pattern. The black rats are from the wild population. The top green rat has had gene drive inserted into it. Every descendant of that rat will inherit the gene drive.

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8

Habitat – somewhere to live and thrive

As well as safety from predators, birds need habitat – somewhere they can live and thrive.

Historically, vast tracts of forests, wetlands, and native grasslands were cleared for cities, towns, and farms. Large-scale clearance is now mostly a thing of the past, although some birds are still losing important habitat.

There are four sections in this chapter.

The first section describes aspects of habitat that birds need to thrive. Some native birds are very particular about the nature of their habitat, while others are more adaptable.

The second section is about the animals that damage bird habitat – including possums, deer, goats, pigs, rabbits, and wasps.

The third section is about the exotic plants that damage bird habitat. Some invade and smother forest, and others spread across open country and infest open stony riverbeds.

The fourth section is about protecting and restoring bird habitat on land outside national parks and other reserves. Many native birds spend all or part of their lives on farmland, along rivers and around lakes, and along the coast.

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8.1 Aspects of habitat that birds need

Once birds are safe from predators, the supply of food is likely to curb increases in bird populations.

New Zealand birds eat a great variety of foods. Fantails and grey warblers eat flying insects, while kiwi forage for grubs in the leaf litter on forest floors. Tūī, hihi, and korimako feed on the sweet nectar in flowers, and thus are important forest pollinators. Kererū follow fruiting trees over large areas.

Ducks – pārera and pāteke – eat aquatic insects and snails. Albatrosses and blue penguins eat squid, and shearwaters eat krill. Some vary their diets as they move between habitats throughout the year. Oystercatchers feed on worms and grubs in fields in summer and on shellfish in winter. Wrybills forage for insects under stones in rivers in summer, but in winter feed on small shrimps and crabs on mudflats.

Native birds also need suitable places to nest and raise their young.

Some are particular as to where they build their nests. Mohua and kākāriki are two of the species that nest in holes in trees. Unlike woodpeckers that carve out their own nesting holes, these birds nest in natural holes in old trees, so will not breed in young forest.

The nests of birds that lay their eggs on the ground are particularly vulnerable, not just to predators, but also to disturbance by flooding, vehicles, farm animals, and dogs. Kakī and wrybills lay their eggs among stones on riverbeds, and dotterels and fairy terns lay their eggs on sand.

The amount and types of habitat needed by birds varies from species to species. Some will fly between isolated remnants of habitat. But some forest birds, including rifleman and saddleback, are unable or unwilling to cross even quite short stretches of open land or water. Thus, they can become trapped in patches of bush, unable to leave to find more food, or to breed outside their own little group.[126] Habitat fragmentation can thus prevent some birds from becoming widespread across the mainland.

Some birds are highly adapted to particular habitats. The whio (blue duck) lives only in fast-flowing forest rivers and streams with sequences of pools and rapids.

Other birds are not fussy and can happily exist in different habitats if they are safe from predators. Kiwi and kārearea (New Zealand falcon) are thriving in some radiata pine forests.

Source: Department of Conservation

Figure 8.1 Birds need plants, but many plants need birds too. Tūī and korimako play a crucial role in the survival and spread of the spectacular native mistletoe. Without these honey-eating birds the pollen is trapped inside the mistletoe flowers. The birds tweak the tip of the flowers to get at the nectar, and in so doing flick the pollen on to their heads and transfer it to other flowers

8.2 Animals that degrade bird habitat

The impacts of introduced animals on native birds go well beyond direct predation – they affect the environment the birds rely on in various ways.

Possums are the most well-known destroyers of the bush. They eat the shoots, flowers, fruit, and seeds of many plants, including tawa, rātā, pūriri, tōtara, and kāmahi – the food that birds such as kererū rely on. Unchecked, possums can eat out the crowns of mature trees, potentially leading to collapse of the forest canopy.

Rats and ***mice*** also compete with birds for food. They eat worms and insects that birds feed on. Ship rats are skilled climbers; they scamper up trees to eat fruit and seeds. Rodents will also eat seedlings, stopping new plants from establishing.

Wasps are at some of the highest densities in the world in South Island beech forest. They eat huge amounts of honeydew, as well as many insects and spiders – food for birds and other native animals.[127,128]

Some animals do not compete directly with birds for food, but modify habitat by selectively browsing on favoured plants, thus causing changes in the composition of the vegetation.

Deer browse the forest floor, grazing on the fallen leaves of broadleaf trees. They also eat seedlings, leading to noticeable gaps in the age structure of the forest, and undermining regeneration. Around half of their diet is made up of broadleaf, lancewood, pōkākā, kāmahi, māhoe, and marbleleaf. In summer they graze on ferns in the bush, and on tussock and other alpine plants like mountain daisy at higher altitudes.[129]

Goats eat an even wider range of plants than deer, and their reach is more extensive because they can climb trees. Like deer, they undermine the regeneration of the forest.

Pigs root up and eat understory plants like nīkau, supplejack, and bracken, and like to wallow in mud-holes and wear their continuously growing tusks down on tree trunks.[130] They will also kill and eat birds nesting in burrows. The loss of eight colonies of Hutton's shearwater in the Kaikōura Ranges has been attributed to feral pigs, and only two colonies of this endemic seabird remain.[131]

Rabbits and ***hares*** eat many native and exotic plants, and, if not controlled, can easily sabotage new plantings. In shrublands, plants eaten by rabbits include five-finger, cabbage tree, Hector's tree daisy, clematis, and pōhutukawa. On sand dunes, rabbits will eat spinifex.[132] Hares will kill plants without eating them, by biting the tops off young trees to mark territory.

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Source: James Reardon/Department of Conservation

Figure 8.2 A wasp feeding on honeydew in a beech forest

Source: Department of Conservation

Figure 8.3 A white goat and a black goat (asleep with a bellyful of foliage) high in a tree in Whareorino Forest in the King Country. In 2012, Department of Conservation hunters shot 3,420 goats in this area.

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8.3 Plants that invade bird habitat

Like introduced animals, some introduced plants can have a big impact on bird habitat.

Some vines can climb high into trees and smother them. They do not generally penetrate deeply into forest, but where forest is more open, such as in the limestone country around Tākaka, they can be very damaging. These invaders include the clematis known as old man's beard, banana passionfruit, Japanese honeysuckle, and moth plant. Climbing asparagus does not actually climb high up trees, but it can creep along the forest floor smothering seedlings and other small plants.

Another potential invader of forests is Douglas fir – the only wilding pine species that can sometimes establish in the low light of native bush.

Along the coast, marram grass has been widely used to stabilise sand dunes, but aggressively outcompetes the native spinifex and pīngao. Marram grass builds steeper and more hummocky dunes than the native sand binders, and this reduces the available nesting habitat of native birds.[133]

In terms of the impact on birds, the most destructive plant invaders are almost certainly the lupins, broom, willow, poplar, and gorse that have become established on the braided riverbeds and adjoining drylands of the eastern South Island. Six species of endemic birds lay their eggs on stony ground and gravel – wrybill, black stilt, black-billed gull, black-fronted tern, banded dotterel, and the pied oystercatcher. The range of these birds has shrunk significantly over the last few decades, and all bar one are in serious trouble.[134,135]

The weeds that have invaded the braided riverbeds crowd out nesting sites and provide perfect cover for feral cats and other predators to creep up on nests. These weeds can also stabilise river islands and force water into fewer and deeper channels, reducing the shallow riffles where wading birds feed.[136]

Responsibility for keeping these open riverbeds free of weeds is often unclear. Some riverbeds are privately owned, but many are owned by the Crown, and 'administered' by Land Information New Zealand (LINZ). LINZ is responsible for controlling weeds and pest animals, but only spends about a million dollars each year for doing this on the land it administers.[137]

However, it is not just invasive plants that have made it increasingly difficult for these birds to find safe places to lay their eggs and raise their young. One major factor is the construction of stopbanks and hydro dams that have changed the natural flow and movement of these rivers. In the past, plants growing in riverbeds were frequently washed away by uncontrolled sporadic floods. More recently, the conversion of undeveloped river margins to more intensive agriculture in the eastern South Island has reduced the diversity and quality of the habitat of some birds.

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Source: Nicholas Head

Figure 8.4 Lupins in a South Island braided river. Although they look beautiful for a month or so, they make it more difficult for the inland wading birds to find somewhere to nest, and provide perfect cover for feral cats, ferrets, and other predators.

Source: Alicia Warren, Department of Conservation

Figure 8.5 A black-fronted tern chick run over by a four-wheel drive vehicle – another kind of invader of habitat. As these vehicles have dropped in price and grown in number, more and more are driven along riverbeds and beaches. They can frighten birds into abandoning their nests, and run over chicks and eggs.

8.4 Protecting and restoring habitat on private land

If native birds are to become abundant on the mainland, protecting and restoring habitat on private land is vital for a number of reasons, including the following.

First, most of the conservation estate is forested and alpine, and some bird habitats are under-represented – lowland forest, wetlands, and coastal ecosystems, for instance. Indeed, relatively little of the conservation estate is in the North Island compared to the South Island.

Second, many public reserves are small and fragmented, and birds within them can become 'trapped' in patches of habitat.

Third, peninsulas are expected to play a valuable role in making the country 'predator-free', because they are largely bordered by sea, thus reducing the rate of reinvasion by predators.[138] Land on peninsulas is mostly in private hands.

The challenge of protecting New Zealand's natural heritage is too great for the state alone.

Across the country, habitat restoration and predator control is being undertaken by a great range of enthusiastic and dedicated individuals and groups, many working on private land. Moreover, many areas of Māori land are relatively undeveloped, and many iwi, hapū and whānau have launched their own initiatives to maintain and enhance habitat, and protect ngā tamariki o Tāne-mahuta.

Bird corridors along streams

Fencing off streams and planting vegetation along the banks – riparian planting – is being increasingly done across farms in New Zealand to improve water quality. Regional councils, the dairy industry, and many individual farmers and community groups are actively involved in planting alongside waterways.

As well as improving water quality, such riparian planting can create corridors for birds and other native wildlife, linking up fragmented patches of habitat. In Taranaki, for instance, planting along creek banks on the ring plain is creating corridors of vegetation that radiate out through farmland from the mountain to the sea. Since 1996, corridors with a total length of about 7,500 kilometres have been established.[139]

But if birds are to live within and move along these corridors, they must be safe. To some extent, wildlife corridors will also become highways for predators – possums, rats, and stoats will generally be reluctant to cross open country.

Control of possums within riparian planting is strongly advised – to help plants become established and to prevent the spread of bovine tuberculosis. Other animals – including rabbits, hares, and in some places, pūkeko – also need controlling to help plants become established. But if riparian plantings are to function effectively as bird corridors, rats, stoats, and feral cats must be controlled as well.

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Source:Fairfax NZ

Figure 8.6 The black-billed gull (tarāpuka) is considered the most endangered gull in the world because its numbers are plummeting rapidly. These birds normally breed near dry stony riverbeds, but in the spring of 2016, a breeding colony of 500 birds set up home on a dairy farm in Canterbury. The farmer has protected them with an electric fence.

Source: Patti Vanderburg

Figure 8.7 Volunteers from the River-Estuary Care group are working to restore the Waikouaiti-Karitāne estuary just north of Dunedin. The estuary supports a wide range of aquatic and bird life, including tarāpuka (black-billed gulls), tūturiwhatu (banded dotterels), kōtuku kutupapa (spoonbills) and tōrea (oystercatchers).

Covenants and kawenata

One way to protect native ecosystems and species habitat on private land is to use a covenant – a legal agreement. The Queen Elizabeth II (QEII) National Trust has now established more than 4,000 covenants with landowners. These covenants are put on land titles and bind all future owners of that land in perpetuity.[140]

Interest in establishing covenants exceeds the resources of the Trust, so various criteria are used to prioritise.[141] One area of land might be a high priority because it provides a corridor linking other protected areas. Another might be a high priority because it is home to a rare bird species.

In the Bay of Plenty, 14 linked QEII covenants have created the Manawahē Ecological Corridor. Near Kaikōura, one of the only two remaining colonies of Hutton's shearwater is protected by a QEII covenant.

