Birds of Aotea

THE STATUS OF THE BIRDS OF AOTEA GREAT BARRIER ISLAND: FULL REPORT

John Ogden

Aotea Great Barrier
ENVIRONMENTAL TRUST
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ABOUT JOHN OGDEN

John Ogden MSc., PhD., DSc., FRSNZ was formerly Associate Professor of Forest Ecology at the University of Auckland. His research includes forest dynamics, and long-term change in climate and landscape. John taught in Australia and the United States and published more than 100 scientific papers and articles on a diverse range of ecological topics, including community issues in pest control and the ecology of endangered N.Z. birds. He was the founding chairperson of the Aotea Great Barrier Environmental Trust. After living at Awana for more than 20 years, John now lives at Oruawharo Medlands with his wife Jenni, and itinerant offspring and visitors. This report is based on his records of Aotea's birds, historical records, recently published data from Windy Hill Sanctuary and the Aotea Bird Count, and the expert input of a wide range of students and ecologists working on Aotea, and Auckland Council and Department of Conservation staff.

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FOREWORD

This foreword is firstly a mihi to Ngāti Rehua Ngātiwai ki Aotea. It is impossible to describe here the cultural significance of the birds of these islands to tangata whenua. But actions speak clearly, and many readers may know that it is the goal of Ngāti Rehua Ngātiwai ki Aotea to return kōkako (**Figure 2**) and other lost taonga species to Te Paparahi, the still-forested northern third of the island (**Figure 1**). The Tū Mai Taonga project began operations in November 2022, laying a pathway to enable this to happen. As Opo Ngawaka puts it:

> *"Our vision is to bring back the birdsong these tupuna once heard, and we need to do this in a way that acknowledges their presence and our connection to the living things of the ngāhere".*

FIGURE 1 (HEADER) & FIGURE 2 (ABOVE)

Okiwi Estuary with Te Paparahi in the distance (photo by Chris Morton) & Kōkako (photo by Halema Jamieson)

The deep knowledge held by tangata whenua of the birds that were found on and around Aotea in the nine centuries of their occupation of these islands, is invaluable. Birds indicate changes to seasons or weather, were used for food, adornment, and many other purposes. The local people's knowledge would have been a great help to the first European ornithologist to reach Aotea, Captain William Hutton. In 1867 he was assisted by them and made a now famous "list" of the birds he encountered on "the Barrier Islands". They gave him local names and no doubt, food, transport, and safe passage. Hutton's list, reported to the New Zealand Institute the following year, stand in stark contrast to the deep connections of tangata whenua to birds such as the kōkako, manu ōi (grey faced petrel), kererū; and not least, tūkaiaia, the now extinct great white-headed eagle. *Te Tūkaiaia, Te Tuatara me Te Mauri* (the shark) are the three kaitiaki of Ngāti Rehua-Ngātiwai ki Aotea.

> ***Te Tūkaiaia – The great sea eagle that once soared over Aotea and ensured protection for our people on land or sea. Tūkaiaia represents our connection to the sky and encompasses the entire expanse of Ngāti Rehua-Ngātiwai ki Aotea.***

Kupu Whakataki, Tū Mai Taonga Feasibility Study (Parkes, 2022, p. 190)

This report should be read in the context of the kōrero about Aotea's birds known to mana whenua. These stories are like citizen science on steroids — built up over centuries of observing, harvesting, and living amongst birds, and reverence for them as both spirits and living beings.

This report does bring together data and observations from approximately the last 20 years, capturing most of the recent published and unpublished records of the birds of Aotea. It is the embodiment of more than thirty years of work and life on Aotea by its author John Ogden, an eminent forest ecologist by training, and an extraordinary observer of birds. We offer John's report as an independent resource for iwi, agencies, land managers and the community, and we tautoko the Kaupapa of Tū Mai Taonga, to restore what has been lost and protect it into the future.

Kate Waterhouse

Chair, Aotea Great Barrier Environmental Trust

December 2022

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DEDICATION

Birds of Aotea is dedicated to the memory of Emma Waterhouse, who initiated this project, but died in 2021 at the age of 52. She is greatly missed. E rere wairua, e rere.

EXECUTIVE SUMMARY

1 PURPOSE OF THIS REPORT

A key goal of the Aotea Great Barrier Environmental Trust is to provide in-depth knowledge of the state of the biodiversity and ecology of Aotea. Such information can support better decision making and encourage increased community engagement in efforts to conserve and restore Aotea's biodiversity. This report focuses on the birds of Aotea. It provides a detailed scientific analysis and overview of the status of Aotea's land and seabirds. It follows the 2010 State of Environment Report for Great Barrier Island, which covered all aspects of the natural environment of Aotea, including a section on land and sea birds.

The information in Birds of Aotea is essential to inform decision-making to mitigate and prevent further population declines of the island's birds, and to prevent further extinctions. This report captures a growing literature on the birds and ecosystems of Aotea, which will be invaluable in setting priorities for environmental initiatives designed to protect the biodiversity of the island.

Increasingly, Aotea's value and significance for seabirds, freshwater, coastal (**Figure 3**) and forest birds is being recognised globally, as the world's climate warms. We hope this report shows you, the reader, why this is the case. The full report can also be found at: **gbiet.org/birds-of-aotea**

FIGURE 3 (HEADER)

Awana Pa (photo by Chris Morton)

2 ABOUT AOTEA

One hundred thousand years ago at the start of the last glacial phase, Aotea (**Figure 4**) was connected to the rest of the North Island, carrying forest, wetland, and other habitats. When sea-level rose about 7,500 years ago, Aotea would have had an avifauna similar to the mainland. This may once have included kiwi, flightless rails, and moa. As the sea level rose Aotea was re-isolated as an island and marine and coastal bird species acquired additional productive habitat, and may have increased in abundance, but some larger species may never have established.

The first human arrivals came by sea from Polynesia around 750 years ago and Aotea was visited by four of the founding waka. Māori bought both kuri and kiore with them to Aotea and the surrounding islands, and these animals had important roles in hunting, food gathering, clothing and ritual. Archaeological records suggest people were hunting birds at Harataonga sometime between 1280 and 1410. Some forest was burned, and people, dogs and kiore would have impacted many birds. The island was occupied by a large population, but habitation was mainly coastal. Some areas were burnt seasonally, and people moved often between Aotea and other islands, where seabirds and forest birds formed part of their diet. Coastal wetlands, lagoons and estuaries were used for food, and increased siltation rates followed forest fires. These processes accelerated greatly following colonisation of Aotea by European settlers.

When the brig *Mermaid* arrived in Port Fitzroy in 1796, the ship's log describes kauri growing to the shore and dozens of canoes meeting the ship. Shortly afterwards, inter-tribal battles greatly reduced the number of Ngātiwai people left on Aotea and most of the island was sold to the Crown in a series of disputed transactions (Tatton, 1994). As a result, the forest equivalent to a gold-rush began in the 1840s. European companies logged the kauri (*Agathis australis*) and settlers burnt and cleared much of the lowland forest cover from the 1860s onwards, with coastal wetlands drained for pasture.

It is thought ship rats and feral cats began to spread through the remaining forest and cleared lowlands from the 1840s. Ship rats proved far more destructive to birds than the smaller kiore had been. Fortunately, other introduced mammals, including Norway rats, possums, stoats, ferrets, weasels, and deer, did not reach the main island, and feral goats, have since been eliminated. This is why the birdlife of Aotea is what it is today.

FIGURE 4 (OPPOSITE)

Map by Shaun Lee using data captured for Auckland Council by AAM NZ Ltd


The Needles
Rangiwhakaea Bay
Te Paparahi
Motairehe
Kawa
Rakitū
Okiwi Spit
Whangapoua Estuary
Okiwi
Glenfern Sanctuary
Windy Canyon Walk
Harataonga
Motu Kaikoura
Mt. Heale
Hirakimata / Mt Hobson
Awana Bay
Kaitoke Wetland
Mahuki Island
Wairahi
Whangaparapara
Te Ahumata
Okupu
Oruawharo Bay
Medlands Beach
Tryphena / Rangitāwhiri
Windy Hill

3 MAJOR FINDINGS USE AN ECOSYSTEMS APPROACH

An ecosystem-based approach is used to assess the current status of the birds of Aotea. We describe the birds of the oceanic temperate forests (and the forest types within it, from the cloud forest to mature and successional), the wetlands, the coastal habitats, and finally, the highly modified farmlands. Within this, we use the list of birds observed by Hutton (**Figure 5**) when he visited the island during the summer of 1867-68[1] as a baseline from which to determine which species have become extinct, are threatened, are stable, have established since, or are flourishing.

FIGURE 5

Illustration of Frederick Hutton in 1867 on Aotea (by Shaun Lee)

We acknowledge the mātauranga of mana whenua Ngāti Rehua Ngātiwai ki Aotea, who name Tūkaiaia, the great eagle as one of their kaitiaki. Their knowledge will enrich understanding of the pre-European avifauna, but it could not be included here. Further, there are technical challenges in determining precise numbers of birds. Thus, relative abundance based on frequency of occurrence from scientific and community bird surveys is the predominant metric used throughout this report to ascertain the current status of the birds.

Ngāti Rehua Ngātiwai ki Aotea

3.1 Oceanic Temperate Forest

The original forest on Aotea is described as Oceanic Temperate Forest (**Figure 22**), but it has been extensively modified since the arrival of humans around 750 years ago. The term 'Oceanic' is important as it highlights that there were once large breeding colonies of oceanic seabirds in these forests. This close connection between the ocean and the land is crucial for general health and nutrient

cycling in the ngāhere (forest). Destruction of these forests, first by fire and then logging and the introduction of mammalian predators has had a huge and ongoing impact on the bird life in these ecosystems.

Of the original 52 species described by Hutton, eleven have become locally extinct, including: kōkako (**Figure 2**), hihi/stitchbird, pōpokotea/ whitehead, kākāriki/yellow-crowned parakeet, and tīeke/saddleback. Others are rare and close to extinction: titipounamu/rifleman and miromiro/tomtit; occasional visitors: korimako/bellbird and kārearea/New Zealand falcon; or became locally extinct and have been reintroduced: toutouwai/North Island robin. The current native forest on Aotea can be subdivided into three broad types:

i. Mature forest (**Figure 6**): A tall, relatively undisturbed forest comprised of canopy species such as pūriri, kohekohe, northern rātā, tawa and taraire with a diverse understorey of smaller trees/nīkau palms.
ii. Successional forest (**Figure 7**): Dominated by mānuka and kānuka it is less diverse and simpler in structure than mature forest, with a dynamic composition as one assemblage of species succeeds another.
iii. The cloud forest of Hirakimatā (**Figure 8**): An ancient mature forest which is floristically distinct from the mature forest at lower elevations due to abundant conifers, including kauri.

FIGURE 6

Mature Forest (photo by Chris Morton)

FIGURE 7

Successional Forest (photo by Shaun Lee)

FIGURE 8

Cloud Forest (photo by Biz Bell)

3.1.1 Birds of the Mature Forest

The canopy and sub-canopy of the mature forest (**Figure 6**) is composed predominantly of fruiting or nectar-bearing flowering plants, which produce abundant food for native birds. Eleven of the terrestrial birds originally listed by Hutton still occur in these remnant forests, including tūī, kererū (**Figure 9**), red-crowned kākāriki (**Figure 10**), kākā (**Figure 11**), shining cuckoo, tomtit, fantail, riroriro/grey warbler, koekoeā/long-tailed cuckoo and ruru. The annual Aotea Bird Count (AGBET, 2022) suggests that tūī, kākā and riroriro/grey warbler are probably the most abundant of these 11 species still present in this forest type. While very conspicuous because of their raucous song, total kākā numbers are in the range of just 300-400 birds. Long-tailed cuckoo no longer breed on the island as the host species, the whitehead/pōpokotea, is now extinct, so they are transitory visitors. The future of red-crowned kākāriki (**Figure 10**) is precarious, with fewer than 20 breeding pairs. There is an extensive community rodent and feral cat trapping programme in the Okiwi valley that is assisting survival of this small population. The kererū is considered a 'keystone species' of the oceanic temperate forest ecosystem. This is because of its importance in dispersing the seeds of large-fruited tree species, including miro, tawa, taraire, pūriri and karaka. Its status on Aotea is hard to assess, but as is the case on the mainland it is

FIGURE 9

Kererū on flax (photo by Emma Waterhouse)

probably in decline because of the low fecundity of the species and vulnerability of its single egg and chick to predation during a long incubation period. Ruru, by contrast, is one of the few New Zealand birds to benefit from the presence of mice and rats.

3.1.2 Successional Forest has Lower Diversity

The successional forest (**Figure 7**) is by far the dominant forest type on the island. Areas burned or cleared for farming in the 19th and 20th centuries are now often dominated by mānuka and introduced 'weed' tree species such as pines. Forests originating from earlier fires, are now dominated by kānuka and small broad-leaved trees. The lower diversity and simpler structure of these forests results in lower bird diversity, favouring insectivorous species such as grey warbler, fantail, silver-eye, the migratory pīpīwharauroa/shining cuckoo, and several introduced species. Kōtare/kingfisher are also widespread in these forests.

3.1.3 The Cloud Forest of Hirakimatā

This very distinctive forest type (**Figure 8**) of low canopy conifers is limited to an area of c. 110 Ha above 400 m in altitude on Hirakimatā. The unique structure and composition of this forest and the bird species found there identify this area as one of the most significant ecosystems on Aotea, in the Auckland region, and probably nationally. A few bird species –

FIGURE 10

Kākāriki/Red-crowned parakeet (photo by Sarah Matthews)

FIGURE 11

Kākā at play (photo by Stuart Farquhar)

miromiro/tomtit, toutouwai/North Island robin and kākāriki – which were formerly found throughout Aotea, are almost entirely restricted to this small area and nearby mature forests. The cloud forest of Hirakimatā, and the nearby predator free island of Hauturu, support the remaining population of black petrels in New Zealand, along with smaller numbers of Cook's petrels. Predation by feral cats and rats remain a significant threat to the survival of these two species on the island. Many species of burrow-nesting seabirds were once found throughout Aotea, but because of the loss of much of the forest cover, and the impact of mammalian predators, only a few seabird species continue to breed on the island.

3.2 The Wetlands, Under Siege

Like most of New Zealand, wetlands (**Figure 12**) once covered large areas of the coastal flatlands around Aotea, but many have been drained for conversion to farming. Two significant wetlands remain on the island: (i) Whangapoua Estuary and (ii) Kaitoke Swamp (**Figure 12**), with both classified as of 'outstanding' wildlife value. Many of the birds associated with wetlands are secretive and nocturnal, which makes it challenging to assess their status. Acoustic monitoring provides a valuable new tool for assessment.

FIGURE 12

Kaitoke Swamp (photo by Chris Morton)

FIGURE 13

Bittern at Medlands (photo by Mike Scott)

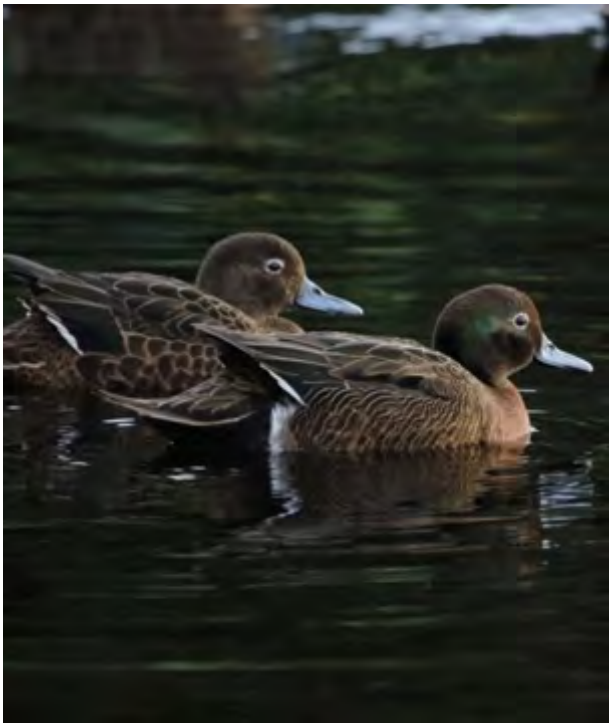


FIGURE 14

Pāteke (photo by Sarah Dwyer)

Key wetland species present include pārera/ grey duck, mātātā/fernbird, matuku-hūrepo/ Australasian bittern (**Figure 13**), pāteke/ brown teal (**Figure 14**), pūweto/spotless crake, and moho pererū/banded rail. With the exception of banded rail, the populations of most of these species are in decline, with some at a critical level and destined for local extinction without major interventions, particularly in terms of predator control.

The decline in the population of pāteke from an estimated population of c. 1200 birds in 1996 to c. 400 in 2021 is alarming. Even in the Okiwi Basin where there is feral cat and pūkeko control and closer monitoring, they have seriously declined. The causes for pāteke decline are varied, but predation by rodents and feral cats is understudied and has likely been underestimated. Grey ducks as a definitive species are close to extinction on Aotea through hybridisation and competition with mallard ducks. Australasian bittern is 'critically endangered' and symptomatic of the dire environmental condition of these wetlands. Community efforts to restore remnant wetlands in Oruawharo Bay will provide more protected habitat for these iconic New Zealand wetland birds on Aotea. Development of an integrated management plan for Aotea's wetlands, including greater predator control and acknowledgment of the fundamental importance of hydrological processes to these wetlands is urgently needed.

3.3 Coastal Birds and Habitats

FIGURE 15

Stony Bay (photo by Chris Morton)

Hutton's list of birds of Aotea includes 20 oceanic birds, four waders, and nine coastal species. Several of the oceanic species nest in burrows in mature forest and were probably once abundant on Aotea. Currently only two species of petrel (black and Cook's; tākoketai and tītī) nest in inland forest and one petrel (grey-faced; ōi), one shearwater (fluttering; pakahā) and common diving petrel (kuaka) breed in small numbers in the coastal forest and/or on some offshore sea stacks. Little penguins/kororā, shags, and reef herons also nest in coastal forest or on the adjacent coast, highlighting the oceanic connection to the Aotea ecosystems.

The extensive coastal zone of Aotea can be readily divided into: (i) steep areas with rocky outcrops and cliffs (**Figure 15** & **Figure 18**), and (ii) sandy beaches, dunes, and estuaries (**Figure 3** & **Figure 17**). The cliffs of Aotea provide few opportunities for nesting seabirds, but the steep, crumbling sandy soil beneath the pōhutukawa (*Metrosideros excelsa*) trees above them is used by a few burrowing petrels and shearwaters. Rocky coastlines, islets, headlands and sandspits provide feeding, and occasionally, nesting sites for shags, matuku moana/reef heron, tarāpunga/red-billed gull and tara/white-fronted tern. The status of the wading birds of sandy beaches and estuaries is based mainly on data from Okiwi Spit and the Whangapoua estuary, which is the most ecologically significant estuarine wetland in the entire Auckland region. This large area of intertidal sand and mudflats, mangroves, saltmarshes, and dunes comprise by far the most significant habitat for shorebirds on Aotea.

3.3.1 The Steep Rocky Fringe of Aotea

Most of the seabirds observed around the rocky shoreline (**Figure 16**) of Aotea are part of a greater Northern New Zealand populations, so their numbers fluctuate in space and time. However, there are small resident populations of reef heron, red-billed and black-backed gulls, white fronted and Caspian terns/tara and kororā/little penguins. A 2021 survey of nesting burrows of kororā using a sniffer dog in accessible sites identified 105 active burrows. However, starvation from oceanic cycles that affect available food supplies are impacting this population and these events are likely to become more frequent with climate change.

Predation is limiting the establishment of petrel and shearwater breeding colonies. Two small but recovering grey faced/ōi (**Figure 19**) breeding colonies occur at Awana Bay and Windy Hill, where an estimated 58 and 11 active burrows were identified in 2020. Fluttering shearwater is one of the most common birds in the Hauraki Gulf but only the occasional nest has been found on Aotea, likely due to their vulnerability to rats. Of the five shag species found in the Gulf just one, the kāruhiruhi/pied shag breeds on Aotea. They usually nest in pōhutukawa or other large trees growing beside tidal creeks near the sea. At least 10 pied shag colonies are known on Aotea, but their overall numbers are likely to be declining. One of the

FIGURE 16

Rangiwhakaea Bay (photo by Chris Morton)

FIGURE 17

Harataonga Coastal Walkway (photo by Shaun Lee)

FIGURE 18

Rakitū (photo by Christine Scott)

FIGURE 19

Ōi/Grey-faced Petrel (photo by Neil Fitzgerald)

largest breeding colonies of seabirds is the gannet colony on Mahuki in the Broken Islands where there are c. 2500 breeding pairs, making it the largest in the Auckland region. Despite appearing to be common the red-billed gull is listed 'At Risk Declining' where competition from fisheries is impacting available food supplies.

3.3.2 Beaches and Estuaries

While there are resident populations of tūturiwhatu/New Zealand dotterel (**Figure 20**) and tōrea pango/variable oyster catcher on Aotea, many of the birds that frequent the beaches (**Figure 17**) and estuaries are migratory. The most significant site on Aotea for these birds is the Okiwi spit where kuaka/bar-tailed godwit, kuriri/Pacific golden plover, pohowera/banded dotterel and ngutu pare/wrybill can be found in relatively small numbers from Spring through to Autumn. While numbers of banded dotterel, bar tailed godwit and Pacific golden plover appear to have changed little over the 22-year period of this report, pied stilts, and wrybills, which have always been present in small numbers, have clearly declined, and the wrybill is now an infrequent visitor. For those birds that breed on the island, protection from predation and human disturbance at breeding sites is critical. With increased tourism and visitors to Aotea, more pressure is occurring at breeding sites, especially where there are uncontrolled dogs and

vehicle access. Feral cats are also a major threat to breeding birds.

3.3.3 Rakitū

Rakitū (**Figure 18**) was declared 'predator free' in 2020 following two aerial bait drops across the island in 2018 to remove rodents. This significant area of predator-free habitat provides a new safe haven for nesting and breeding of many seabirds found around the shores of Aotea. These are likely to include fluttering shearwater, grey faced petrel and diving petrel and possibly Cook's petrel and others. Hutton met a party of mutton birders there in 1867 and it was a very significant place for mana whenua for this and other reasons.