While a fence will keep cattle and sheep out of a covenanted area, it will not keep out the animals that prey on birds and other native fauna and damage habitat. Nor will a fence keep out invasive plants. The land is protected in perpetuity, but the ecosystem is under constant threat from invaders. While many landowners with covenanted land do work to protect the native life within the fence, the task is beyond others.[142]

The QEII Trust thus faces a difficult trade-off – using funding to better protect the life within existing covenanted areas versus establishing new covenants. Recently, the Trust has launched a fund to assist landowners to 'enhance' their covenants.[143]

Another form of covenant is available for kaitiaki of Māori land.

Ngā Whenua Rāhui was established in 1991 in response to concerns that the cost of protecting indigenous forest (rates, fencing, and pest control) was increasing pressure to sell or develop land.

Kawenata (covenants) can be set up to protect land of ecological and cultural significance, and are reviewed every 25 years, in order that future generations can make their own decisions about resources. However, unlike the QEII National Trust, the Ngā Whenua Rāhui Fund is also used to support the landowners in various ways, including assistance with planting and predator control.

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Source: QEII Trust

Figure 8.8 A kārearea sits on a fence post near Lake Tekapo. A QEII covenant protects over 1,000 hectares of montane tarn wetland and dryland on Glenmore Station.

Source: Rob Suisted / Ngā Whenua Rāhui, with thanks to Tahamata Incorporation and Ransfield Incorporation

Figure 8.9 Dr Huhana Smith, Richard Anderson, and Rangimarkus Heke above the regenerating Te Hākari dune wetland on the Horowhenua coast. This wetland is under a Ngā Whenua Rāhui kawenata.

What should be planted where?

During this investigation, communities and others working to control predators and restore habitat on private land have expressed some frustration with policies and rules that seem unnecessarily restrictive. When it comes to habitat, two related concepts – *natural range* and *ecosourcing* – have become entrenched in conservation circles in New Zealand.

One of the goals in New Zealand's Biodiversity Strategy states that populations of all indigenous species should be maintained and restored *"across their natural range."*[144]

But Nature does not stand still – the dynamic forces of evolution are always present, and the ranges of species change over time.[145] And climate change will begin to affect the ranges of both plants and animals.

There seems to be only one good reason for confining species to their natural range.

> *"Unless range changes, unaided or anthropogenic, seem likely to do permanent and substantial harm to the biodiversity of New Zealand, they should be ignored. In effect, this is already the implicit policy with regard to exotic biota, and there is no reason why it should not apply to native biota."*[146]

Indeed, it may be very sensible to deliberately expand the range of some species. For instance, kauri dieback disease is threatening the continued existence of these magnificent trees in Northland and Coromandel. A cure cannot be guaranteed, and there is a strong case for planting kauri far south of its natural range.

Ecosourcing is a stronger version of keeping plants within their natural ranges. It is the practice of collecting seeds from plants in a local area, growing seedlings, and planting the seedlings back in the same local area.

The argument given for ecosourcing is that plants are highly adapted to local conditions, and that 'local is best' for a variety of reasons, such as climate gradients. [147]

On the other hand: *"Is there a reasonable case for supporting increased genetic mixing between plant populations to restore greater population resilience?"*[148] And Nature does its own mixing as seeds and pollen are dispersed by birds, insects, and wind.

Understanding of genetic science is growing rapidly, and it is important that this concept of ecosourcing be re-examined. It is not an inviolable principle, yet appears to have achieved such a status in New Zealand. Auckland Council, for example, has a guideline that divides the region into 12 ecological districts, and *"requires ecosourced plants be used as part of resource consent conditions"*.[149]

Policies and rules that are unnecessarily restrictive carry an opportunity cost. Ensuring seeds are ecosourced may make them more expensive and take energy and attention away from bigger issues like predators or invasive exotic weeds.

The issue of adaptation and genetic diversity as applied to birds is discussed in some depth in the next chapter.

Source: Alex Mitchell

Figure 8.10 A wattle bird in a wattle tree. A small population of kōkako live on the island of Tiritiri Matangi in the Hauraki Gulf. In the past there were two species of kōkako – North Island kōkako with blue wattles and South Island kōkako with orange wattles. The latter is almost certainly extinct, though some people have not lost hope. On Tiritiri Matangi, the kōkako rely on the seeds of Australian wattle trees for food in winter.

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9 Bird genetics – resilience and restoration

This chapter is about the application of genetic science to the management of native birds in two situations.

The first situation is when an isolated population of birds has become inbred, or is in danger of becoming inbred. For instance, genetic analysis has shown that most of the little spotted kiwi on Long Island in the Marlborough Sounds are brothers and sisters.[150] Moving a few birds between different isolated populations to counter the risk of inbreeding is known as genetic rescue.

The second situation is concerned with the restoration of native birdlife in different parts of the country. Again, this requires moving birds from one area to another. But should this be done if genetic analysis shows distinct regional differences have developed? For instance, North Island brown kiwi are currently managed as four separate populations that are not to be mixed, despite all being a single species.

There are six sections in this chapter.

The first section describes the four forces of evolution. The fourth force is migration – individuals moving into a population and widening its gene pool. Migration has been greatly reduced in New Zealand birds as populations have become smaller and more isolated.

The second section is about the possibility of restoring the evolutionary force of migration. This has not been a priority in the conservation of native birds in New Zealand.

The third section covers inbreeding and genetic rescue. Black robin, little spotted kiwi, and kākāpō are used to illustrate the issues.

The fourth section is about the translocation of birds to restore populations on the mainland. It includes two case studies – one concerned with North Island brown kiwi and one concerned with kākā.

The fifth section highlights the need for clear principles and policies to guide when and how translocations are done.

The sixth section is about different approaches to risk and the use of the precautionary principle.

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9.1 The four forces of evolution

Nature is constantly changing. Over millions of years, species of plants and animals appear and disappear. Over shorter time scales, the gene pools of species change. An understanding of the evolutionary forces that change genetic makeup is essential for managing the genetic diversity of New Zealand's native birds.

There are four evolutionary forces that change gene pools – mutation, natural selection, genetic drift, and migration.[151]

Mutation

Mutation occurs when a gene changes from one form to another. These mutations occur randomly, but can become permanent and passed on to offspring.

Mutation is the origin of all new genetic variation. If the changed form (allele) of the gene gives the plant or animal a characteristic that is beneficial, it can become locked in by the second force of evolution – natural selection.

Natural selection

Natural selection is the evolutionary force with which we are most familiar because of the scientific revolution that followed the publication of Darwin's *On the Origin of Species.*

If an individual has a characteristic that enables it to survive and breed more successfully than others, it will have more offspring, and some of them will inherit that beneficial characteristic.

At some distant point in time, a mutation in an ancestor of the wrybill led to a curve in the bill of some of its offspring – a curve that enabled them to reach food more easily. Through natural selection, all wrybills today have curved bills.

Natural selection only occurs when there is a gain to be made.

Genetic drift

Genetic drift is a process that erodes genetic diversity. Purely by chance, some forms of genes are passed on to subsequent generations more than others, and some are lost entirely.

This random genetic drift occurs in all populations all of the time, but is particularly significant in small isolated populations in which its effects are magnified by inbreeding.

Charles Darwin, who married his first cousin, became concerned about the risk of inbreeding in the aristocracy due to their propensity to marry within their class.[152] The relatively high incidence of haemophilia in the royal families of Europe in the 19th century was due to genetic drift and inbreeding – it was not an adaptation to living in palaces.

Many New Zealand birds are in small populations on offshore islands or in isolated pockets of habitat on the mainland, and have lost significant amounts of genetic variation as a consequence of genetic drift.

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Migration

Migration is a process that increases genetic diversity. In this context, it refers to individuals moving into a population and thus widening its gene pool. The evolutionary process of migration is often called gene flow, because genes 'flow' from one population to another.

In the plant world, wind-blown pollen is one kind of migration. In the bird world, birds fly (or walk) from one population to another and set up house with mates that are a little different genetically.

Over the last two centuries, the fourth evolutionary force – migration or gene flow – has been significantly reduced in New Zealand native birds.

Source: Tony Whitehead

Figure 9.1. The wrybill is an endemic wading bird that shows a clear adaptation to its environment. It is the only bird in the world with a bill that curves laterally, always to the right, which it uses to prise out insect larvae under rounded riverbed stones.

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There are two reasons why migration – the fourth evolutionary force – has been greatly reduced in New Zealand birds.

The first is the division of some bird populations on the mainland into isolated smaller populations. As farms, towns, and cities have spread across the landscape, habitat for birds has not only shrunk but become fragmented. Some bird populations are remnants of mainland populations clinging on in a few refuges.

The second reason is the creation of sanctuaries on islands. A great success of New Zealand conservation has been the eradication of predators from offshore islands, enabling them to be used as sanctuaries for birds. Kapiti Island, for example, is home to more than 20 species of native birds.

The existence of small isolated populations of birds raises the spectre of inbreeding. Inbred birds may struggle to produce fertile viable offspring. A population with low genetic diversity is also likely to be less able to cope with challenges like the arrival of a new parasite or a warming climate.[153]

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9.2 To mix or not to mix?

As outlined in Chapter 4, the development of genetic science has enabled the discovery of ever-finer distinctions between different populations of the same bird species – hence, taxonomic inflation. Such distinctions are the result of two forces of evolution – natural selection and genetic drift.[154] The assumption that natural selection is the more important has been a widely held view in New Zealand – a view that has had a significant influence on conservation management.

Certainly an isolated population of birds is likely to adapt to some extent to its local environment through natural selection. But genetic drift is inexorable – it happens all the time. Moreover, drift towards genetic homogeneity occurs most rapidly in small isolated populations, especially where there are few offspring in each generation.[155]

An isolated population of birds may be inbred yet still grow in numbers. But the longer it is left isolated, the more inbred it will become, and the less valuable it may be for repopulating the mainland.

Despite this, the general approach in New Zealand has been to keep populations separate.

> *"As far as we are aware, … only in New Zealand is there a widely held view that threatened bird species are less susceptible to the effects of inbreeding depression than species elsewhere".*[156]

The reluctance to mix birds from different populations can have two consequences on conservation management in New Zealand.

The first consequence is that birds have not been transferred from one population to another to reduce the risk of inbreeding until the need for genetic rescue is indisputable. While it is expensive to translocate birds, leaving them in small isolated populations drifting to oblivion will be costly too.

The second consequence is the setting of (potentially unnecessary) restrictions on the translocation of birds for restoring populations. Clearly, restrictions of various kinds are needed. For instance, moving a diseased bird into a healthy population would clearly be a bad thing to do. But the restrictions on mixing birds of different provenances should be thoroughly examined.[157]

The next two sections illustrate these two issues using some short case studies.

9.3 Inbreeding and genetic rescue

Three bird species that are suffering from inbreeding are black robin, little spotted kiwi, and kākāpō.

Black robin

The black robin is found only on the Chatham Islands. This species was saved from imminent extinction in the 1980s by the remarkable longevity and fecundity of the sole productive female, known as 'Old Blue'.

The population of five surviving black robins has now grown to more than 250 on two islands – Māngere and Rangatira. Since all surviving birds are descended from 'Old Blue', they are very inbred. Signs of genetic deterioration in black robins are deformed beaks, poor plumage, and reduced breeding success.[158]

Although black robins overall are inbred, keeping them separated on two islands is likely to make the situation worse.[159] Introducing gene flow between the two populations is essential for maintaining the genetic variation that remains in the species. This would only involve moving a few birds from each island to the other every few years.

Little spotted kiwi

The little spotted kiwi is one of five species of kiwi and was once widespread. A handful of birds a century ago has grown to about 2,000, spread across 11 separate populations.[160]

Despite the increase in numbers, at least one population is showing signs of inbreeding depression. Most of the 50 little spotted kiwi on Long Island are siblings, the direct offspring of the single founding pair. The inbreeding appears to be causing malformed embryos, reduced hatching success, and lower survival rates. The authors of a study of the Long Island population concluded that a translocation of birds from other locations could help with the genetic rescue of the population.[161]

The Department of Conservation has now recognised the need to move little spotted kiwi around to maximise the remaining genetic diversity, and has recently drawn up a translocation proposal for the species.[162]

Kākāpō

Kākāpō were once widespread across New Zealand. Confirmation that these birds still existed in Fiordland in 1958 and on Stewart Island in 1977 caused great excitement, but the population continued to decline. About 35 years ago, the remaining 63 birds were transferred to island sanctuaries, and the population has grown to 154.[163]

All but one of the 63 founders were from Stewart Island. A single male – named Richard Henry after New Zealand's first park ranger – came from Fiordland. As a result, genetic diversity in the species is low and the effects of inbreeding are apparent. Many eggs are infertile, and only a third hatch successfully. The breeding success of the most genetically homogeneous females is particularly low.[164]

The birds with Fiordland genes – the descendants of Richard Henry – appear to be essential for any genetic rescue of the species. Some of the Fiordland genes affect immunity.[165]

Research is underway to sequence the genomes of the kākāpō. It is hoped that this information can be used to maximise the remaining genetic diversity in the population. This could include collecting sperm from selected males and artificially inseminating the 'optimal' females.[166]

Beyond this, the only way to increase the genetic diversity of the kākāpō would be to genetically engineer the birds themselves. This possible way of saving endangered species has been dubbed 'facilitated adaptation' and is being discussed in the scientific literature – though not specifically for kākāpō.[167]

Drifting toward homogeneity

Once an isolated population of birds has drifted towards genetic homogeneity, it may lack resilience in the long term. Genetic variation can be lost in a few decades, but it takes thousands of years for mutations to build it up again. The black robin, the little spotted kiwi, and the kākāpō are three species that have little genetic variation, and sit precariously on the brink of extinction.