There is opportunity for both the reintroduction and natural recolonisation of forest birds which were once common on the island, such as whitehead/pōpokotea, bellbird/korimako, and kākāriki. There is also an area of wetland probably suitable for the reintroduction of fernbird (pāteke are already present). However, the decision by DoC to return 60 North Island weka to the island, removed before the aerial drops, puts at risk the future recovery of these seabirds (and lizards/invertebrates) because weka are known predators of their eggs. There is an urgent need to develop a restoration and management plan for Rakitū in partnership with Ngāti Rehua Ngātiwai ki Aotea.

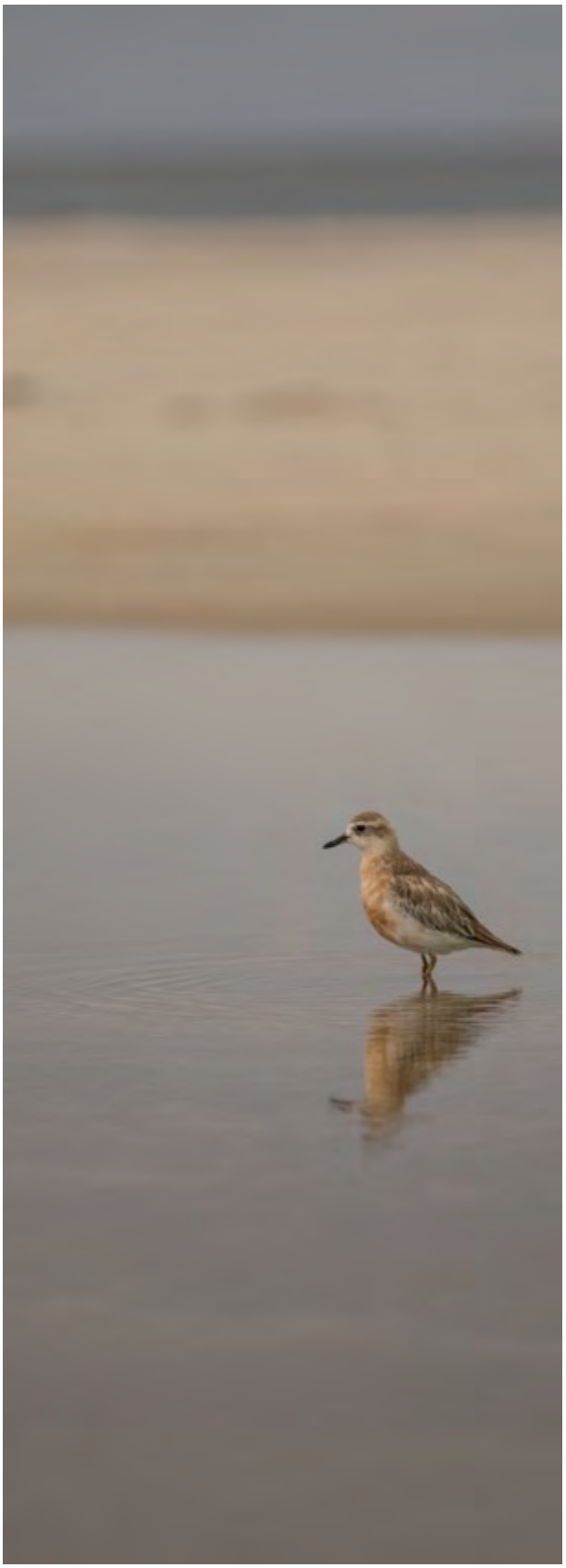


FIGURE 20

Tūturiwhatu on Kaitoke Beach (photo by Shaun Lee)

3.4 Farmlands, a Diverse Birdlife

The farmed and settlement areas of Aotea (**Figure 21**) are where most of the introduced bird species occur, with up to 37 species recorded in annual bird counts. This high level of diversity reflects the diversity of habitat with a mixture of trees, paddocks, wetland or seasonally flooded areas, and human settlements. Most of the species are relatively recent arrivals having been introduced to New Zealand intentionally during the nineteenth century. The populations of the smaller birds, finches in particular, have increased since they reached Aotea, and now appear to be stable or increasing. These species aggregate during the winter months when mixed flocks are notable. However, the most conspicuous birds in summer are pūkeko, kōtare/kingfisher and spur-winged plover. In the damp eastern paddocks paradise shelducks form noisy flocks after breeding. Endemic and native species are relatively infrequent, but the ubiquitous tūī, kākā, grey warbler, fantail, and silvereye are often present where there is scrub or trees.

Two species (the harrier/kāhu and pūkeko) are periodically culled by the Department of Conservation because it is thought they prey on pāteke. Other species (myna, magpie, and spur-winged plover) are generally regarded as pests because of their aggressive behaviour towards other birds. The skylark, although conspicuous when singing, and the pipit/pīhoihoi may be declining. The house sparrow, myna and possibly starling, appear to be increasing as the human population on the island grows.

FIGURE 21

Farmlands (photo by Chris Morton)

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Since Hutton's observations in 1868, Aotea has lost 11 species and gained 18 new species. However, there is an asymmetry around this statistic as the lost and endangered birds are predominantly endemic species with an ancient lineage in New Zealand—and are therefore of much greater cultural, scientific, and conservation value.

Species loss may have slowed, but predators, vegetation transition, and climate warming threaten some with extinction.

The two significant factors that drove the loss of these species have been the loss of habitat from destruction of forests and wetlands and the severe impact of introduced mammalian predators. Looking ahead, three factors will be key drivers of current and future bird abundance and richness on Aotea. They are predators, vegetation transition, and climate change. Unless rats and feral cats are eliminated the many remaining small populations of birds will dwindle to extinction within 50 years.

The transition from successional to mature forest will be important in providing crucial habitat for Aotea's forest-dwelling species. While this transition is underway there is the need to assist and promote it through protection of seed from being taken by rats, removal of highly invasive and flammable species such as pine, and avoiding, at all costs, major fires on the island. Fire is a significant risk and will only increase with the extreme events associated with climate warming. While the impact of climate change is mostly out of our control, we must do all we can to monitor and mitigate against its impacts. While more events such as sea level surges and heavy rainfall are predictable, much is uncertain, including the arrival of new species from elsewhere. This makes for a challenging future environment in which to work. What is certain is the avifauna of Aotea will change because of it.

> ***Tiakina ngā manu, ka ora te ngahere***
> ***Look after the birds and the forest flourishes***
> ***Ka ora te ngahere, ka ora ngā manu***
> ***If the forest flourishes, the birds flourish***

Māori Values and Native Forest (Ngahere) Maanaki Whenua Landcare Research
(Harsworth et al., 2005)

4.2 Recommendations for the Birds of Aotea

ONE	**Recognise Aotea as a connected set of ecosystems of national significance**
	That the highest conservation priority be given to Aotea as a connected whole, ki uta ki tai, and in particular, the nationally significant ecosystems of the: (i) Whangapoua estuary and Okiwi spit: a national significant estuary with many rare and endangered wading and migratory seabirds. (ii) Kaitoke wetland: a nationally significant swamp that provides habitat for the endangered Australasian bittern, spotless crake, and fernbird. (iii) Cloud forest of Hirakimatā: a unique, unmodified forest that is the largest remaining breeding and nesting site for tākoketai/black petrel and one of two for titi/Cook's petrels. (iv) Islets and islands of the Aotea group, including Rakitū and the numerous mana whenua-owned islands around the coast. (v) Te Paparahi: the largest tract of forest in Aotearoa that is free of mustelids, possums, and ungulates.
TWO	**Enable the eradication of rodents and feral cats**
	With the successful establishment of the Ngāti Rehua Ngātiwai ki Aotea lead Tū Mai Taonga project, a pathway to eradication has begun. What is critical, is that long term funding is secured from the accountable local and central government entities to ensure that vision can be achieved. Aotea's biodiversity and ecosystem value in its entirety (see Recommendation 1), and its defendability as Aotearoa's largest predator free island, should be sufficient justification for Auckland Council and the Department of Conservation to partner with iwi and the community to securely fund intensive predator control and eventually, eradication.

THREE	**Support the restoration of Rakitū**
	That urgent attention be given to supporting the development of a restoration plan for Rakitū island, under the leadership and kaitiakitanga of Ngāti Rehua Ngātiwai ki Aotea. The now predator-free status of this island provides an expanded area for nesting and breeding of up to nine seabirds that frequent the "Seabird Super-highway" of northern New Zealand waters and the Hauraki Gulf – at a time when seabird populations are in decline (Cronin, 2017). Crucial for seabird recovery on Rakitū is removal of the introduced North Island weka, which are known to predate eggs of seabirds and limit island ecosystem recovery through predation of lizards and invertebrates.
FOUR	**Accelerate pāteke recovery action on Aotea**
	In order to avoid extinction of this species on Aotea, that the relative role of food availability, habitat health, and predation be urgently investigated and a management plan that is research-informed be developed and funded to ensure the long-term survival of pāteke. Aotea has been a bastion for pāteke and the source of translocations for the majority of mainland populations outside Northland. While many of these populations are currently thriving, on Aotea the parent population is in very serious decline and is symptomatic of the dire state of most other wetland bird species on the island.

John Ogden

George Perry, Barry Scott, and Kate Waterhouse (Editors)

December 2022

[1] Freely available at https://paperspast.natlib.govt.nz/periodicals/TPRSNZ1868-1.2.15.1.16

PART 1: INTRODUCTION

FIGURE 22

View across northern Aotea from Maungapiko (photo by Hannah Smith)

5 BIRDS OF AOTEA

5.1 Author's Notes

This account of the birds of Aotea Great Barrier Island (hereafter called Aotea (map as per **Figure 4**) summarises information about their status on the island up to 2022. We define 'status' as comprising numerical estimates, and an assessment of trends, whether increasing or decreasing, for all species. From such information an overall picture of change should emerge. With the marked exception of a few species, reliable numerical data are not available, however trends can be inferred from published accounts, and from some more recent counts made in sanctuaries and elsewhere throughout the island. Note that this report does not include the detailed mātauranga which is held by Ngāti Rehua Ngātiwai ki Aotea, or any other iwi with connections to Aotea.

The amount of published or otherwise recorded information about particular species on Aotea varies greatly. Where much information is available, I have summarised, simplified, and referenced it. Where little has been published, I have relied largely on personal notes and unpublished reports spanning the last thirty years. In some cases, numerical increases or decreases are well established, but in many cases estimates of abundance and trends are speculative (John Ogden in the field **Figure 23**).

A feature of avifaunas – the list of bird species of an area – is that a few species are common, while many are rare. The commoner species can, at least in principle, be assessed numerically, but inferences on the abundance of rarer species, infrequently occurring on the island or infrequently seen, are less robust. Some of the current rarities may be doomed to local extinction (Australasian bittern, wrybill), or alternatively may increase (spotted dove, royal spoonbill), as climatic and other changes influence their distributions in future. Therefore, comment on their current status is of value.

Lovegrove (2004) discussed the pre-human birds of Aotea, and there is some data from archaeological sites (Allen & Holdaway, 2010), but the earliest recorded list based on observations of living birds is that of Hutton (Hutton, 1868). Since Hutton's visit, ornithologists have made further lists and commented on abundance, so that some gross changes, such as extinctions or new arrivals, can be documented, and some trends suggested with more or less confidence. In particular, the papers by Bell and Brathwaite, based on visits in 1957 and 1960 (Bell & Brathwaite, 1964) by (Ben) Bell in 1975 (Bell, 1976), and a report by Ogle (Ogle, 1980), addressed the status of the majority of the island's birds. I have relied heavily on these for indications of change.