There are others in the same situation or close to it. And it is not just isolated populations on offshore islands that are becoming more genetically homogeneous. For instance, there is no migration between the various populations of pāteke (brown teal) on the mainland, and there is limited genetic variation within every population bar a single population in Northland.[168]

Translocations between small populations of birds for maintaining genetic diversity have been done in New Zealand.[169] But there is currently no consensus or guidance on when this should be done.[170]

The cases of the black robin, little spotted kiwi, and the kākāpō show the importance of preserving genetic diversity. It is vital that the maintenance of genetic diversity be an integral part of managing populations of native birds long before the effects of inbreeding become evident.

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Source: Department of Conservation

Figure 9.2 The black robin population today stands at around 300 individuals, having previously declined to just five – and only one breeding female, known as 'Old Blue' (pictured).

Source: Andrew Digby/Department of Conservation

Figure 9.3 Sinbad the kākāpō is one of the few birds with the precious Fiordland genes.

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9.4 Moving birds to restore populations on the mainland

During this investigation, it has become evident that there is strong disagreement about the translocation of birds to restore populations on the mainland. Two examples of this are outlined in this section – one concerned with North Island brown kiwi and the other concerned with kākā.

North Island brown kiwi

North Island brown kiwi are the most numerous of the five kiwi species. They are managed by the Department of Conservation as four separate populations – Northland, Coromandel, Eastern, and Taranaki.[171] These populations do not differ enough to be considered species (or even subspecies) in their own right.

But how different are these birds? Do their genetic differences reflect major adaptations to local conditions, or is it just genetic drift? Would birds from one region thrive in another? Would some migration between populations be harmful or beneficial?

'Kiwis for kiwi' is a charity with the vision of taking *"kiwi from endangered to everywhere"*. It plans to establish a large genetically diverse population of over 800 North Island brown kiwi in the largest fenced sanctuary in the country – Sanctuary Mountain Maungatautari in Waikato. The aim is to use these kiwi as a source for other restoration projects in the region. In order to do this, they need to get kiwi from elsewhere.

One potential source is Pōnui Island. This island in the Hauraki Gulf has a large population of kiwi. The number of kiwi exceed the carrying capacity of the island, and few of the chicks survive to set up territories of their own. Adding some of these birds to the existing population of kiwi at Maungatautari would be far cheaper than obtaining birds from the wild on the mainland.

However, Kiwis for kiwi has not been granted permission to move any kiwi from Pōnui to Maungatautari because they are considered to have *"no genetic value whatsoever for use in restoration"*.[172] Currently, Kiwis for kiwi is investigating the option of taking eggs from wild kiwi in the Taranaki population and incubating them.[173,174]

Kākā in Abel Tasman National Park

Project Janszoon is a trust working with the Department of Conservation and others to restore the ecology of the Abel Tasman National Park over a 30-year time frame.

Kākā were once widespread across the country. When protected from predators and with adequate food, small populations can multiply rapidly.

These large, gregarious parrots are now very rare in Abel Tasman National Park. Project Janszoon is planning to restore thriving populations of kākā back into the park, through a combination of predator control and translocations of birds from elsewhere.

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Currently, kākā are divided into two subspecies – North Island kākā and South Island kākā. An analysis in 2006 found little genetic difference between birds in different parts of the country.[175] This prompted Project Janszoon to propose translocating some birds from the thriving population at Zealandia in Wellington in 2013.

This proposal was vigorously debated. On the one hand, Zealandia would be a relatively cheap source of kākā. On the other hand, the Zealandia kākā are likely to be genetically similar because there were only 14 birds in the founding population.[176]

In June 2015, the Department of Conservation issued a permit to the trust for translocating kākā. But only birds that originated from the northern South Island could be moved under this permit. This would entail catching kākā in the wild in the Nelson Lakes area – an expensive and risky enterprise.

A second genetic analysis in 2015 also found no basis for distinguishing between North Island kākā and South Island kākā.[177]

In 2016, a revised permit was issued that does allow for birds to be translocated from outside the northern South Island from 2019 onwards. However, this can only be done if attempts to establish a population using birds from the wild are unsuccessful.[178]

Source: Zealandia

Figure 9.4. A kākā taking flight at Zealandia in Wellington. The number of kākā in and around the sanctuary has grown from an original population of 14 birds to about 800 individuals today.

9.5 An urgent need for translocation policy based on clear principles

Translocations of birds are expensive and risky, and should not be done without good reason.

The maintenance of genetic diversity by moving birds from one small population to another is one very sound reason. But there are some important questions to consider when translocations are proposed for other reasons.

Translocations can be done to re-establish bird populations. The kiwi case study was concerned with a proposal to move kiwi from an offshore island into a sanctuary on the mainland. The kākā case study was concerned with a proposal to move kākā from a sanctuary on the mainland to a national park.

Questions to consider in such situations include:

- Will there be adequate genetic diversity in the re-established population?
- What is the cost of translocating birds from sanctuaries compared with the cost of trapping birds in the wild and then moving them?

Translocations of birds are often sought by community groups. The arrival of new birds and the accompanying ceremony are understandably very motivating for people who have spent many hours suppressing predators and restoring habitat. For Māori, in particular, seeing birds that were once lost come back brings hope and pride.

But again, there are important questions that should be asked. Would the money spent on a translocation achieve much more if it was spent on suppressing predators and restoring habitat over a wider area?

The Department of Conservation does not have a *policy* on the translocation of birds – the *why* and *when* it should be done. (It does have a set of *procedures* governing the process from application through to reporting – the *how* birds should be translocated.)

A translocation policy must be based on a clearly articulated set of principles.[179] Without clear guidance, this difficult area will continue to be vigorously debated, leading to slow and inconsistent decision-making.

A book titled *Genetic Management of Fragmented Animal and Plant Populations* by Richard Frankham and seven co-authors is to be launched by Oxford University Press at the International Congress for Conservation Biology in July 2017. A shorter, simpler practical guide will follow, and should provide a sound basis for rethinking the genetic management of New Zealand's flora and fauna.[180]

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9.6 Being precautionary? Different attitudes to risk

In discussions on contested environmental issues such as the translocation of birds, it is not unusual to hear appeals to the precautionary principle. Such appeals can close down discussions. This is because the principle is sometimes viewed as inviolable, despite there being no consensus on its meaning.

In 1992, the Rio Declaration defined the precautionary approach to protecting the environment as:

> *"Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."*[181]

In other words, when it comes to the environment, full scientific certainty will always be elusive, and we cannot prevent environmental degradation without taking action.

However, the current Kiwi Recovery Plan states that:

> *"Where possible, a precautionary principle will be applied to management of the genetic structure of these taxa until the importance of their genetic diversity is fully understood."*[182]

Here the precautionary principle is taken to mean do not act without full scientific certainty – the opposite of the Rio Declaration.

In his landmark 2011 book *Thinking, Fast and Slow,* Daniel Kahneman links the precautionary principle to the human tendency of loss aversion. This tendency is sometimes expressed as 'losses loom larger than gains' or 'better safe than sorry'. Strong aversion to loss may in part explain the reluctance to move kiwi from Pōnui Island and kākā from Zealandia.

Over recent years, the private sector has become increasingly involved in conservation in New Zealand. During this investigation, it has become clear that there are tensions between private and public sector players.

It is likely that one source of this tension is different attitudes to risk – different degrees of loss aversion. Those who work in the public sector are generally averse to taking risks – taking an action that has a bad outcome and ends up on the front page of the newspaper is to be avoided. In contrast, private sector players have a much greater appetite for risk.

Whatever the reasons for the tensions between public and private sector players are, they need to be identified and worked through. The deep knowledge and experience of the public sector and the entrepreneurship of the private sector are both needed in the great enterprise of conserving New Zealand's natural heritage.

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10 Conclusions and recommendations

With virtually no native mammals, New Zealand was once a land dominated by birds. Some, including the towering moa and the much-prized huia, have gone forever. Of the 168 species that remain, 80% are in trouble, and some are close to extinction.

It is possible to turn this around, but it will take clear thinking and planning, significant investment, the efforts of many New Zealanders, and a great deal of ingenuity and innovation.

Safety from predators is the first requirement. For native birds to flourish on the mainland, they need, first and foremost, to be protected from the introduced animals that kill them.

Somewhere to live and thrive – habitat – is the second requirement. Some birds are very particular about what they eat and where they nest, while others are more flexible.

A degree of genetic diversity is the third requirement. Birds living in small isolated groups can become so alike that their long-term survival is in doubt.

Much good work is already being done. Government initiatives include the Battle for Our Birds and the ambitious goal of becoming predator-free by 2050. The Department of Conservation continues to be of central importance. Private initiatives and the endeavours of hundreds of community groups are testament to the wider commitment of the New Zealand public.

Over recent decades, New Zealand has had some great successes in conservation. However, it is now time to rethink why and how we seek to preserve our natural heritage.

Great effort has been put into saving individual species – without this, the kākāpō and the black robin would have joined the moa and the huia. But trying to bring birds back from the brink of extinction is very expensive and difficult, if not impossible. We need to put much more effort into stopping birds getting into this state.

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Clearing islands of predators so they can be used as refuges for threatened species has been invaluable for stopping some species from disappearing forever. However, some of these islands are at their carrying capacity – on some, birds are dying for lack of food and space.

Moreover, small populations of birds, whether they be on offshore islands, in mainland sanctuaries, or in remnants of habitat, will drift toward genetic homogeneity, increasing their vulnerability. We must focus on clearing predators from large areas of habitat that can support bigger populations of birds.

Our natural heritage is not confined to the conservation estate. Nor can the Department of Conservation be solely responsible for its preservation. Some of our birds find their natural habitat on farms, and some will happily live in cities.

It is also important to think clearly about what is possible or even desirable to achieve. The clock cannot be rolled back to a time when these islands were pristine wilderness, brimming with birds, and completely without people.

The recommendations in this chapter are aimed at helping us 'rethink conservation'. There is much more to protecting our natural heritage than saving birds, but if we can restore our bird populations, our ecosystems as a whole will benefit.

There are seven sections in this chapter, each leading to one or more recommendations from the Commissioner.

The first three sections are concerned with the most important and urgent need of New Zealand's native birds – safety from predators. The recommendations address the following issues.

- The development of a plan for Predator Free 2050, beginning with the identification of a portfolio of priority areas for predator control.
- Research into predator control that should be strongly supported.
- The development of a programme for engagement with the public on the use of genetic techniques to control predators.

The fourth section is concerned with the restoration of habitat – somewhere for birds and other native creatures to live and thrive. Some aspects for consideration when developing policy are recommended.

The fifth section is concerned with the effective management of genetic diversity in birds and other fauna. A measure of genetic diversity in bird populations is importance for resilience.

The sixth section addresses the need for more funding for protecting and restoring our natural heritage. A biodiversity border levy on visitors to New Zealand is recommended, along with increased use of user pays for the provision of infrastructure and services on the conservation estate.

The seventh section is concerned with supporting and coordinating the hundreds of community groups that work to control predators and restore habitat. The number of these groups has grown rapidly as conserving our natural heritage has engaged the hearts and minds of many New Zealanders.

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10.1 Predators - Starting a plan for Predator Free 2050

The Government's announcement of the Predator Free 2050 goal has been rightly lauded as a big step forward. It is ambitious and inspiring, and has attracted attention around the world. While the business case prepared in support of the goal is an excellent starting point, it is not a plan of action – it provides little detail of how we are to get there from here. And this is what is now needed.