Arid Island/Rakitū, now rat-free, presents a special bird conservation issue because weka were not present in the past, but introduced to Rakitū in 1951 (Bellingham et al., 1982). The status of seabirds that occur around, but (mostly) not currently nesting on, Aotea (including Rakitū), is briefly summarised, based in part on beach-wrecked birds. Trends in waders are covered mainly from records of the author's 20 years at Whangapoua and elsewhere. Introduced passerines, though now the most numerous and conspicuous birds on Aotea, appear to have been cursorily covered by previous writers, and I have relied mostly on my own records for these.

FIGURE 23

John Ogden and student Grace MacMahon on Hirakimatā, ABC 2022 (photo by Kate Waterhouse)

5.2 About Island Avifaunas

There are generally fewer bird species on islands than on equivalent, larger

'continental' land areas, and the population sizes of individual species on islands are often smaller (Diamond, 1985; Diamond & Veitch, 1981; MacArthur & Wilson, 1967). The number of species, and their population sizes are also relatively unstable on islands. Arrival of new species, from the nearby 'mainland' (in the case of Aotea, from the North Island of New Zealand) occurs frequently. Invading species may establish and expand or fail to establish and become extinct.

Extinction, due in part to the chance events that influence small populations, is a feature of island bird populations (Diamond, 1969, 1976; Diamond, 1985; MacArthur & Wilson, 1967). Consequently, even if the total number of bird species remains constant, some species are lost and others are gained, so that the composition of the fauna is dynamic. Before we conserve bird populations on islands using some pre-conceived concept of what the species composition 'ought to be' as a baseline, we must recognise the dynamic nature of bird populations and communities especially on islands. Birds are the most mobile component of the ecosystem; they come and go in time and space.

5.3 Aotea Before the Presence of Humans

During most of the last glacial phase (100,000 years ago) Aotea was connected to the rest of the North Island by continuous land (Hayward, 1986; Hayward, 2017), carrying forest, wetland, and other habitats. When sea-level rose to form the current island shoreline c. 7,500 years ago, Aotea would have had an avifauna similar to the adjacent mainland (Atkinson & Millener, 1991; Lovegrove, 2004). This might have included kiwi, flightless rails (**Figure 24** - a living flighted relative of the flightless rails which may have been present), and moa. However, large species require large areas, and it is likely that some of the 'original' species were lost from Aotea long before Māori arrived and began to harvest them. The former presence of moa is indicated by finds of gizzard stones on dunes and ridges. More mobile species probably commuted between island and mainland, following seasonal food supplies. As the sea level rose after the last glacial cold period, Aotea was re-isolated as an island and marine and coastal bird species acquired additional productive habitat, and possibly increased in abundance.

5.4 Consequences of Human Arrivals

The first human arrivals – Māori –came to Aotearoa New Zealand c. 750 years ago (c. 1280 AD. (Wilmshurst et al., 2008)). Soon after, extensive areas of forest were burned, and humans, dogs (kurī, *Canis familiaris*) and Pacific rats (kiore, *Rattus exulans*) reduced and sometimes exterminated the populations of many indigenous birds (Holdaway, 1989; Worthy & Holdaway, 2002). Coastal wetlands, lagoons and estuaries were modified by exploitation for food, and by increased siltation rates following forest fires (McGlone, 2009; Ogden et al., 2006).

With colonisation of Aotearoa New Zealand by Europeans after c. 1840, forest clearance by logging and fire, conversion of forest to grassland to graze livestock, and drainage of wetlands occurred again and to a much greater extent. Europeans also introduced a new suite of carnivorous mammals to the mainland including hedgehogs (*Erinaceus europaeus*), mice (*Mus musculus*) Norway and ship rats (*Rattus norvegicus* and *R. rattus*), three species of mustelids, stoat (*Mustela erminea*), ferret (*M. putorius*) and weasel (*M. nivalis*), and cats (*Felis catus*) along with omnivorous brush-tailed possums (*Trichosurus vulpecula*) (King, 1984). The combined effects of hugely increased predation and loss of habitat devastated the indigenous avifauna; more species became extinct or survived only on offshore islands not yet reached by predators and less modified by people.

Aotea was a microcosm of these events and processes. Māori bought both kuri and kiore with them to Aotea and the surrounding islands, and these animals had important roles in hunting, food gathering, clothing and ritual (Hori Parata, personal communication). People were hunting birds at Harataonga sometime between 1280 and 1410 AD. By c. 1350 AD, extensive forest areas were cleared by fire (Allen & Holdaway, 2010; Horrocks et al., 2001). If there were small populations of the large flightless birds (such as moa) on Aotea, they would have soon been eliminated

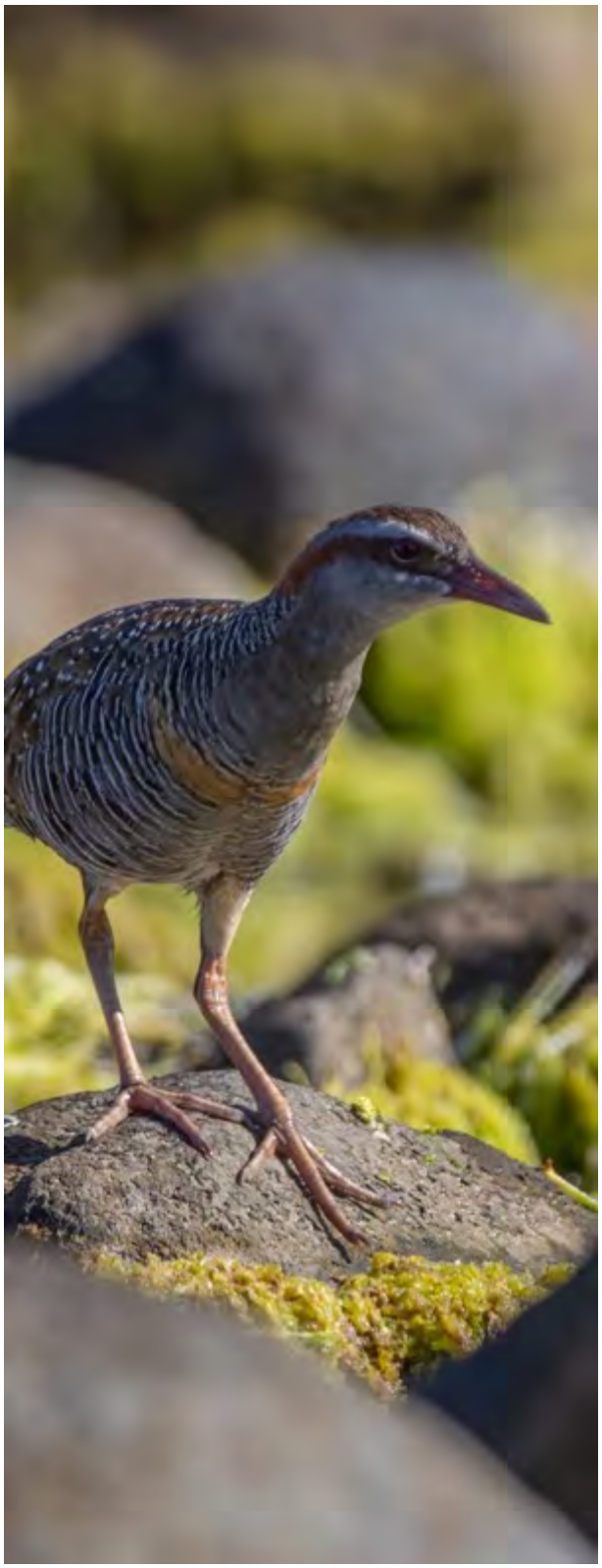


FIGURE 24

Moho pererū/Banded Rail on Mulberry Grove Beach – a living flighted relative of the flightless rails (photo by Shaun Lee)

FIGURE 25

Pāteke/brown teal (photo by Fenella Christian)

– extinction of moa across all of Aotearoa likely happened within 150-200 years of human arrival (Perry et al., 2014).

In her thesis "The Settlement Archaeology of Aotea", Kim Tatton concluded in 1994 that while at some time prior to European settlement Aotea was occupied by a large population, habitation was mainly coastal, and the vegetation remained intact. Some areas were burnt seasonally, as also occurred elsewhere. Ngātiwai people are known to have moved seasonally between Aotea and other islands, and seabirds and forest birds formed part of their diet. When the brig the *Mermaid* arrived in Port Fitzroy in 1796, the ship's log describes kauri growing to the shore and dozens of canoes meeting the ship. Subsequently, inter-tribal battles greatly reduced the number of Ngātiwai people left on Aotea and most of the island was sold to the Crown in a series of disputed transactions (Tatton, 1994).

As a result, something equivalent to a gold-rush began in the 1840s. European companies logged the kauri (*Agathis australis*) forest. Settlers burnt and cleared much of the lowland forest cover, and coastal wetlands were drained for pasture. Logging of kauri continued until the mid-twentieth century, and drainage continues today. It is thought that from c. 1840, predators, particularly ship rats and feral cats, began to spread through the devastated forest and the cleared

lowlands. Some birds could persist in the presence of the smaller kiore, ship rates (or "pākeha rats" as they were called) proved far more destructive than kiore alone had been.

Fortunately, some introduced mammals, including Norway rats, possums, stoats, ferrets, weasels, and deer (*Cervus* spp.), did not reach the main island, and feral goats, which did, have since been eliminated.

5.5 Hutton's List

Hutton (1868) spent two summer months on Aotea in 1868 and compiled a "tolerably complete" list of birds he found there. This list and his notes form one baseline for the pre-European avifauna. Hutton was assisted by local Māori, but their mātauranga relating to Aotea's pre-colonisation birdlife is not known to have been recorded

Hutton lists 52 bird species and mentions three others (two failed introductions: Chinese pheasant and Java sparrow, and the endemic but now nationally extinct New Zealand quail, formerly present on Rangiahua, Flat Island). Hutton's list has a few notable absences – in particular, brown teal/pāteke (*Anas chlorotis* - **Figure 25**) – indeed, he specifically stated that grey duck (*Anas superciliosus*) was the only duck present on the Island.

In making comparisons between Hutton's list, those of later authors, and the current 'checklist' (see Appendix), it is important to note that Hutton's list is based on a relatively short visit. His 1868 total of 52 bird species has now increased to 130, by the addition of species recorded by many observers over more than a century since. These include many migrants and vagrants not likely to be seen in any short observation period. It also includes birds seen in the surrounding waters and washed ashore dead on beaches. Only 62 species currently breed on the island. Seventeen new non-native species have invaded and established during the nineteenth and twentieth centuries, in some cases with large populations.

Hutton's list is of greatest value in indicating the extinction of much of the forest avifauna present in the nineteenth century: of the ten species he listed that are now lost, seven are forest species. Several other indigenous forest species are now close to extinction. In contrast, the new introductions are predominantly birds of agricultural and urban landscapes introduced to New Zealand from elsewhere in the world. Only a few introduced birds are capable of successfully invading intact indigenous forest (Barnagaud et al., 2014; Diamond & Veitch, 1981; McCallum, 1982). The difference in the fate of these two bird groups reflects the changing proportions of mature forest, successional 'scrub' forest and pastoral habitat, and shows the importance of habitat as a key determinant of the success of species.