Trying to prepare a detailed plan stretching out to 2050 would be unwise. Rather, the plan should be a living document that can be frequently edited and updated.

The starting point should be geographic – developing a portfolio of areas in different parts of the country where it makes sense to focus efforts on clearing predators. What would be the criteria for choosing such areas?

First, clearing an area of predators is not an end in itself – it is a means to an end. That end is the restoration of abundant, resilient, and diverse birdlife, and lizards, frogs, bats, snails, and insects. So a primary criterion for choosing areas to focus efforts on is the potential for native wildlife to flourish in the absence of predators. This might mean focusing on areas rich in different wildlife species. And it might mean focusing on some areas where the deep endemic birds can still be found.

Second, while the presence of predators is the major threat to native wildlife, other things matter too. An area might be cleared of predators, but still be unable to support abundant birdlife because of the damage to the habitat by goats or wasps.

Third, the areas chosen should be in different regions of New Zealand, include different ecosystems, and not be restricted to the conservation estate.

Fourth, committing to clearing predators from large areas is important. Large safe areas can support more abundant wildlife. Large safe areas can also support larger populations of any species, thus maintaining greater genetic diversity. Also, reinvasion by predators from outside occurs more slowly in large areas than in small areas.

Fifth, there is merit in targeting peninsulas because the sea is a natural barrier that will slow reinvasion by predators.

Sixth, the potential for connecting different areas through wildlife corridors should be considered.

Finally, the support of local communities for restoring natural heritage – and for the methods used to kill predators – may be an important factor.

Another dimension of a plan for Predator Free 2050 would need to be coordination with other initiatives to restore natural heritage. There are many such initiatives underway, some involving large areas. A Crown entity – Predator Free 2050 Ltd – has been created, but it is not evident how this organisation will interact with the Department of Conservation and the great range of different players, all with different mandates and priorities.

Clarity will be needed on what needs to be done in targeted areas, and on who is responsible for what. Until predators are eradicated, if this proves possible, they will always reinvade cleared areas.

Maintenance of suppression is vital. Without commitment to ongoing control of predators, it may not be worth beginning to clear them from some areas.

Then there are questions of resources – Where does funding come from and how can it be optimally spent? Finally, there must be some way of assessing progress.

Thus, creating a portfolio of priority areas for predator control, though not trivial, is only a first step. These priority areas should be large.

Such a portfolio should be developed based on advice from a committee of the best scientific minds drawing on the criteria above. The committee would need to consult iwi, local authorities, and others, including those behind major initiatives such as Project Janszoon and Cape to City.

I recommend that the Minister for the Environment and the Minister of Conservation direct officials to establish an expert committee to advise on a portfolio of large priority areas for sustained and effective predator control that will allow birds and other native wildlife to thrive.

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10.2 High priority research for predator control

The vision of making New Zealand 'free' of predators by 2050 is, in large part, based on the possibility that developments in genetic science can make the wide-scale suppression, and even eradication, of predators a reality.

But 2050 is more than three decades away. Most of our birds are already in trouble, and the same is true for other native wildlife. We cannot wait for long-term breakthrough science before stepping up predator control. If we do, the patient will die before the hospital is built.

Fortunately, there is a wave of innovation underway in the development and use of trapping and poisoning, both within the private sector and in Crown research institutes. This must continue.

During this investigation, three key areas for research have been identified and these are the subject of the recommendations below. Some work is underway, but all three need to be supported as high priorities.

Predator return

For the foreseeable future, the use of aerial 1080 is critical for knocking down populations of possums, rats, and stoats cost-effectively over large areas. But after any predator control operation, predators always return – whether they are invaders from outside the control area or the progeny of survivors.

Research into ways of extending the knockdown period should be given a high priority. For instance, the knockdown period after a 1080 drop may be significantly extended by putting resetting traps and bait stations along 'rat highways' on fertile valley floors.

One source of reinvasion after an aerial operation is the buffer zones placed around tracks and waterbodies. Those setting such restrictions should understand that excessive buffer zones can substantially undermine the effectiveness of an aerial drop. Such restrictions should be based on a scientific assessment of actual risk, not perceived risk.

Rodents – rats and mice – rebound first, and stoats follow. Rebound occurs most quickly in warmer, more fertile podocarp forests than in colder, less diverse forests. Using 1080 optimally to prevent the devastation of a mast seeding is well understood. But more research is needed on minimising rodent bounceback in other forest types.

A related important area of research is the interaction between populations of rats and populations of mice. Mice are not one of the target predators in Predator Free 2050, yet mice will multiply in the absence of rats and provide food for stoats. In some ecosystems, mice are the only rodents. The effectiveness of 1080 in killing mice is variable, and research is needed to understand why.

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Keeping vulnerable birds safe

If native bird populations are to be restored on the mainland away from the safety of predator-free islands, they must be safe.

Some birds are much more vulnerable to predators than others. These include mohua, tīeke, and kōkako – all precious deep endemics. When particularly sensitive birds are being re-introduced to an area, the presence of only a few predators can wipe them out.

There is a critical need for research into *how low* levels of predators need to be, in order for different bird species to be safe. Associated with this is the need for more accurate ways of measuring predator densities when they are at low levels.

Feral cats

Like mice, feral cats are not targeted in Predator Free 2050. Yet these skilled killers almost certainly number in the millions in the countryside and along forest margins. They will be breeding particularly quickly where there is an unlimited supply of fresh rabbit.

Feral cats and mustelids are particularly susceptible to the poison PAPP, which kills them rapidly and humanely. PAPP is currently used in bait stations for stoats, and work is underway on developing a long-lasting lure to entice stoats to the bait. But there appear to be no plans in New Zealand for its widespread use on feral cats or for the development of a cat lure.

In Australia, feral cats are recognised as a great threat to their native species. Work is underway there measuring the effectiveness of different cat lures, such as the sounds of cats on heat and birds in distress. Australian research on feral cats should be followed closely because of the potential for its use in New Zealand.

I recommend that the Minister for the Environment, the Minister of Conservation, and the Minister of Science and Innovation direct officials to give a high priority to the following areas of research.

a) Slowing the return of predators after a control operation;

b) Optimising the use of 1080 in different forest systems;

c) Improving the effectiveness of 1080 for controlling mice;

d) Understanding the predator levels that are safe for different bird species, and developing techniques for measuring predators at low densities; and

e) Developing new baits and lures for the control of feral cats.

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10.3 Breakthrough methods for predator control using genetic science

The modern era of biology began over 60 years ago with the discovery of the double helix structure of DNA. Since then, the understanding and tools provided by genetic science have been applied to more and more areas, including conservation.

There are at least three areas of research into predator control underway in New Zealand that rely on genetic science – toxins that kill only one species of predator; the Trojan female technique, which produces infertile sons; and gene drive, which increases the prevalence of a particular trait in a predator population. As knowledge grows, more possibilities will arise.

The nature of research is that there are no guarantees of success in the laboratory, let alone practical application in the real world. One approach may be very effective, but would face many hurdles in becoming registered for use; another may be the opposite. It is important that all options be kept open, and that research money is not prematurely funnelled into one area.

Approaches that rely on some kind of genetic modification are likely to encounter strong opposition from some. But the use of genetic science does not necessarily involve modifying genomes. Nor does the use of genetic modification necessarily involve transferring genes from one species to another.

Some techniques, like the Trojan female and gene drive, once introduced, will spread through predator populations by themselves. This attribute will make such techniques very cost-effective, but is likely to create public concern.

Informed and early public discussion about different methods for using genetic science for predator control will be essential. Such discussion should not only cover the risks associated with such methods but also the promise they hold – the widespread control and potential eradication of the predators that are killing many millions of birds and other native wildlife every year. The Royal Society of New Zealand has set up a panel of experts on gene editing.

I recommend that the Minister for the Environment, the Minister of Conservation, and the Minister of Science and Innovation direct officials to begin developing a programme of staged engagement with the general public on the potential uses of genetic techniques to control predators.

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10.4 Habitat - somewhere for birds to live and thrive

The habitat for New Zealand's native birds is not just forest, and it is not all within national parks and other reserves. Restoring abundant, resilient, and diverse birdlife back on to the mainland will involve bringing birds back to farmland, coasts, riverbeds, and cities.

Covenants on private land

An increasingly common way of protecting a native ecosystem on private land is the use of a covenant. But while a fence will keep cattle and sheep out of a covenanted area, it will not keep out other introduced animals that prey on birds or damage habitat. (In the same way, putting land into the conservation estate does not guarantee its protection.)

There are a range of types of covenants set up by different organisations, including the kawenata set up by Ngā Whenua Rāhui. The QEII National Trust is the major player, and has now established thousands of covenants protecting areas of private land in perpetuity. With the demand for new covenants, it is difficult for the QEII Trust to assist landowners with controlling pests in covenanted areas. The same will apply to other organisations that establish covenants. But some of the areas under these covenants contain ecosystems that are underrepresented.

Bird corridors

Fencing off streams and planting vegetation along the banks is increasingly being done on farms across New Zealand to improve water quality. As well as reducing the flow of pollutants into water, riparian vegetation can link remnants of habitat, thus providing corridors for birds and other wildlife to extend their range. But as in covenanted areas, predator control will be needed to keep the birds safe.

A collaborative process is currently underway to develop a National Policy Statement on Indigenous Biodiversity. There is potential for this to cover the win-win for biodiversity and water quality that can be provided by riparian planting.

Invasive plants

In terms of the impact on birds, the most destructive plants invading bird habitat are almost certainly the lupins, broom, willow, poplar, and gorse that have become so dense on the braided riverbeds and adjoining drylands of the eastern South Island. These weeds are not the only factor causing the decline of the six endemic inland waders, but they are a major one – crowding out nesting sites and providing cover for feral cats and other predators to creep up on nesting birds.

Responsibility for keeping these open riverbeds free of weeds is often unclear. In most cases, the responsible party is Land Information New Zealand, but biodiversity is not a priority for this agency.

The state of the braided riverbeds is of increasing concern. The inclusion of the Tasman and Godley rivers in the Aoraki/Mt Cook National Park, as currently proposed, would be a move in the right direction since biodiversity is a priority for the Department of Conservation.

Restoring habitat - what should be planted where?

When preserving or restoring our natural heritage, it is important to be clear about what it is that we seek to achieve. In relatively untouched parts of the country, such as virgin forest in national parks, most would agree with the aim of keeping them as close as possible in the state they were in before humans arrived.

But elsewhere, we need to recognise that people and nature must thrive alongside one another. The British conservation scientist Dame Georgina Mace addressed this challenging topic recently in New Zealand when she delivered the Royal Society Rutherford Memorial Lecture.

Policies and rules governing the restoration of habitat that are unnecessarily restrictive can add cost, frustration, and delay, and thus reduce what can be achieved.

There are two related concepts that need examination – *natural range and ecosourcing.*

The natural ranges of plants have changed in the past and will do so again. There will be cases for keeping some plants inside their natural range, and cases for not doing so.

Neither should ecosourcing be regarded as an unviolable principle. Pollen and seeds are carried from place to place by wind, insects, and birds.

I recommend that the Minister for the Environment and the Minister of Conservation direct officials to consider the following in policy development:

a) **Increasing the control of predators within covenanted areas and riparian vegetation;**

b) **Addressing the degradation of the habitat of braided rivers and dryland margins; and**

c) **Clarifying the circumstances where the concepts of natural range and ecosourcing should be applied and not applied.**

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10.5 Bird genetics - inbreeding and restoration

Efforts to save birds on the brink of extinction have rightfully focused on keeping the few remaining individuals alive. If they had not, kākāpō, black robin, and hihi would have become extinct. More recently, attention has started to shift to managing the genetic diversity of some species to make them more resilient and increase the likelihood of their long-term survival. This can often be done by translocating – moving – a few birds from one isolated population to another.

Translocations are also sometimes used to re-establish and supplement bird populations. The arrival of new birds is understandably very motivating for community groups and iwi who have worked long and hard to control predators and restore habitat.

However, translocations are expensive and risky. In some cases, the money spent on a translocation might achieve more if it were spent on expanding predator control over larger areas, or on creating habitat corridors so the birds can more readily spread of their own accord.

The Department of Conservation does not have a *policy* on the translocation of birds. What it does have is a set of standard operating procedures governing the *process* that must be followed for a translocation to be approved. These procedures lay out *how* a translocation is to be carried out, but not *why* and *when* it should be done.

Some reference is made in the Department of Conservation procedures to International Union for Conservation of Nature (IUCN) guidelines. But these guidelines are high-level, and have not been articulated in a New Zealand context.

Some efforts are underway to address this gap for individual fauna. But without a policy based on a clear set of principles, decisions on genetic rescue and translocation are inconsistent. Moreover, the line between science and opinion is often blurred, adding to the problem.

There are other ways in which the lack of a policy on genetic diversity within a species is leading to management decisions that should be questioned. Unnecessary restrictions generally add cost to any enterprise. For instance, regional, and even subregional, populations of North Island brown kiwi are being managed separately to preserve small genetic differences. But in a predator-free future where kiwi are abundant, birds from different regions will meet and sometimes mate. So, why not now?

The genetic management of New Zealand's flora and fauna needs a firm and consistent foundation. The forthcoming book and practical guide by Richard Frankham soon to be published by Oxford University Press should provide a sound starting point.

I recommend the Minister of Conservation directs officials to:

a) **Develop principles and policies for the effective management of genetic diversity in native birds and other fauna; and**

b) **Develop a translocation policy that outlines why and when translocations should be undertaken, and ensures translocation decisions are made transparently and consistently.**

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10.6 Investing in our natural heritage

New Zealand is a country with an extraordinarily rich and unusual natural heritage, and is widely recognised as a biodiversity hotspot. The degree of endemism is particularly high. Many of our plants and animals are found nowhere else in the world, including more than half of our bird species.

Nearly two million tourists came to New Zealand last year. Few, if any, came to go shopping. Almost all would have come because they saw photographs of stunning landscapes. Not all of them would have actually visited a national park, but that is what drew them here. Wilderness is becoming increasingly scarce around the world, and in scarcity lies value.

For a long time, conservation was seen as the business of the Department of Conservation and regional councils. Encouragingly, philanthropists, private land owners, companies, and hundreds of community groups are now investing money and time and enthusiasm into conservation.

But preventing the devastation caused by predators on a landscape scale is expensive. In 2014, the Battle for Our Birds cost about $20 million. That battle was fought using cost-effective 1080, but it was only fought over 16% of the area of forest that was masting and causing rodent and stoat populations to soar. To control predators in all masting forest in 2014 would have cost about six times as much. And then there are warmer, more fertile forests in places like Northland where rat numbers are high every year.

The Department of Conservation must, at the same time, protect natural heritage and enable people to experience that natural heritage. The number of international tourists is projected to double in the next five years, and this will put increasing pressure on tracks, bridges, huts, visitor centres, toilets, car parks, and all the other infrastructure that supports the visitor experience.

The duty of care to protect people visiting a national park will always trump the protection of the biodiversity within the park. Early this year, a norovirus outbreak swept through a popular tramping route in Nelson Lakes. Containing the outbreak involved disinfecting every hut and toilet on the track. Helicopters were needed to reach remote areas. While this had to be done, it would have diverted resources away from activities like predator control.

As this was being written, the Government announced that more funding is to be given to the Department of Conservation for tourism infrastructure. This will help, but the principle of 'user pays' for infrastructure and services needs to be applied further. The Department of Conservation has recently decided to charge higher fees for huts and campsites. However, this will not help the congestion on the Tongariro Crossing where more toilets are desperately needed. One possible new source of revenue is to charge for car parks, as is done in some places in Canada, Australia, and the United Kingdom.

There are also precedents for charging for access to national parks in other countries. For instance, a seven-day pass to visit Yellowstone National Park costs US$30 in the United States. But under the Conservation Act, charging anyone for access is currently prohibited in New Zealand.

Free access to the conservation estate – the right to wander without restraint into our wild places – is deep in the psyche of many New Zealanders. That right should be protected. But the Conservation Act could be amended to allow for charging overseas visitors for access.

The more that user pays charges can cover the provision of infrastructure and services, the more money there will be available for protecting birds and other ecological treasures, *provided* Vote Conservation is not reduced.

The cost of administration and compliance is frequently raised as a criticism of user pays on the conservation estate. There must be ways of addressing this using modern technology.

The increasing investment in conservation by philanthropic trusts, private land owners, and many others is very encouraging. But the task ahead of us is immense. Only a fifth of our bird species are secure, and a third are in serious trouble. The situation is similar for lizards, frogs, insects, and other native fauna. And, at the time of writing, news has come that myrtle rust has arrived in New Zealand threatening pōhutukawa and mānuka.

Another hugely important issue for this isolated country is biosecurity. New Zealand already has a border levy as an efficient way of paying for biosecurity enforcement at ports and airports.

Currently, there is a call for a similar levy that would provide revenue for biodiversity. The great majority of visitors to New Zealand come because of the unique natural beauty of these islands. There is a strong case for a Nature levy at ports and airports to provide another source of revenue for protecting our natural heritage.

I recommend that the Minister of Tourism, the Minister of Finance, and the Minister of Conservation direct officials to investigate new sources of revenue for conservation, including:

a) Requiring visitors to New Zealand to pay a Nature border levy; and

b) Additional ways of charging visitors to New Zealand for the provision of infrastructure and services on the conservation estate, in order to free up more of Vote Conservation for the protection of biodiversity.

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10.7 Supporting and coordinating community groups

Across New Zealand, hundreds of community groups are working hard on conservation. Some focus on controlling predators, others on restoring habitat, and others on protecting a specific species. But all are devoting time, effort, and passion to protecting New Zealand's rich natural heritage.

During this investigation, staff visited a number of community groups in different parts of the country, and heard about the challenges and frustrations that they face.

The process of setting up a non-profit community group, obtaining grants, and managing funds requires specialist skills. Carrying out conservation work also requires a range of skills, such as the kind of traps to use and how to operate them, what species to plant where, and the requisite health and safety measures.

There are many organisations that provide funding, but all place different restrictions on how the funds are to be used. Most will provide money for the obvious needs – traps and plants. But many do not allow grants to be spent on administration or financial management, despite these activities being vital for a group to be effective. One group coordinator commented that the hardest person for a group to find is a treasurer.

Reporting requirements attached to funding are important for accountability and, in theory, for measuring effectiveness. However, when many grants are small (several thousand dollars) and funding is short term (one to three years), the burden of submitting regular detailed reports can be disproportionate. This is even more so when groups rely on several small grants from different organisations – each with their own requirements for reporting.

Funding organisations are often reluctant to renew funding for groups that have been successful in a previous round. Instead, they move on to other groups. This often leads to groups having to continually look for new funding sources. If they cannot secure new funding, the effort they have already put into conservation will be largely wasted – activities like predator control and weeding must be sustained over time to be effective.

In contrast to the current approach, funding organisations should give priority to groups that have already made significant conservation gains to ensure that the benefits are not lost. Such groups will have also demonstrated their ability to be in for the long haul. This is not to say that no new groups should be funded, but in many cases, it will be better to encourage people to join a group that already exists than to form a new group.

The number of people keen to become actively involved in conservation is likely to grow, particularly as baby boomers reach retirement age. Targeted support for, and better coordination of, community groups would make this great collective effort more effective and more rewarding for those involved.

Support and coordination can be provided through the creation of regional hubs. These could provide services such as:

- administrative and accounting expertise;
- assistance with funding applications and reporting;
- training and certification in trapping and laying poison, including health and safety;
- advice on plant choices and habitat restoration; and
- sharing of information among groups.

Coordination is also vital – dozens of community groups working in small separated areas dotted across a region will struggle to have an impact at a landscape scale.

Regional organisations that aim to coordinate and support the efforts of community groups in different ways are being formed in some regions.

One example that hits the mark is the Bay Conservation Alliance, which was recently established in the Western Bay of Plenty. Its aim is to provide *"a professional support team tasked with 'taking the load' off volunteers so that they can get on with the practical work"*.[183]

Another example is Wild for Taranaki – a trust with the purpose of coordinating action and raising funds for protecting biodiversity in the region that is financially supported by the regional council. It offers workshops and training to its members, and employs a regional biodiversity coordinator.

I recommend that the Minister of Local Government, the Minister for the Environment, and the Minister of Conservation direct officials to work with councils to establish regional biodiversity hubs to coordinate and support community conservation groups.

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Notes

1 Beaglehole, 1962, p.125.

2 Langton, 2000, p.250.

3 McNab, 1994.

4 Note that having fewer eggs may be for a variety of reasons (Franklin and Wilson,2003).

5 Some species of New Zealand birds have particularly strong body odour compared to those from other countries, making them even more vulnerable to detection by predators that hunt by smell. Two of the most pungent birds are the kākāpō, which has been described as smelling 'sweet' or 'musty', and the kiwi, which has a strong ammonia-like smell.

6 Robertson et al., 2013.

7 Holdaway, 1989.

8 Ewers et al., 2006.

9 Atkinson, 2006, p.51.

10 See New Zealand Birds Online entries regarding Little Barrier snipe, Chatham Island fernbird, Imber's petrel, Forbes' snipe, Chatham Island rail, Lyall's wren, and South Island piopio (http://nzbirdsonline.org.nz/).

11 Clarke and Dzieciolowski, 1991.

12 Nugent et al., 2001.

13 3.5 million hectares of native forest (27% of what remained) was cleared during the 1890s. Ministry for the Environment, 1997.

14 Star, 1997.

15 Star, 2002.

16 Potts, 1878, p.6.

17 Taylor, 2007.

18 Nightingale and Dingwall, 2003.

19 Grzelewski, 1999.

20 National parks "shall be preserved as far as possible in their natural state: except where the Authority otherwise determines, the native plants and animals of the parks shall as far as possible be preserved and the introduced plants and animals shall as far as possible be exterminated" (National Parks Act 1952, s3(2)(a)).

21 Miskelly, 2014.

22 Towns and Broome, 2003.

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23 Resource Management Act 1991 s6(c). The protection of indigenous fauna is not a matter of national importance, only the protection of their habitat. This is an instance where the law has fallen behind the scientific understanding of the enormous impact of predators on birds and other indigenous fauna.

24 Burns et al., 2012.

25 Elliott and Suggate, 2007.

26 The original claimants were Haana Murray (Ngāti Kurī), Hema Nui a Tawhaki Witana (Te Rarawa), Te Witi McMath (Ngāti Wai), Tama Poata (Ngāti Porou), Kataraina Rimene (Ngāti Kahungunu), and John Hippolite (Ngāti Koata).

27 Waitangi Tribunal, 2011, p.147.

28 Following enactment of the Te Urewera Act in 2014, Te Urewera ceased to be a national park. Other co-governance agreements include Te Waihora Co-Governance Agreement, which recognises Ngāi Tahu's mana whenua over the Te Waihora/Lake Ellesmere catchment.

29 Wilson, 2006.

30 In 2000, the Department of Conservation (DOC) released an Action Plan for Seabird Conservation in New Zealand (Taylor, 2000), the first document to provide a summary of the status, threats, and priority actions required for each seabird taxa in New Zealand. In 2012 the Royal Forest and Bird Society launched a campaign to increase public awareness of New Zealand's seabirds.

31 In the 2015 Budget, $11.2 million was allocated to kiwi conservation (Barry, 2015).

32 Key, 2016.

33 Ozarski, 2015, p.11.

34 New Zealand Cabinet, 2016; DOC, 2016.

35 Barry, 2016.

36 Two other species, the South Island kōkako and the South Island brown teal, are classified as 'data-deficient', and are most likely extinct.

37 Figure 3.1 is taken from Townsend et al. (2008, p.11). The latest application of the New Zealand Threat Classification System to birds – Conservation status of New Zealand birds, 2017 – is the source of the threat rankings in Chapter 3 and in the Appendix.

38 `There are two bird species that have been included in this report because they have been given threat rankings, despite being non-resident natives; that is, they fall outside the dotted line in Figure 3.1. The bar-tailed godwit and the lesser knot are classified as 'migrants' because although they spend time in New Zealand; they do not breed here. 'Vagrants' are species only rarely found in New Zealand – the emperor penguin known as Happy Feet, which came ashore at Peka Peka in 2011, was a much-loved vagrant. 'Colonisers' are birds that have established a breeding population in New Zealand since 1950 without any human assistance – the Australian coot is a coloniser.

39 The threat rankings of all the bird taxa are given in the Appendix. In this chapter, where the threat rankings of the subspecies and/or isolated populations of a species differ, the following process has been followed.