5.6 Data Sources and Graphs

For the status of species on Aotea since Hutton's (1868) list, the main references consulted were Bell and Brathwaite (1964), Bell (1976), and Ogle (1980) (1981), and references therein. For seabirds, Gaskin and Rayner (2013) was consulted. Data on pāteke (**Figure 25**), swamp harrier and pūkeko were supplied by Department of Conservation officers at Okiwi and Northland, and data on petrels by E. Bell (Wildlife Management International Ltd). Recent national data on all species can be found in Miskelly C. M. [Ed.] New Zealand Birds Online (2022). Occasional observations of rarities by the author or visiting ornithologists are reported were well supported or relevant. Details can be obtained from the author (ogden.trees34@gmail.com).

Since 2000, numerical bird counts have been carried out at Windy Hill Sanctuary, and more than 30 seasonal and annual reports are available. These are referred to in the text as Windy Hill Rosalie Bay Catchment Trust Reports by year (WHRBCT year), or simply reported as Windy Hill data in figure legends. Annual bird counts at Windy Hill were discontinued in 2018 because the beneficial effects of reducing the rat population had been clearly demonstrated by then. Some counts have been reported from Glenfern Sanctuary; a few observations from these are mentioned where relevant but not referred to in detail (Ogden & Thomson, 2012). Between 2006 and 2008 the Great Barrier Island Charitable Trust (GBICT) (subsequently Great Barrier Island Environmental Trust (GBIET), now Aotea Great Barrier Environmental Trust (AGBET) organised a series of 5-minute bird counts (5MBCs) by community members at sites throughout the island (**Figure 26** and **Figure 27**). The first five reports of these surveys (Final Report: GBICT 2009) are referred to as GBICT 2006-2007 (Ogden, 2009). A useful summary of the then current knowledge is in Chapter 13 and Appendix 2 of *The Great Barrier Island State of Environment Report* (GBICT) (2010).

Similar surveys to those undertaken in 2006-2008 were organised in 2019 and 2020 by the same trust (now AGBET) and local employees of Auckland Council, and these have also been used (2021 count data were not available at the time of writing). These later counts are called the 'Aotea Bird Counts' and are referred to as ABC 2019 and ABC 2020. Each annual count in December was reported in the following year (Asena, 2021; Simmonds, 2020). Although there is some coherence in sites and methodology between the GBICT 2006-2008 surveys and those of the ABC, they are hard to compare strictly (Ogden, 2020), except in terms of species frequencies. Frequency is the probability of seeing/hearing a species at a particular place/season in a particular time interval – usually 5 minutes. Percentage frequencies are a crude measure of relative abundance and only useful within a species. Frequency data are influenced by conspicuousness and do not translate into population estimates. Generally, several independent lines of evidence are required to arrive at suggestions of trends, or

population size. The population estimates herein are mostly speculative and should be regarded simply as hypotheses to test by other methods. The unpublished reports, and accounts in AGBET's *Environmental News* (**gbiet.org/environmental-news-archive**) constitute a considerable database, but the different methodologies and seasons complicate between-study comparisons. Generally, only 'frequency' can be used.

5.6.1 Statistical Treatment

Records from the author's diaries covering the period 1999 to 2021 have been analysed and, in many cases, graphed and presented; all graphs, unless otherwise stated, are from unpublished records. Observations since 2021 are generally not included. The meaning of the x (horizontal) axis is in the legend and/or on the graph. Trends over years are generally presented as scatter graphs with linear regression lines. The significance of a trend line is indicated in the legend with n (number of points or averaged points), *r* (correlation coefficient) and *P* (probability of *r* value occurring by chance). Linear trend lines are solid where the correlation coefficient is statistically significant ($P<0.05$), otherwise they are dashed to indicate a possible but unconfirmed trend. Data points on most graphs are averages of several counts, but error bars are generally not shown to simplify presentation. Where error bars are included, they are defined in the legend.

FIGURE 26

Counters at a Glenfern transect during the ABC, 2022 (photo by Christine Clemow)

FIGURE 27

Counter at a Wairahi Mt Young transect point during the ABC, 2022 (photo by Kate Waterhouse)

FIGURE 28

Tākoketai (black petrel) off the coast of Aotea (photo by Hannah Smith)

FIGURE 29

Black petrel chick in burrow (photo by Biz Bell)

The monthly graphs are derived from observations during those months averaged over many years. The trend lines (curves) on those graphs are smoothed lines, with each month (b) smoothed by (a+2b+c)/4 where 'a' is the prior month, 'b' the current month, and 'c' the next month. This formula gives most weight to the number in the month plotted but takes into account the adjacent months. This helps to adjust for the actual dates of the monthly observations sometimes being only a few days apart in different years (e.g. March 30th and April 1st).

5.6.2 Nomenclature

Nomenclature generally follows readily available field guides such as Heather & Robertson (1996), the *Checklist of the Birds of New Zealand* (Gill et al., 2010), and New Zealand Birds Online (2022). The most widely used English or Te Reo Māori bird names are used throughout the text. The scientific Latin binomial names of birds have mostly been avoided in the text. A complete list of the bird species known to have been present on Aotea at some time since 1868, with Māori and scientific names, is in the Appendix. Trinomials (subspecific names) are given only where it seems necessary. Māori names can be singular or plural depending on context.

5.7 Citizen Science

As noted above, considerable quantities of data on Aotea's (map in **Figure 4**) birds have

been obtained by groups of citizens organised by charitable institutions funded by local or national government bodies, or by donations from private individuals. While such projects normally produce a report on their activities, these reports are not peer-reviewed publications and can easily become lost in the bureaucratic system or ever-changing web pages. Moreover, the results obtained are sometimes not adequately analysed, and may suffer from poor reporting of methods or different procedures by different individuals or groups within a project. Having professional input from the start certainly helps to avoid, but does not rule out, such problems. All the citizen bird counting on Aotea presented here has been organised with the help of professionals, and appropriately assessed statistically (Bird et al., 2014). The *interpretation* of the statistical results is the critical step in which awareness of possible errors and acknowledgement that different individuals/groups will vary in their approach, is essential. But, despite these uncertainties, there is a wealth of data in the many reports the author has been involved with, and our knowledge of the bird life on Aotea has been much extended by the enthusiastic participation of many members of the community (Brown & Williams, 2019; Dickinson et al., 2010). The number of environmental/ecological community groups and the quantity and quality of their observations is increasing on Aotea. The information is also now being effectively communicated by cell phone images etc. posted on social media and to online platforms such as ebird.com.

5.8 Habitats

In this account of the status of birds on Aotea, species are discussed in relation to their habitats – the types of places or vegetation cover in which they nest and/or spend most of their time. A few species are almost restricted to a single habitat, and easily categorised, but many feed in one habitat and nest in another. For example, tākoketai (black petrels - **Figure 28** & **Figure 29**) feed at sea but nest mostly in the mountain cloud forest. Seasonal changes in habitat preference, exemplified most extremely by migrant waders, which spend the summer in New Zealand but breed in the Northern Hemisphere, present a similar problem. In fact, most bird species use different habitats at different times, so categorising them by habitat is a simplification. However, as birds are linked to habitats, and habitat change implies changes in species diversity and individual population sizes, this categorisation remains useful.

The broad habitats recognised for this account are forest, wetland, the coastal zone, and farmland. Settled/urban areas are also briefly discussed. Each category can be further subdivided (Singers et al., 2017), but this seems unnecessary on a small island where birds move readily between ecosystems.

The forests fall readily into two categories: (1) the remnant Oceanic Temperate Forest of McGlone et al. (2016), referred to here as ‘mature forest’ and, (2) the younger successional forest that covers most

of the island at present (c. 60% is kānuka shrubland). A third category, (3) the small area of 'cloud forest' on the summit of Hirakimatā (Mt. Hobson), could be considered as the higher altitude version of mature forest, but, because it is floristically distinct (Ogden & Perry, 2023) and contains some remnant bird populations, it is given separate status. The forest of the coastal cliffs and dunes also contains characteristic plants and birds but is now very restricted in area and considered as 'coastal zone' rather than forest.

While the same bird species may occur in all forest categories, their relative abundance varies, so that the two main forest types have distinct, but overlapping, bird communities (**Table 1**).

TABLE 1

Common Name English/Māori	Frequency average in Successional Forest	Frequency average in Mature Forest
Tūī	42	71
Kākā	55	65
NZ Pigeon/Kererū	5	24
Grey Warbler/Riroriro	72	51
Fantail/Pīwakawaka	50	49
Silvereye/Tauhou	55	47

Table 1*: The characteristic native birds of forest and 'scrub' (Successional Forest) on Aotea, based on frequency in 5-minute bird counts in 2006-2008 (Ogden, 2009).*

The six species in **Table 1**, fall into two groups or guilds: (1) large birds (kākā, kererū (**Figure 32**) and tūī (**Figure 33**)), feeding mainly on fruit or nectar (but also some invertebrates seasonally in the case of kākā and tūī), and (2) small birds (grey warbler, fantail, and silvereye), which are mainly or partly insectivorous, although silvereye eat fruit seasonally. The former group are "deeper" or older endemics and characterise the mature forest ecosystem, while the latter three species include a species-level endemic (grey warbler) and two natives, (fantail and silvereye) with closely related species in Australia. This second group, though common throughout, is more characteristic of the successional forests. Both these 'guilds' of species formerly had more endemic species; kōkako, and stitchbird/hihi have been lost from the fruit and nectar group, and bellbird/korimako and kākāriki

almost so. Rifleman/titipounamu and whitehead/pōpokotea have gone from the insectivores, and tomtit/miromiro and robin/toutouwai (the latter reintroduced in 2004 and 2007) are present only in small numbers in the Hirakimatā region. Saddleback/tīeke, which overlapped both groups but fed more on the forest floor, have also gone. In addition, there could have possibly been other losses during the early Polynesian era such as moa, kiwi, rails, kākāpō, flightless wrens, and piopio. Consequently, significant ecological niches are depleted. Removal of these and other components of the forest food web must have had significant impacts on the whole biota (e.g., via loss of pollination, seed dispersal, and ocean-land nutrient movement), but few of these impacts are known. One possible example is the extinction of the bellbird-pollinated and dispersed mistletoe (*Trilepidia adamsii* - **Figure 30**) since the 1920s (Norton, 1991).

Some terrestrial bird species, such as kingfisher/kōtare (**Figure 31**), are seasonally conspicuous in forest. For example, in the 2007 GBICT surveys, kingfisher was the second most prominent bird in lowland bush, with 100% frequency in summer. This species is ubiquitous, very noisy, and probably over-estimated by the 5-minute bird-count method.

FIGURE 30

Extinct Adam's Mistletoe, photograph of illustration by Fanny Osborne drawn on Aotea in around 1920

FIGURE 31

Kōtare in the wetlands (photo by Lotte McIntyre)

FIGURE 32

Kererū (photo by Halema Jamieson)

5.9 Population Estimates for Birds by Habitats

At the end of each habitat section, estimated population sizes for species in that habitat are provided. The estimates are of variable quality; most are little better than guesses based on a few density estimates and extrapolation for vegetation areas (from Landcover Database 2) in which the species is most frequently found. In some cases, other data, even island-wide counts, have been used, giving more confidence in the estimates. However, there is no doubt that these estimates will be wrong in many cases and require independent surveys to validate or reject.

Colour coding draws attention to approximate abundance rankings, and de-emphasises the numerical estimates, which are mostly speculative and require more thorough study. The terms ‘common’, ‘rare’ etc. are best avoided because they may relate to conspicuousness rather than actual population sizes. Many conspicuous species are limited to relatively small parts of the island such as the paddocks or swamps, which together comprise less than 10% of the area of Aotea. Species which are less evident to the general observer, such as dunnock or grey warbler, but that occur in many vegetation types throughout the island, may have large populations for that reason. Thus, the

estimates in the tables may not reflect local abundance or local conspicuousness; they are an attempt to estimate total population sizes on Aotea.

Total population sizes are important because they indicate the vulnerability of a species; tiny populations on islands are at risk of extinction unless they are replenished by inputs from outside including intensive conservation management (Diamond, 1985). Species highly restricted to particular habitats, even if they are frequent in that habitat (e.g., fernbird), may also be at risk if the habitat is reduced or altered.

Colour coding on the tables showing population estimates for birds by habitats is as follows:

Green	Probably > 1000 Individuals
Orange	500 – 1000
Pink	100 – 500
Grey	< 100

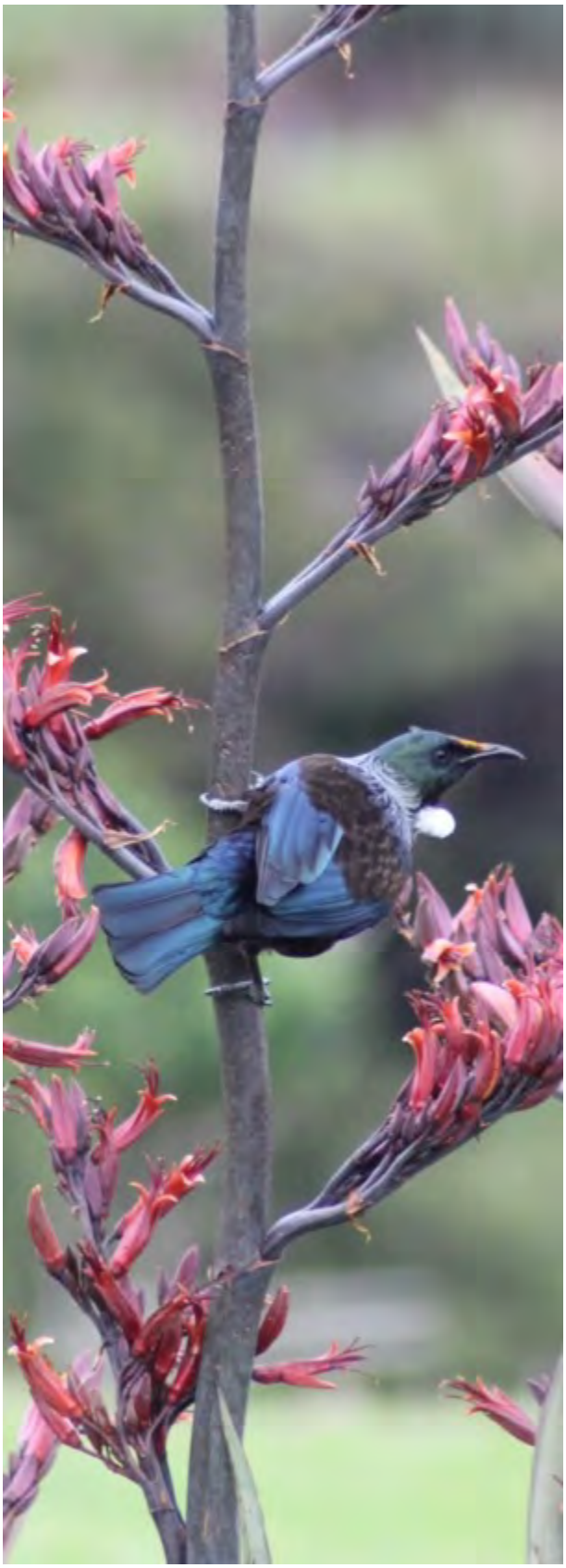


FIGURE 33

Tūī in Flax (photo by Emma Waterhouse)

PART 2: BIRDS OF THE FORESTS

FIGURE 34

Mature Forest: Conifer/broadleaf forest on the Hog's Back, Hirakimatā (photo by John Ogden)

6 THE ORIGINAL OCEANIC TEMPERATE FOREST

6.1 The Temperate Forest Habitat

The pre-Māori forest cover of Aotea was the Oceanic Temperate Forest described by McGlone et al. (2016). The term is useful as it draws attention to the oceanic linkages involved, because several species of oceanic seabirds formerly had large breeding colonies in these forests, that lacked predatory mammals. The remnants of this forest are here referred to as "Mature Forest" (**Figure 34** & **Figure 35**) to distinguish these patches from the widespread cover of younger successional forest dominated by kānuka (*Kunzea ericoides*). Mature forest refers to tall forest with no signs of burning, logging, or other human-induced damage. Canopy gaps due to natural tree death and localised wind-throw occur in mature forest and contribute to its diversity. The mature forest is now present mainly in unburned gullies, and more extensive tracts in the north (Te Paparahi) and south (Windy Hill), covering c. 35% of the Island. Characteristic canopy species are pūriri (*Vitex lucens*), kohekohe (*Dysoxylum/Didymocheton spectabile*), northern rātā (*Metrosideros robusta*), tawa (*Beilschmiedia tawa*) and taraire (*B. tarairi*), with a diverse understorey including smaller angiosperm trees, nīkau palms (*Rhopalostylis sapida*) and tree-ferns (*Cyathea* and *Dicksonia* spp.). Where mature forest remains in the central block it usually has an admixture of kauri (*Agathis australis*) and rimu (*Dacrydium cupressinum*), with other conifers in

the Hirakimatā cloud forest. Much of the central block below 400 m elevation was burned and logged for kauri during the nineteenth and twentieth centuries and the mosaic of mature patches and successional stages there reflects this widespread disturbance, along with the varied topography and aspect (Perry et al., 2010).

The canopy and sub-canopy of the mature forest is composed predominantly of fruiting or nectar-bearing flowering plants, producing abundant food for native birds relying on these resources; for example, in the 2006-2008 surveys by the GBICT, tūī and kākā had average frequencies of 71% and 65%, respectively, in mature forest, compared with 42% and 55% in kānuka stands (**Table 1**). The diverse and complex structure of the mature forest also provides many niches for insects and other invertebrates, so that insectivorous birds can obtain food from the ground layer to the canopy. The GBICT surveys recorded 24 bird species in lowland forest, with 12 species found in all seasons. The surveys did not include nocturnal species, but the morepork/ruru, though widespread in many vegetation types, nests in tree hollows, and is regarded as a mature forest species. The most frequent species in the GBICT surveys were kingfisher, tūī, kākā and the almost ubiquitous grey warbler.

FIGURE 35

Taraire-kohekohe-pūriri forest in Te Paparahi (photo by John Ogden)

6.2 The Lost and Remnant Birds of the Oceanic Temperate Forest

Before human arrival one forest type, the Oceanic Temperate Forest (McGlone et al., 2016) covered the whole island apart from the 'cloud forest' on Hirakimatā summit and the coastal cliffs, swamps, and dunes. The species composition of this forest varied with aspect, altitude, soil moisture and other factors. In the central part of the island, with low-nutrient rhyolitic substrates, there were significant areas of kauri (*Agathis australis*) and other conifers, which were exploited by Europeans. Large areas were logged, burned and/or cleared for farming, creating a new landscape with only remnants of the Oceanic Temperate Forest remaining.

Most of the bird species that once characterised the Oceanic Temperate Forest of Aotea are now rare and restricted in distribution, or totally absent (**Table 2**).

Although the loss of forest cover and destruction of the bird-burrowed and bird-fertilised surface soils which accompanied it (Bellingham et al., 2010), have been important factors in the loss of forest species where those habitats have been lost, there is no doubt that introduced predatory mammals (e.g. kiore, ship rats and feral cats) have played by far the major role in the loss of forest and coastal bird species from the island (Atkinson, 1985; Atkinson, 1986; Innes et al., 2010; King, 1984; Tennyson & Martinson, 2006). As shown by examples elsewhere in the region (Hauturu, Tāwharanui, Tiritiri Mātangi), reversing the declines of surviving endemics, and successful reintroduction of lost bird species, requires the elimination of these predators. The additional indirect effects of competition by rats for invertebrate foods and on forest regeneration by the consumption of seeds and seedlings, has been documented (Best, 1969; Campbell & Atkinson, 1999; Campbell & Atkinson, 2002), but little appreciated (Perry et al., 2015). Harrier/kāhu and morepork/ruru might be the only species that have benefitted from the presence of rodents.

Five former species of the Oceanic Temperate Forest are now extinct on the island (**Table 2**). Three of these (whitehead, saddleback and yellow-crowned kākāriki) were predominantly insectivores; two, kōkako and stitchbird, were more dependent on foliage, nectar, and fruit, but also ate insects, while one species was a raptor feeding on smaller native birds (New Zealand falcon, kārearea). One insectivore (North Island robin) appears to have been successfully re-introduced (see later). While six species have disappeared during the last 150 years, two (kōkako, and whitehead) have disappeared within living memory, and one (rifleman) probably almost so. These locally extinct species are discussed below. The yellow-crowned kākāriki is discussed later under 'kākāriki'.

TABLE 2

Common Name English/Māori	Scientific Name	Current Location or Status	Former Location	Major Foods and Feeding Niche	Status
Kōkako	*Callaeas wilsoni*	Extinct	Throughout but later only Te Paparahi	Fruit, leaves, invertebrates. All levels of forest	AR (incr.)
Bellbird/Korimako*	*Anthornis melanura*	Vagrant from adjacent islands	Throughout (Okiwi, Windy Hill)	Nectar, fruit, invertebrates. All levels of forest	NT
Stitchbird/Hihi	*Notiomystis cincta*	Extinct	Throughout	Nectar, fruit invertebrates. All levels of forest	NV (con.)
North Island robin/Toutouwai**	*Petroica longipes*	Hirakimatā, few	Throughout	Invertebrates. Forest floor	AR (decl.)
Whitehead/Pōpokotea	*Mohoua albicilla*	Extinct	Throughout, and later, Rakitū	Invertebrates. Canopy, trunks branches	NT
Rifleman/Titipounamu ***	*Acanthisitta chloris*	Close to extinction	Hirakimatā Throughout	Invertebrates. Trunks, branches	AR (decl.)
Kākāriki/Yellow-crowned parakeet	*Cyanoramphus auriceps*	Extinct	Throughout	Invertebrates, flowers. Canopy and sub-canopy	AR (decl.)
Saddleback/Tīeke	*Philesturnus rufusater*	Extinct	Throughout	Invertebrates, fruit, nectar. Canopy to forest floor	AR (rec.)
New Zealand falcon/Kārearea*	*Falco novaeseelandiae*	Extinct/ Vagrant	Rare visitor from Coromandel. Sparse throughout.	Small birds. Aerial predator	NV

Table 2*: Forest bird species formerly present on aotea but now extinct or nearly so. (colour: green = predominantly herbivorous (fruit, nectar, leaves); brown = predominantly invertebrates (insects, spiders, worms, caterpillars); yellow = both herbivorous and insectivorous; purple = predatory on small birds, lizards, large insects, and rodents in European times).*

Current location or status on Aotea. Status: overall in New Zealand (Robertson et al., 2021). NT = Not Threatened, AR = At Risk, NV = Nationally Vulnerable. Qualifiers (in brackets) as follows: con. = conservation dependent; rec.= recovering population; nat.= naturally rare; decl.= declining population; incr.= nationally increasing).