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- If the split of the species is based on a mainland/offshore island divide, then the species has been assigned the threat ranking of the mainland taxon. For example, there are three diving petrel taxa – one living on the mainland, and two living on islands. The diving petrel species has been assigned the threat ranking of the mainland taxon; that is, 'in some trouble'.
- If the split of the species is based on a North/South Island divide, then the species has been assigned the lower threat ranking. For example, there are two rifleman taxa – one living in the North Island and 'in some trouble', and the other living in the South Island and 'doing OK'. The rifleman species has been assigned the lower threat ranking; that is, 'doing OK'.
- There are four cases that do not fit into either category – weka, subantarctic snipe, grey duck, and Kermadec petrel – where the threat ranking has been assigned after examining aggregate populations and trends.

40 'Extinct' and 'Not threatened' are clear. But 'At risk' of what? Of slipping into 'Threatened'?

41 Townsend et al., 2008, p.11.

42 The ruru is a bird of prey, but lives mainly in the forest.

43 Agapow et al., 2004, p.162.

44 Darwin, 1859.

45 The biological species concept was proposed by Ernst Mayr. He defined a species as a "group of interbreeding natural populations that are reproductively isolated from other such groups" (Mayr, 2000).

46 'Phylo' is the Greek word for tribe, and 'genesis' is the Greek word for 'origin'.

47 Isaac et al., 2004.

48 Agapow et al. (2004) compared the effect on the number of species of using phylogenetic and non-phylogenetic classifications. "It is startling that taxonomically well-studied groups like mammals, arthropods, and birds showed large and roughly similar increases (87%, 77%, and 88% respectively)" (p.168).

49 This is because the average population and the average range of a species will decrease (Isaac et al., 2004, p.308; Agapow et al., 2004, p.169).

50 A taxonomic system for British birds has been developed by the British Ornithologists' Union (Helbig et al., 2002). It relies more on the biological species concept than on the phylogenetic species concept. In summary: "We believe that taxa should only be assigned species rank if they have diverged to the extent that merging of their gene pools in the future is unlikely." (p.519).

51 Agapow et al., 2004, p.172. See also Mace, 2004.

52 This order is Apterygiformes, from the Greek meaning 'without wings'.

53 The ancestors of birds endemic at the family level arrived in New Zealand between 25 to 70 million years ago. The ancestors of birds endemic at the genus level arrived in New Zealand between 1 to 25 million years ago. The ancestors of birds endemic at the species level arrived in New Zealand between 15 thousand and 1 million years ago (McDowall, 1969; Fleming, 1962).

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54 Weitzman, 1993.

55 The estimates of ranges in the 1970s and the 2000s come from two national bird surveys. During the 1970s, hundreds of keen bird watchers spent many hours searching for and recording the presence of native birds across the country. In 1985, the Ornithological Society of New Zealand published its first bird atlas (Bull et al., 1985). Thirty years later, a second national bird survey was undertaken, resulting in the publication of a second bird atlas in 2007 (Robertson et al., 2007).

56 Walker and Monks, 2017, pp.21–22.

57 Robertson et al., 2007, p.262.

58 In New Zealand's threat classification system, the qualifier TO is added to the conservation status of bird species considered threatened overseas, and the qualifier SO is added to the conservation status of bird species considered secure overseas (Townsend et al., 2008).

59 Shepherd et al., 2014.

60 Brown et al., 2015, p.7.

61 Estimates of lethal doses are based on the LD50 method; that is, the amount that has a 50% chance of killing the animal. LD50s are expressed in terms of milligrams of poison per kilograms of body weight. The LD50 of PAPP for stoats is 9.3 mg/kg, and the LD50 for rats ranges from 177 to 697 mg/kg (Eason et al., 2014). The average weight of a stoat is about 250 grams, and the average weight of a ship rat is about 140 grams.

62 Brodifacoum is relatively inhumane and can persist in the environment for a long time. It is the active ingredient in rat poisons like Talon. Rats were eradicated with a brodifacoum drop on Ulva Island, off Rakiura/Stewart Island in 1995, but because rats can swim several hundred metres, a second drop was done in 2011 when numbers had begun to build up again (DOC 2011). More recently, brodifacoum was used to eradicate Norway rats on Campbell Island and mice on the Antipodes Islands – the latter was done through the Million Dollar Mouse project (http://milliondollarmouse.org.nz/). Aerial broadcast of brodifacoum has been very seldom used on the mainland, and only within pest-proof fences (Fisher et al., 2011).

63 Leech et al., 2008; Mudge, 2002; Powlesland et al., 2011.

64 `The cost of operations – helicopters plus bait – is about $20 per hectare. Information supplied by OSPRI and DOC, February 2017.

65 Possum populations do not irrupt during masts since they only bear one or two young each year.

66 The first coordinated programme to counteract masts at multiple sites, dubbed 'Battle for Our Birds', was launched by Dr Nick Smith, the then Minister of Conservation at the end of January 2014.

67 The impact of the 2014 Battle for Our Birds on populations of rats and stoats can be seen in Figures 6 and 7 of Elliott and Kemp (2016). The density of predators was measured before and after the drops using footprint tracking tunnels. One major problem in dealing with masts is the inability to do all aerial drops at the optimal time. The best time to drop 1080 during a mast is when the rat populations have begun to climb, but before the female stoats have gone to earth to prepare for the birth of their young. The optimal time varies from site to site. In 2014, delays due to weather, availability of helicopters, and the granting of permits were as long as four months. At some sites, there was a "disappointing and rapid" bounce back of

rodents within a few months (Elliott and Kemp, 2016, p.206). This issue is discussed in the next section.

68 Figure 8 in Elliott and Kemp (2016). The most vulnerable birds in a mast are species like mohua and rock wren that nest in cavities.

69 Bykill – the death of native birds from eating 1080 – is often raised as a concern, but it was a much bigger issue in the past when carrot baits were sown in high densities. The amount of 1080 sown per hectare has steadily fallen from more than 25 kg per hectare in the 1970s. In 2016, it was down to 2 kg per hectare, and even lower sowing rates are being trialled. Now cereal baits dyed green or blue so that birds cannot see them are used on conservation land. Kea, by virtue of their inquisitive nature, do sometimes peck at 1080 baits, and now a number are radio-tagged so they can be monitored during 1080 operations. With new protocols in place, the net effect of a 1080 drop on a kea population has been shown to be positive. In 2014, 4 out of 49 radio-tagged kea at several sites died from 1080 poisoning. But in 2016, all radio-tagged kea in Kahurangi National Park survived, and the nesting success was far greater where 1080 was dropped than in other areas (27% compared with 2% nesting success). Almost all of the 24 deaths of radio-tagged kea (out of a total of 222 monitored birds) have been in Arthur's Pass and Fox Glacier. These deaths appear to be related to more interactions with people, and thus a greater tendency to try novel foods. Kea in these areas also have higher levels of lead from eating old lead nails and flashings, and this may affect their behaviour (pers. comm., Josh Kemp, Department of Conservation, 2017).

70 At the time of writing, data on chnages in the numbers of birds were still being analysed. There are many factors that influence the growth or decline of bird populations. For instance, the biggest mainland population of the nationally endangered orange-fronted kākāriki is in the Hawdon Valley in Arthur's Pass National Park. Despite predator tracking rates falling in response to 1080 operations, the population has continued to decline (Elliott and Suggate, 2007). One reason may be the presence of the more aggressive yellow-crowned kākāriki. Other reasons may be that this refuge into which the species has been driven is too cold and harsh or that numbers are too low to detect any increase.

71 It is not expected that climate change will lead to more frequent mast events. The temperature differences between successive summers have now been shown to be a major predictive factor of masts (see Kelly et al., 2013).

72 Walker et al., 2017, p.vi. Two national bird surveys have been done in New Zealand – one in the 1970s and one in the early 2000s. The results of many thousands of observations of birds were published in the two bird atlases (Bull et al., 1985; Robertson et al., 2007). Both atlases were published by the Ornithological Society of New Zealand. One of the findings in the analysis of the data by Walker et al. (2017) is that over the 30 years between the two surveys, the deep endemic birds, in particular, retreated to refuges in cold forests.

73 If a 1080 drop kills 98% of the rats in an area, the remaining 2% will begin to breed again. This will occur faster in warmer, more productive forests because the initial population of rats is higher – 2% of 100 rats is 2, 2% of 1,000 rats is 20.

74 This does not, however, mean that the operation has been pointless. Knocking rats down to low levels even for a short time can result in far fewer stoats being born that year and protect birds through the breeding season.

75 Brown et al., 2015, pp.12–13.

76 However, it does not seem feasible that traps could deal with mice that multiply once rats are removed.

77 Griffiths and Barron, 2016.

78 Note, however, the 1080 in any baits dropping into water is diluted rapidly, and then it biodegrades. Following a 1080 drop, water bodies in the vicinity are monitored, including any sources of drinking water. If any residues are found, drinking water supplies must not be used until the concentration of 1080 drops to below 2 parts per billion. Since 1990, over 3,000 samples have been taken, with traces of 1080 found in less than 100. Between 1990 and 2011, only 6 samples have been found with concentrations above the Ministry of Health trigger level of 2 parts per billion, and none of these were from a public drinking water supply. Since 2011, no samples have been found to contain 1080 above the trigger level. (Data sourced from Landcare Research for the September 1990 to February 2011 period, and EPA Annual Reports for the period ending December 2015.)

79 Aerial 1080 is generally less effective at killing mice than rats. Kill rates for mice are about 25% compared with 95% for rats (Broome et al., 2009, pp.55, 64).

80 Parkes et al., 2017, p.157.

81 See King and Murphy, 2005, p.278, and Table 54, pp.268–269.

82 McLennan, 2013, pp.51–54.

83 Work with kōkako found that the species could survive when tracking rates of ship rat were reduced to less than 5%. This level has been adopted by conservation managers as a 'rule of thumb' for New Zealand passerines.

84 Staff at Cape Sanctuary have been working on a modified tracking tunnel index, where the tunnels are monitored for a full 7 days – rather than the standard single night. Saddleback appear to be able to survive if tracking rates of Norway rats over the 7 nights are only 1–2% (pers. comm., John McLennan, 7 April 2017).

85 This figure has been adapted from the figure titled 'What do Cape-to-City birds need?' in Innes and Fitzgerald (2016, p.15).

86 Cuthbert and Hilton, 2004. See also Dilley et al. (2015), and Dilley et al. (2016). Mice have been shown to eat eggs and chicks of other seabirds that breed in winter on islands – the time of year when mouse populations typically collapse due to lack of food.

87 Information from the Million Dollar Mouse website (http://milliondollarmouse.org.nz/).

88 Innes et al., 2014.

89 Sanders and Maloney, 2002.

90 Clapperton and Byrom, 2005, p.297.

91 Brockie, 1975.

92 Jones, 2014, para.5. "Hedgehogs don't possess the sharp 'killing' teeth of other predators like cats and stoats, so, when attacking a chick or adult bird, they tend to bite and gnaw away until the bird is exhausted, causing it a long and painful death."

93 Sanders and Maloney, 2002.

94 Farnworth, 2013, p.33. One study found that putting collars with bells on cats halved the number of birds caught (Gordon et al., 2010). A fence that confines

cats to property boundaries (the Oscillot® System) is now available in New Zealand. Some cat breeders now recommend keeping cats indoors to extend their lifespan – a practice common in many countries to prevent cats being hit by cars or contracting disease.

95 The percentage of domestic cats microchipped increased from 12% in 2011 to 31% in 2015 (New Zealand Companion Animal Council, 2016, p.10). Microchipping is done by a vet or other trained professional. Costs vary, though some initiatives offer the service for free. It then costs $15 to register the microchip with the New Zealand Companion Animal Register.

96 National Cat Management Strategy Group, 2016, p.7.

97 Harper, 2004, p.19.

98 Herekopare Island. The extermination of these bird species occurred over a period of 45 years when cats were the only mammals on the island (Gillies and Fitzgerald, 2005, pp.323–324).

99 In a study of ground-nesting birds in the Upper Waitaki Basin, cats were responsible for nearly half of the 'lethal events' that reduced the populations of banded dotterels, black-fronted terns, and black stilts (Sanders and Maloney, 2002).

100 These are Northland, Auckland, Bay of Plenty, and Southland. Some others do invest in suppression at some sites. Marlborough, Otago, and the West Coast do not recognise feral cats as pests at all.