**Periodic visitor from adjacent rat-free islands or mainland. **Extinct since 1868 but re-introduced and currently breeding. ***Recent records from Hirakimatā (Elizabeth Bell, personal communication).*

6.2.1 *Kōkako*

The kōkako (**Figure 2** & **Figure 36**) is a wattlebird (Family *Callaeidae*) related to the globally extinct huia (*Heteralocha acutirostris*) and the locally extinct saddleback. There are now no representatives of this family on Aotea (the last kōkako was removed to Hauturu in 1994), although historically both saddleback and kōkako occurred throughout the forest. Both species were recorded by Hutton (1868), and subsequently several observers noted kōkako (Bell, 1976; Bell & Brathwaite, 1964; Hay et al., 1985). Most reports came from the northern forest block (Te Paparahi), but while there is confusion over the numbers (Ogle, 1981, p. 190) it is certain that kōkako were rare there by the 70's. By 1982/1983 a survey of Te Paparahi found only twelve kōkako, all in the catchments draining into Rangiwhakaea Bay. Three were seen in the Ahuriri catchment in 1985 (Williams, 2010). In 1993 only two birds could be located, and these were subsequently caught by DoC staff and transferred to Hauturu in 1994, where they joined a growing population derived from a number of kōkako translocations to Hauturu from the Rotorua district (Innes et al., 2013). Their demise on Aotea was probably the result of ship rat predation of eggs, young and nesting females (Innes et al., 1999; Innes et al., 2010).

Ngāti Rehua Ngātiwai ki Aotea are planning to return offspring of the Aotea kōkako to Te

FIGURE 36

Kōkako - Callaeas wilsoni
(illustrated by Erin Forsyth)

FIGURE 37

Two hihi, photograph of illustration by J. G. Keulemans, Royal Society of New Zealand

Paparahi. The vegetation is recovering following removal of goats and feral cattle, and Tū Mai Taonga, an ambitious plan to rid the area of feral cats and to suppress rats, is currently progressing with the support of the Department of Conservation, Predator Free 2050, Auckland Council, AGBET, and others.

6.2.2 Stitchbird/Hihi

The stitchbird/hihi is (**Figure 37**) the only member of an endemic family (*Notiomystidae*), related to the wattlebird family, which includes the extinct huia, and the endangered kōkako and saddleback. As such, it is one of New Zealand's most significant forest bird species. It was only naturally found in the North Island and on some of its offshore islands.

Hihi were present on Aotea at the time of Hutton's (1868) visit. It was not noted by Weetman (1889) during his prolonged stay on Aotea, nor by any subsequent observers. It declined rapidly throughout New Zealand in the 1870s. It has been suggested this was due to disease (Oliver, 1955), but the rapid decline is more likely due to predation by ship rats, which swept across the North Island after 1860 (Atkinson, 1973). The decline occurred too early for mustelids to have played an important role. Extensive destruction of the forest may have also contributed, by reducing the area of mature forest habitat. Like the saddleback, hihi nest and roost in tree cavities, a behaviour which makes these two species extremely vulnerable to ship rat predation. This behaviour may explain the early extinction of both species on the North Island mainland during the second half of the nineteenth century (see Lovegrove *et al*. in Wade and Veitch (2019)). By the late 1880s, hihi were extinct everywhere in the North Island except on Hauturu, which remained free of European rats, and which became a reserve in 1894 (Hamilton, 1961; Wade & Veitch, 2019). Between 1976 and 1980 feral cats were removed from Hauturu, and in 2004, kiore were eradicated using an aerial drop of brodifacoum anti-coagulant bait (see Griffiths & Veitch in Wade and Veitch (2019). Although hihi increased on Hauturu after cats were eradicated in 1980, their numbers did not change much following the removal of kiore in 2004 (see Lovegrove *et al*. in Wade and Veitch (2019). Like the saddleback, hihi seem able to coexist with kiore, possibly because unlike European rats, kiore rarely prey on adult birds. The hihi is now more secure following translocations to other rat-free sanctuaries. These interventions have improved the conservation status of this species from 'Nationally Endangered' to 'Nationally Vulnerable'. However, its continued survival depends on habitats free of European rats and cats, so there is little chance of its return to Aotea until those predators can be removed.

6.2.3 Whitehead/Pōpokotea (and Brown Creeper/Pīpipi)

The whitehead and its close South Island relatives, the yellowhead (mohua) and brown creeper (pīpipi), are related to the whistlers (*Pachycephalidae*) of Australia. Whiteheads move through the forest

canopy in small flocks, gleaning invertebrates from trunks, branches, and twigs. They often occur in mixed feeding flocks with other forest birds. Although whiteheads were very common in Hutton's time, by 1957 they were restricted to the remnant forest on Rakitū (Bell & Brathwaite, 1964), but could not be found there in 1981 (Bellingham et al., 1982). It was one of the last forest species to disappear from Aotea. Apart from the abundant population on Hauturu and thriving translocated populations at Tiritiri Mātangi and Tāwharanui, whiteheads have vanished from the northern North Island, roughly north of a line between Te Aroha and Pirongia (Heather & Robertson, 1996). Bell justifiably (1976) questions the record of brown creeper by Hutton & Kirk (1868). Hutton (1868) refers to it as the "New Zealand titmouse (*Certhiparus novae zelandiae*) seen by Mr. Kirk on Arid Island". The brown creeper only occurs in the South Island and Kirk clearly confused it with the closely related whitehead, which was common on Aotea at the time of Hutton's (1868) visit, and still present on Rakitū in 1957 (Bell & Brathwaite, 1964).

6.2.4 Rifleman/Titipounamu

Along with the rock wren (*Xenicus gilviventris*) of alpine regions in the South Island, the rifleman belongs to a unique, primitive family of passerines, the Acanthisittidae (New Zealand wrens) (Heather & Robertson, 1996). This family includes several extinct species of flightless wrens (Tennyson & Martinson, 2006) and the bush wren (*Xenicus longipes*), the last population of which became extinct when ship rats invaded Big South Cape Islands in the 1960s (Atkinson, 1978; Bell, 1978; Russell & Broome, 2016). The rifleman is the smallest (6 g) New Zealand bird, feeding on insects found in arboreal moss and debris, or on tree trunks and branches. Hutton (1868) recorded it in the Harataonga area, and it seems likely that it was present throughout the tall forest. However, it was not found in an extensive search of both the central and northern forests by D. V. Merton in 1963 (Bell & Brathwaite, 1964), nor again in 300-400 hours searching by Colin Ogle and his team in 1980 (Ogle, 1980). Cook did not record it in his observations on Hirakimatā in the summer of 2012-2013 (Cook, 2013). However, there have been several unconfirmed sightings of the species this century, and in late January 2018 Biz Bell heard the species and saw a male near the top of the South Fork track on Hirakimatā. In 2020, rifleman was again heard by her near the same spot (Bell E.A. personal communication). Consequently, although very few may remain, it appears that the rifleman is possibly not extinct on Aotea.

6.2.5 North Island Saddleback/Tīeke

Like hihi, the saddleback/tīeke (**Figure 38**) was recorded on Aotea by Hutton (1868), but disappeared soon after, probably because of predation by introduced cats and ship rats. Extensive destruction of the forest may also have contributed to their decline, by reducing the area of suitable habitat. Their diet is mainly invertebrates taken from the forest floor to the canopy, although seasonally, nectar and

fruit are also important. Tīeke spend much time on the ground digging invertebrates from rotted wood and flicking aside the leaf litter. When feeding on the ground they are vulnerable to cat predation. Perhaps more importantly, their cavity roosting and nesting behaviour, like the hihi, makes them extremely vulnerable to rat predation throughout the year. Along with hihi, tīeke was an early mainland extinction following European settlement when ship rats spread across much of the country (Atkinson, 1973). Tīeke are also very vulnerable to stoat predation; however, the species was already very rare in the North Island by the time stoats became widespread after the 1880s (King, 1984).

The former Wildlife Service successfully pioneered inter-island bird translocations with this species in the 1960s (Merton, 1973). Since then, tīeke have been re-introduced to many Hauraki Gulf islands free of European rats and, more recently, to some largely predator-free mainland sanctuaries. Tīeke would probably flourish on Aotea if rats and feral cats were removed. At the time of writing, planning had begun to attempt a carefully monitored experimental introduction of tīeke to Aotea's rat-managed sanctuaries at Glenfern and Windy Hill.

FIGURE 38

North Island Saddleback/Tīeke on Tiritiri Mātangi (photo by Tim Lovegrove)

6.2.6 New Zealand Falcon/Kārearea

New Zealand has very few birds of prey with the widespread swamp harrier and endemic New Zealand falcon/kārearea the only extant raptors (several others, including the sea eagle tūkaiaia, guardian of Ngāti Rehua Ngātiwai ki Aotea, suffering extinction following human arrival). Kārearea was reported as present on Aotea by both Hutton (1868) and by Bell (1976) a century later. It also formerly occurred on Hauturu (Wade & Veitch, 2019). It is no longer present as a breeding species, but there are recent records from Mount Moehau and the Hunua Ranges to the south, and there are occasional reports from the island (Bell, 1976). One was found dead at Tryphena in 2010. Kārearea may wander widely and are even occasionally reported in suburban Auckland. Kārearea could potentially recolonise the island from the small populations in the Coromandel and Hunua Ranges, or from populations further south.

The chances of birds recolonising successfully would be enhanced if the island was free of important predators, such as feral cats, which are known predators of adults and chicks (Seaton & Hyde, 2013).

6.3 Status of Birds in Mature Forest

Eleven terrestrial forest birds listed by Hutton (1868) still occur on the island, albeit in much reduced numbers in most cases (**Table 3**). Five of these, characterising mature forest (tūī, kākā, kererū, korimako (bellbird), and ruru (morepork)), are discussed in more detail.