101 Guthrie, 2016.

102 The virus released (illegally) in 1997 to control rabbits is the 'rabbit haemorrhagic disease virus' (RHDV). It is commonly known as calicivirus. Approval for the release of a more virulent strain of calicivirus called K5 is currently being sought by Landcare Research and others.

103 After the calicivirus was released in 1997, DOC implemented an intensive predator control programme in the upper Waitaki Basin. In a three-month period, 1,067 hedgehogs, 328 ferrets, 196 cats, 96 rats, and 69 stoats were killed (Keedwell and Brown, 2001). See also Murphy et al. (2004).

104 Taborsky, 1988.

105 Dogs known to have killed kiwi in Northland include farm dogs, hunting dogs, and family pets including Rottweilers, Labradors, fox terriers, and a poodle (Pierce and Sporle, 1997). "In Northland, it has been shown that the average lifespan of an adult brown kiwi is only 13–14 years rather than the 30–40 years in all other brown kiwi populations due mainly to predation by dogs." (Germano et al., 2016, p.12).

106 'Kiwis for kiwi' website (https://www.kiwisforkiwi.org/).

107 Dog Control Act 1996, s 59.

108 In the 2014–15 fishing year, there were nearly 5,000 seabirds killed in the commercial trawl and longline fisheries. The black petrel is the species with the highest risk ratio from commercial fisheries (Ministry for Primary Industries, 2016a, pp.252, 268).

109 Pers. comm., Graeme Elliott, 29 April 2017.

110 See Ministry for Primary Industries (2016b) and Agreement on the Conservation of Albatrosses and Petrels. Amended by the Fifth Session of the Meeting of the Parties Santa Cruz de Tenerife, Spain, 4–8 May 2015.

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111 Information from Ministry for Primary Industries, 2 May 2017.

112 See details of the Deepwater Fleet Vessel Management Plans and the actions taken by the Black Petrel Working Group on the Southern Seabird Solutions website (http://www.southernseabirds.org/).

113 New Zealand Cabinet Committee Paper "Improving fisheries management through an Integrated Electronic Monitoring and Reporting System (IEMRS) and Enabling Innovative Trawl Technologies (EITT)" (24 April 2017).

114 New Zealand Cabinet, 2016.

115 These are three of the areas of research being funded through the Biological Heritage National Science Challenge.

116 Information for this section has been supplied by Dr Brian Hopkins, Landcare Research, 15 March 2017.

117 Norbomide kills rats within three hours, more quickly than 1080, which takes a day, and far more quickly than brodifacoum, which takes up to a week.

118 Gemmell et al., 2013.

119 Patel et al., 2016.

120 Gemmell et al., 2013.

121 Patel et al., 2016, p.15.

122 Burt, 2003.

123 The term CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats. The feasibility of using a gene drive to skew sex ratios in naturally breeding populations of mice is being explored. It is predicted that fewer than 10% of the immediate offspring will be female (Piaggio et al. 2017, p.101).

124 Oye et al., 2014.

125 Esvelt et al., 2014, p.16..

126 Innes and Fitzgerald, 2016, p.14.

127 Honeydew is a sugary substance produced by small native insects that live in the bark of beech trees. During certain times of the year, introduced wasps can eat up to 90% of the honeydew in a forest (Beggs, 2001). Wasps have also been observed to prey on recently hatched birds.

128 Until recently, the only way of killing wasps was to poison individual nests. Now a protein-based wasp bait containing the insecticide fipronil – Vespex™ – is available that enables many nests to be poisoned from one bait station. Wasps gather the bait up and take it back to their nests. In December 2016 the community-led Wasp Wipeout project was launched in the Nelson-Tasman region. The project has used crowd-funding to support the placement of Vespex bait-stations, with the goal of creating a wasp-free corridor around conservation and urban areas in the region.

129 Nugent et al., 1997; Ewans, 2010.

130 McIlroy, 1995, p.340; Thompson and Challies, 1988, p.75.

131 National Possum Control Agencies, 2008, p.10.

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132 Norbury, 1996, p.18.

133 On Stewart Island, dotterels nest high inland, but they feed and breed in the open sandy and stony areas of the dunes. DOC has been controlling marram grass on Stewart Island for more than 20 years (DOC, 2006).

134 The pied oystercatcher is in some trouble, and the non-endemic pied stilt, which also nests in this area, is doing OK.

135 Walker and Monks, 2017, pp.40, 45.

136 O'Donnell et al. (2016) provides a discussion of the pressures facing birds in braided rivers, and includes a good description of the impacts of weeds on river habitats and best practice for managing weeds.

137 LINZ spends about $2 million annually on controlling weeds and pest animals, but about half of this usually goes towards controlling lake weeds.

138 DOC, 2016, p.7; New Zealand Cabinet, 2016, p.7.

139 Taranaki Regional Council, 2017. Taranaki Regional Council does envisage riparian plantings as habitats for wildlife and corridors for bird and fish migration (Taranaki Regional Council, 2010).

140 There are other covenants that can be established to protect native ecosystems. For instance, the Nature Heritage Fund has established 395 covenants in perpetuity since 1990 (Molloy, 2016).

141 Currently, the QEII Trust receives 150–210 expressions of interest from landowners each year, but is only able to enter into 110 new covenants. The Trust generally pays for the surveying of a new covenanted area and half of the cost of fencing it.

142 The QEII Trust does monitor the condition of covenanted areas, and often gives advice about predator and weed control.

143 The Stephenson Fund is a contestable fund open to all registered QEII covenantors to apply to for assistance.

144 Goal Three of the New Zealand Biodiversity Strategy: "Maintain and restore viable populations of all indigenous species and subspecies across their natural range and maintain their genetic diversity" (Department of Conservation, 2000).

145 Thus the concept of natural range is somewhat elusive. At what point in time is the natural range of a species 'right'? Just before humans arrived, or when Europeans began to settle in New Zealand, or now?

146 McGlone and Walker, 2011, p.57.

147 See, for instance, Simpson, 2009.

148 MacGibbon, 2009, p.83.

149 Auckland Council, 2013.

150 68% of the population are siblings (Taylor et al., 2017, p.807).

151 For a comprehensive description of the four forces of evolution, see Russell (2002).

152 Burkhardt and Secord, 2010, p.xxiii.

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153 The opposite of inbreeding – outbreeding – can also be a problem. Birds that are genetically too distant from each other will also produce less fit offspring. For instance, the very endangered endemic black stilt sometimes mates with the much more numerous pied stilt on riverbeds in South Canterbury. The hybrid offspring have low fertility and relatively short lives.

154 These are distinctions that show up in the gene pool. Some distinctions between two populations of the same species may not be genetically based but due to environmental differences such as diet.

155 Some of New Zealand's endemic forest birds produce relatively few offspring. For instance, kiwi lay one or two eggs a year, and kererū lay two or three eggs a year (Heather and Robertson, 2005, pp.168–170, 349).

156 Jamieson et al., 2006, p.40.

157 Provenance means place of origin. The provenance of a work of art or an antique – the record of its ownership – is used when deciding whether it is authentic or not. The word is used in conservation science to denote local genetic variation – or the assumption of local genetic variation.

158 Pers. comm., Dr Melanie Massaro, 24 March 2017. The entry for black robin in New Zealand Birds Online states that "Inbreeding depression is expressed through lowered reproductive output. Long-term persistence of populations is uncertain."

159 Forsdick et al., 2016.

160 In 1912, five little spotted kiwi were moved to Kapiti Island. The remaining little spotted kiwi on the mainland then disappeared. As a result of successful breeding on Kapiti Island, 10 further populations were established – on seven islands (Tiritiri Matangi, Motuihe, Red Mercury, Hen, Long, Chalky, and Anchor), and in three mainland sanctuaries (Zealandia in Wellington, Cape Sanctuary in Hawkes Bay, and Shakespea on the Whangaparāoa Peninsula).

161 Taylor et al., 2017, p.810.

162 Pers. comm., Dr Jen Germano, Kiwi Recovery Group Leader, April 2017.

163 Some kākāpō are on Anchor Island in Dusky Sound, some are on Whenua Hou (Codfish Island) off the west coast of Stewart Island, and some are on Little Barrier Island in the Hauraki Gulf.

164 White et al., 2015.

165 O'Connor, 2016. Since 2002, there have been outbreaks of infection, causing cloactitis ('crusty bum') among the kākāpō. There are questions over whether these outbreaks have a genetic basis (Gartrell et al., 2005; White et al., 2015).

166 Kākāpō recovery webpage (http://kakaporecovery.org.nz/). See also Robertson (2006) and White (2012).

167 See, for example, Thomas et al. (2013).

168 Bowker-Wright et al., 2012, p.184.

169 For example, see Innes et al. (2013).

170 For example, the Shore Plover Recovery Plan notes "Consideration should be given to obtaining eggs for the captive-breeding programme from the Western Reef population to increase the genetic diversity among captive stock and within

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reintroduced populations" (DOC, 2001, p.11). In comparison, the Draft Kiwi Recovery Plan notes that management actions should keep isolated populations separate because this will maintain genetic variation within kiwi species (Germano et al., 2016, p.16).

171 It is only last year that new research suggested that the North Island brown kiwi had been isolated into four populations by the end of the last ice age, about 20,000 years ago (Weir et al., 2016). But 20,000 years is a short period of evolutionary time.

172 Allendorf et al., 2016. The two reasons given for this opinion appear somewhat contradictory. The first is a concern that the birds are descended from only 13 founders, so may lack genetic diversity and be inbred. The second is that the birds are of 'mixed provenance'. The 13 founders came from Northland and Taranaki – which would increase their genetic diversity. There are already some North Island brown kiwi of mixed provenance on the mainland (Pers. comm., Dr Isobel Castro, April 2017).

173 Kiwis for kiwi has estimated that this will cost $947,500.

174 The Department of Conservation requires a more thorough application if kiwi hatched from eggs are to be moved more than 50 kilometres from the source of the eggs. Maungatautari is 60 kilometres from the closest potential source of eggs (Department of Conservation, 2010, p.7). Another restriction on translocations of North Island brown kiwi is that the Northland population of brown kiwi has been divided into four subpopulations, which are to be kept separate.

175 Sainsbury et al., 2006.

176 Website of the Zealandia Eco-Sanctuary (http://www.visitzealandia.com)

177 Dussex et al., 2015.

178 DOC permit for kākā translocations to Abel Tasman National Park, September 2016 (Ogle, 2016). The key conditions in the permit include the following (paraphrased):

- The contribution of northern South Island kākā should be maximised in all releases into the park.
- Attempts to establish a captive population of northern South Island birds should continue.
- Up to eight additional captive-raised females of South Island provenance may be released into the park.

If no more than three female chicks have been obtained for the captive breeding programme by the end of the 2018/19 summer, then the restrictions on breeding and releasing kākā from sites outside the northern South Island will be relaxed.

179 Note that the draft Kiwi Recovery Plan refers to "sound genetic principles", but it does not say what these principles are (Germano et al., 2016).

180 In a 2015 paper, Richard Frankham provides a set of guidelines for managing genetic rescues (Frankham, 2015).

181 United Nations General Assembly, 1992, Principle 15.

182 Holzapfel et al., 2008, p.35.

183 Application from Bay Conservation Alliance to Western Bay of Plenty District Council Community Committee for financial support, 1 March 2017.

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Appendix

This appendix supplements the information on the conservation status of New Zealand's native birds presented in Chapter 3. It contains the (high level) threat rankings of all native bird species, subspecies, and isolated populations taken from the Conservation Status of New Zealand Birds, 2016. .

The three high-level threat rankings are presented here using the more accessible terminology used in Chapter 3 – 'Doing OK', 'In some trouble', and 'In serious trouble'.

Where a species has been divided into a number of subspecies and/or isolated populations, the threat ranking of each is represented by an X. Thus, one subspecies of the rifleman is doing OK, but the other is in some trouble.

Green rows denote bird species that are endemic; that is, found in no other country. (Migratory birds are classed as endemic if they breed in New Zealand.)

The bold crosses indicate the threat ranking assigned to the sepcies as a whole (based on the process identified in note 39).

Forest birds

Perching birds

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Tītipounamu / Rifleman	*Acanthisitta chloris*	**X**	X	
Tuke / Rock wren	*Xenicus gilviventris*			**XX**
North Island kōkako	*Callaeas wilsoni*		**X**	
South Island tīeke / Saddleback	*Philesturnus carunculatus*		**X**	
North Island tīeke / Saddleback	*Philesturnus rufusater*		**X**	
Pōpokatea / Whitehead	*Mohoua albicilla*		**X**	
Mohua / Yellowhead	*Mohoua ochrocephala*		**X**	
Pīpipi / Brown creeper	*Mohoua novaeseelandiae*	**X**		
Hihi / Stitchbird	*Notiomystis cincta*			**X**
Korimako / Bellbird	*Anthornis melanura*	**X**	XX	
Tūī	*Prosthemadera novaeseelandiae*	**X**		X
Pīhoihoi / New Zealand pipit	*Anthus novaeseelandiae*		**XXX**	X
Mātātā / Fernbird	*Bowdleria punctata*		**XXXX**	X
Chatham Island warbler	*Gerygone albofrontata*		**X**	
Riroriro / Grey warbler	*Gerygone igata*	**X**		

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Kakaruai / South Island robin	*Petroica australis*		**XX**	
Toutouwai / North Island robin	*Petroica longipes*		**X**	
Miromiro / Tomtit	*Petroica macrocephala*	**XX**	XX	X
Kakaruai / Black robin	*Petroica traversi*			**X**
Pīwakawaka / New Zealand fantail	*Rhipidura fuliginosa*	**XX**	X	
Warou / Welcome swallow	*Hirundo neoxena*	**X**		
Tauhou / Silvereye	*Zosterops lateralis*	**X**		

Parrots

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Kākāpō	*Strigops habroptilus*			**X**
Kea	*Nestor notabilis*			**X**
Kākā	*Nestor meridionalis*		**X**	X
Red-crowned kākāriki	*Cyanoramphus novaezelandiae*		**XXX**	
Orange-fronted kākāriki	*Cyanoramphus malherbi*			**X**
Yellow-crowned kākāriki	*Cyanoramphus auriceps*	**X**		
Forbe's kākāriki	*Cyanoramphus forbesi*			**X**
Reischek's kākāriki	*Cyanoramphus hochstetteri*		**X**	
Antipodes Island kākāriki	*Cyanoramphus unicolor*		**X**	

Kiwi

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Kiwi / North Island brown kiwi	*Apteryx mantelli*		**X**	
Kiwi pukupuku / Little spotted kiwi	*Apteryx owenii*		**X**	
Roa / Great spotted kiwi	*Apteryx haastii*			**X**
Rowi / Ōkārito brown kiwi	*Apteryx rowi*			**X**
Tokoeka / Southern brown kiwi	*Apteryx australis*			**XXXX**

Pigeons

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Parea / Chatham Island pigeon	*Hemiphaga chathamensis*			**X**
Kererū / New Zealand pigeon	*Hemiphaga novaeseelandiae*	**X**		

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Cuckoos

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Koekoeā / Long-tailed cuckoo	*Eudynamys taitensis*		**X**	
Pīpīwharauroa / Shining cuckoo	*Chrysococcyx lucidus*	**X**		

Ducks

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Whio / Blue duck	*Hymenolaimus malacorhynchos*			**X**

Field, river, and coast birds

Birds of prey

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Kārearea / New Zealand falcon	*Falco novaeseelandiae*		**XX**	X
Ruru / Morepork	*Ninox novaeseelandiae*	**X**		
Kāhu / Swamp harrier	*Circus approximans*	**X**		

Rails

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Takahē	*Porphyrio hochstetteri*			**X**
Pūkeko	*Porphyrio melanotus*	**X**		
Weka	*Gallirallus australis*	X	**XX**	X
Mioweka / Banded rail	*Gallirallus philippensis*		**X**	
Auckland Island rail	*Lewinia muelleri*		**X**	
Koitareke / Marsh crake	*Porzana pusilla*		**X**	
Pūweto / Spotless crake	*Porzana tabuensis*		**X**	
Australian coot	*Fulica atra*		**X**	

Ducks and swans

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Pāteke / Brown teal	*Anas chlorotis*		X	
Auckland Island teal	*Anas aucklandica*			X
Campbell Island teal	*Anas nesiotis*			X
Tētē moroiti / Grey teal	*Anas gracilis*	X		
Kuruwhengi / Australasian shoveler	*Anas rhynchotis*	X		
Pārera / Grey duck	*Anas superciliosa*			X
Pāpango / Scaup	*Aythya novaeseelandiae*	X		
Pūtangitangi / Paradise shelduck	*Tadorna variegata*	X		
Kakīānau / Black swan	*Cygnus atratus*	X		

Grebes

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Weweia / Dabchick	*Poliocephalus rufopectus*		X	
Pūteketeke / Southern crested grebe	*Podiceps cristatus*			X

Herons, bitterns, and spoonbills

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Matuku moana / White-faced heron	*Egretta novaehollandiae*	X		
Matuku moana / Reef heron	*Egretta sacra*			X
Matuku hūrepo / Australasian bittern	*Botaurus poiciloptilus*			X
Kōtuku / White heron	*Ardea modesta*			X
Kōtuku ngutupapa / Royal spoonbill	*Platalea regia*		X	

Kingfishers

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Kōtare / Sacred kingfisher	*Todiramphus sanctus*	X		

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Shags

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Campbell Island shag	*Leucocarbo campbelli*		X	
Kawau / King shag	*Leucocarbo carunculatus*			X
Kawau / Otago shag	*Leucocarbo chalconotus*		X	
Auckland Island shag	*Leucocarbo colensoi*			X
Chatham Island shag	*Leucocarbo onslowi*			X
Bounty Island shag	*Leucocarbo ranfurlyi*		X	
Kawau / Foveaux shag	*Leucocarbo stewarti*			X
Pitt Island shag	*Stictocarbo featherstoni*			X
Kawau tikitiki / Spotted shag	*Stictocarbo punctatus*	X	X	
Kawau / Black Shag	*Phalacrocorax carbo*		X	
Kawaupaka / Little shag	*Phalacrocorax melanoleucos*	X		
Kawau tūī / Little black shag	*Phalacrocorax sulcirostris*		X	
Kāruhiruhi / Pied shag	*Phalacrocorax varius*		X	

Waders

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Ngutu parore / Wrybill	*Anarhynchus frontalis*			X
Tōrea tai / Chatham Island oystercatcher	*Haematopus chathamensis*			X
Tōrea / South Island pied oystercatcher	*Haematopus finschi*		X	
Tōrea pango / Variable oystercatcher	*Haematopus unicolor*		X	
Tūturiwhatu / Banded dotterel	*Charadrius bicinctus*		X	X
Tūturiwhatu / New Zealand dotterel	*Charadrius obscurus*		X	X
Black-fronted dotterel	*Elseyornis melanopes*		X	
Subantarctic snipe	*Coenocorypha aucklandica*		X	XX
Tutukiwi / Snares Island snipe	*Coenocorypha huegeli*		X	
Tutukiwi / Chatham Island snipe	*Coenocorypha pusilla*			X
Kakī / Black stilt	*Himantopus novaezelandiae*			X
Poaka / Pied stilt	*Himantopus himantopus*	X		

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Tūturuatu / New Zealand shore plover	*Thinornis novaeseelandiae*			X
Spur-winged plover	*Vanellus miles*	X		
Huahou / Lesser knot	*Calidris canutus*			X
Kuaka / Bar-tailed godwit	*Limosa lapponica*		X	

Gulls and skuas

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Tarāpuka / Black-billed gull	*Larus bulleri*			X
Tarāpunga / Red-billed gull	*Larus novaehollandiae*		X	
Karoro / Southern black-backed gull	*Larus dominicanus*	X		
Hākoakoa / Brown skua	*Catharacta antarctica*		X	

Terns

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Tarapirohe / Black-fronted tern	*Chlidonias albostriatus*			X
Tara-iti / Fairy tern	*Sternula nereis*			X
Antarctic tern	*Sterna vittata*		X	
Tara / White-fronted tern	*Sterna striata*		X	X
Sooty tern	*Onychoprion fuscata*		X	
Taranui / Caspian tern	*Hydroprogne caspia*			X
Pacific white tern	*Gygis alba*			X
Grey ternlet	*Procelsterna cerulea*		X	
White-capped noddy	*Anous minutus*		X	

Seabirds

Albatross and mollymawks

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Toroa / Antipodean wandering albatross	*Diomedea antipodensis*			XX
Toroa / Southern royal albatross	*Diomedea epomophora*		X	
Toroa / Northern royal albatross	*Diomedea sanfordi*		X	
Toroa pango / Light-mantled sooty albatross	*Phoebetria palpebrata*		X	

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Toroa / Southern Buller's mollymawk	*Thalassarche bulleri*		XX	
Toroa / Chatham Island mollymawk	*Thalassarche eremita*		X	
Toroa / Campbell Island mollymawk	*Thalassarche impavida*			X
Toroa / Salvin's mollymawk	*Thalassarche salvini*			X
Toroa / White-capped mollymawk	*Thalassarche cauta*		X	
Grey-headed mollymawk	*Thalassarche chrysostoma*			X

Petrels and shearwaters

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Kaikōura tītī / Hutton's shearwater	*Puffinus huttoni*			X
Pakahā / Fluttering shearwater	*Puffinus gavia*		X	
Rako / Buller's shearwater	*Puffinus bulleri*		X	
Wedge-tailed shearwater	*Puffinus pacificus*		X	
Tītī / Sooty shearwater	*Puffinus griseus*		X	
Subantarctic little shearwater	*Puffinus elegans*		X	
Toanui / Flesh-footed shearwater	*Puffinus carneipes*			X
Little shearwater	*Puffinus assimilis*		XX	
Pycroft's petrel	*Pterodroma pycrofti*		X	
Tāiko / Chatham Island tāiko	*Pterodroma magentae*			X
Kōrure / Mottled petrel	*Pterodroma inexpectata*		X	
Tītī / Cook's petrel	*Pterodroma cookii*		X	
Chatham Island petrel	*Pterodroma axillaris*			X
Black-winged petrel	*Pterodroma nigripennis*	X		
Kermadec petrel	*Pterodroma neglecta*		X	X
Soft-plumaged petrel	*Pterodroma mollis*		X	
Tītī / Grey-faced petrel	*Pterodroma macroptera*	X		
White-headed petrel	*Pterodroma lessonii*	X		
White-naped petrel	*Pterodroma cervicalis*		X	
Tāiko / Westland petrel	*Procellaria westlandica*		X	

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Tāiko / Black petrel	*Procellaria parkinsoni*			X
Kuia / Grey petrel	*Procellaria cinerea*		X	
White-chinned petrel	*Procellaria aequinoctialis*	X		
South Georgian diving petrel	*Pelecanoides georgicus*			X
Kuaka / Diving petrel	*Pelecanoides urinatrix*	X	XX	
Pāngurunguru / Northern giant petrel	*Macronectes halli*		X	
Snare's Cape petrel	*Daption capense*		X	

Storm petrels and prions

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Kermadec white-faced storm petrel	*Pelagodroma albiclunis*			X
Takahikare-moana / New Zealand white-faced storm petrel	*Pelagodroma marina*		X	
New Zealand storm petrel	*Fregetta maoriana*			X
White-bellied storm petrel	*Fregetta grallaria*			X
Black-bellied storm petrel	*Fregetta tropica*	X		
Grey-backed storm petrel	*Garrodia nereis*		X	
Fulmar prion	*Pachyptila crassirostris*		XXX	
Tōtōrore / Antarctic prion	*Pachyptila desolata*		X	
Tītī wainui / Fairy prion	*Pachyptila turtur*		X	
Pararā / Broad-billed prion	*Pachyptila vittata*		X	

Gannets and boobies

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Tākapu / Australasian gannet	*Morus serrator*	X		
Masked booby	*Sula dactylatra*			X

Penguins

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Hoiho / Yellow-eyed penguin	*Megadyptes antipodes*			X

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Tawaki / Fiordland crested penguin	*Eudyptes pachyrhynchus*			X
Snares crested penguin	*Eudyptes robustus*		X	
Erect-crested penguin	*Eudyptes sclateri*		X	
Eastern rockhopper penguin	*Eudyptes filholi*			X
Australian little penguin	*Eudyptula novaehollandiae*		X	
Kororā / Little penguin	*Eudyptula minor*		XXXX	

Tropicbirds

Common name	Latin name	Doing OK	In some trouble	In serious trouble
Amokura / Red-tailed tropicbird	*Phaethon rubricauda*		X	

EMBARGOED until 2.30pm Wednesday 31 May 2017