TABLE 3

Common Name English/Māori	Scientific Name	Current Location or Status	Former Location	Major Foods and Feeding Niche	Status
Tūī	*Prosthemadera novaeseelandiae*	Common Throughout	Throughout	Fruit, nectar, invertebrates	NT (incr.)
Kākā	*Nestor meridionalis*	Common Throughout	Throughout	Fruit, nectar, large invertebrates	AR (rec.)
Red-crowned kākāriki	*Cyanoramphus novaezelandiae*	Hirakimatā, Okiwi. Sparse	Throughout	Fruit, seeds nectar	AR (rel.)
NZ Pigeon/Kererū/ Kūkupa	*Hemiphaga novaeseelandiae*	Throughout	Throughout	Foliage, flowers, fruit	NT (CD incr.)
Shining cuckoo/ Pīpīwharauroa	*Chrysococcyx lucidus*	Summer resident. Throughout	Summer resident. Throughout	Invertebrates, especially caterpillars	NT
Tomtit/Miromiro	*Petroica macrocephala*	Hirakimatā Few	Throughout	Invertebrates	NT
Fantail/Pīwakawaka	*Rhipidura fuliginosa*	Abundant Throughout	Throughout	Aerial insectivore	NT
Grey Warbler/Riroriro	*Gerygone igata*	Abundant Throughout	Throughout	Aerial insectivore and leaf gleaner	NT
Silvereye/Tauhou	*Zosterops lateralis*	Abundant Throughout	Throughout	Nectar, small fruits, small invertebrates	NT
Long-tailed cuckoo/Koekoeā	*Eudynamys taitensis*	Rare passage migrant	More common. Throughout	Large invertebrates, skinks, small birds	NV
Morepork/Ruru	*Ninox novaeseelandiae*	Common Throughout	Throughout	Large invertebrates, lizards, rodents, small birds	NT

Table 3*: Extant forest birds with current and former status, food and feeding niches. (Colour: Green = predominantly herbivorous (fruit, nectar, leaves); brown = predominantly invertebrates (insects, spiders, worms, caterpillars); yellow = both herbivorous and insectivorous; purple = predatory on small birds, lizards, large insects, and rodents in European times).*

Current location or status on Aotea. Threat status: overall in New Zealand (Robertson et al. 2021).

6.3.1 Kākā

The kākā (**Figure 39** & **Figure 40**) is an endemic forest parrot, closely related to the kea of the South Island mountains. In early European times it was abundant throughout New Zealand, but by 1900 it had retreated to larger forested areas and some offshore islands. Numbers continued to decline, and by 2008 its conservation status was listed as 'Threatened, Nationally Vulnerable' (Miskelly et al., 2008). Being a hole-nesting species (**Figure 41**), kākā are extremely vulnerable to mammalian predators, especially stoats, which prey on nesting females and young (Wilson et al., 1998). However, conservation efforts (especially stoat and rat control) in some larger forest areas have lessened the threat. Although still listed as "At Risk" (Robertson et al., 2021) the species is recovering. Around mainland Auckland, kākā are increasing at Tāwharanui and in the Hunua Ranges, and they are becoming more common on Waiheke, where they are now breeding. Kākā are abundant on Hauturu, and the Hen and Chicken Islands. Radio-tracking has shown that kākā commute between these islands and Aotea, so it can be regarded as one population. Since Aotea lacks mustelids, it is a stronghold for the species. However, while kākā may benefit by having safe nesting holes on mustelid-free Aotea, young birds are vulnerable to feral cat predation. The young are especially at risk just after leaving the nest

FIGURE 39

Kākā - Nestor meridionalis

(illustrated by Erin Forsyth)

FIGURE 40

Kākā in Port Fitzroy (photo by Stuart Farquhar)

FIGURE 41

Kākā chicks in hollow tree base at Windy Hill. Note: differences in chick size because eggs hatch on different days (photo by Henry Cookson, Windy Hill Rosalie Bay Catchment Trust)

when they may spend several days living on the ground before they learn to climb and fly.

Kākā are gregarious and active, and in early summer they are noisy and conspicuous on flowering pōhutukawa (*Meterosideros excelsa*). They move widely about the island during day and night, calling loudly, so it is easy to get the impression there are more kākā than there actually are. Getting an accurate count for the whole island requires simultaneous counts at many locations. From 2007 to 2010 the GBICT made five widespread kākā counts, which were partly synchronised with observations on the mainland (Ogden, 2011a). The results indicated that the summer population was 200-250 birds, but about half this number in the winter (**Figure 42**).

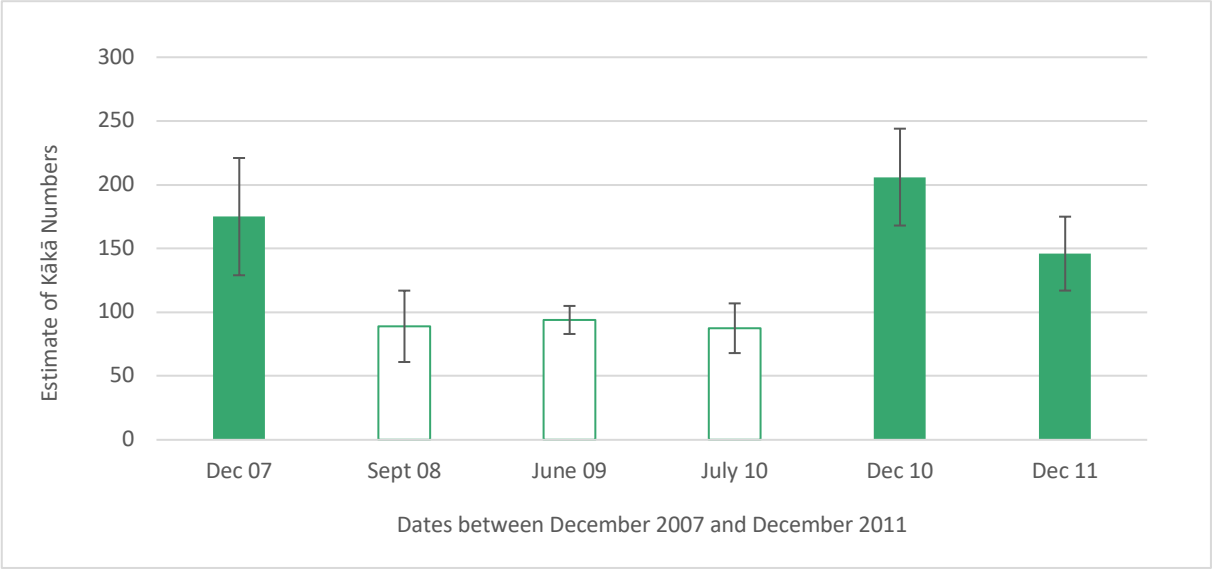
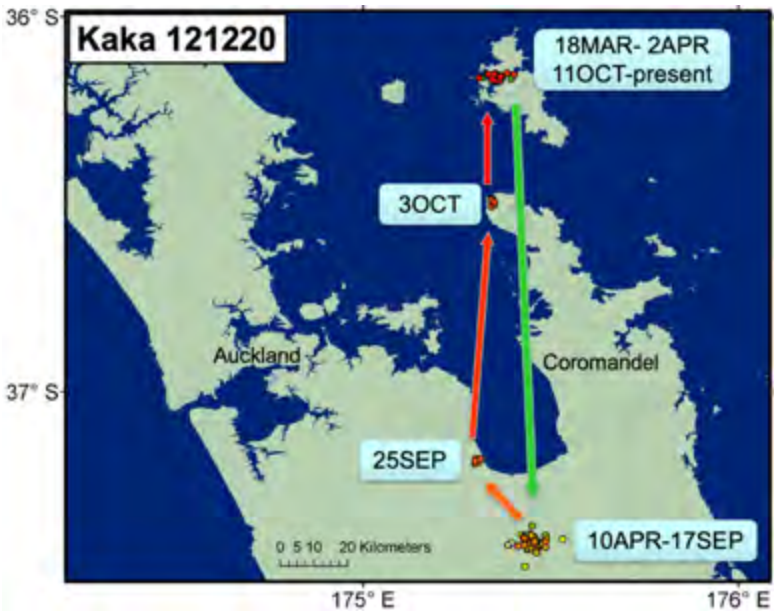


FIGURE 42

Number of kākā on Aotea estimated from counts using standardised methods. Counts are from observations by 33-45 people at 16 locations throughout the island on 6 dates between Dec 2007 & Dec 2011. Unshaded bars are winter, shaded are summer. The error bars are maximum and minimum estimates at each date (Ogden, 2011a).

FIGURE 43

Movement of one ARGOS satellite-tagged kākā between summer at Glenfern Sanctuary and winter around Hamilton (2013). From: Todd Landers, Auckland Council Research and Evaluation Unit (RIMU). Green arrow indicates implied outward journey, red indicates return. '11 Oct- present' is date of return to Glenfern.



These figures are possibly underestimates as some remote parts of the island were not covered. The decline in April-May coincided with an increase on the mainland (Suzi Phillips, pers. communications and www.kakawatchnz.org). Movement to the mainland has since been confirmed with ARGOS satellite receiver tags on birds (Figure 43). Kākā return to the island in September and October when they also decline on the mainland. Food supplies are likely to be an important driver of these migratory movements (Ogden, 2011a).

FIGURE 44

Comparison of kākā numbers in rat managed area compared to unmanaged control at Windy Hill Sanctuary 2008-2018. The dashed lines show statistically non-significant trends similar in both rat-managed and unmanaged areas (Ogden, 2019).

There is much anecdotal evidence that kākā have increased on Aotea over the last two decades at least. This is supported by comparison of GBICT counts in 2007, Windy Hill data, and the Aotea Bird Count (ABC) results in 2019. Five-minute bird counts at Windy Hill in June 2000, 2011, and 2021, show significant increasing trends for kākā (Ogden, 2021b).The current estimated density/ha of kākā at Windy Hill is c. 1.5 in the rat-managed area and c. 0.5 in the unmanaged control. The island-wide 5 MBCs of the 2019 ABC Survey (Simmonds, 2020) gave a density of 1.24 ind/ha. These densities are certainly inflated by the conspicuousness of the species, and probably cannot be realistically extrapolated to the whole island. Most bird count methods, including 5 MBCs, only provide an index of numbers, although a long-term 5 MBC programme can provide useful trends over time.

TABLE 4

Tree Species	Summer	Winter
Number of Observations	***93***	***103***
Pōhutukawa	30.1	6.7
Pūriri	6.5	12.6
Total native trees (a)	63.1	41.8
Pines	11.8	18.4
Total exotic (non-fruit) trees (b)	21.5	39.7
Total fruit tress (c)	17.2	18.6

Table 4: *Percentage of observations of kākā in different tree species or tree categories. Highest seasonal values bold. Total observations = (a) + (b) + (c) (Modified from Ogden (2011a), Table 4).*

Nesting has increased at Windy Hill as pest control has reduced rats and feral cats, although the positive trends in kākā counted in the annual bird counts are not statistically significant (**Figure 44**). Over three seasons since 2017-18, 44 kākā nests were found in the 770 ha of Windy Hill, giving 0.04 adult birds/ha, which extrapolates to 364 for the whole Aotea forest area (excluding mānuka/kānuka as mostly unsuitable for nesting). This figure is higher than the GBICT estimate of 200-250 kākā in 2010, but given the errors involved in these extrapolations, the evidence for an increasing population, and the likelihood that not all birds breed every year, it seems likely that the current summer kākā

population lies somewhere in the range of 300-400 birds. **Figure 42** shows that it is probably about half this number in winter.

While the species is classified here as herbivorous, kākā use their sturdy bills to shred tree-bark and dig into live wood to extract insect grubs such as kānuka longhorn beetle larvae, which are a significant feature of its diet. In summer, kākā take nectar from pōhutukawa and flax (*Phormium tenax*), and may attack ripening fruit in gardens, especially citrus. Pūriri flowers and fruit are important in the diet throughout the year but especially in winter. Over-wintering kākā make much use of exotic trees, especially the cones and sap of wilding pines (*Pinus radiata, P. pinaster*) (**Table 4**). They are particularly destructive to Macadamia (*M. integrifolia*) crops.

6.3.2 Tūī

Anecdotal views that tūī (**Figure 33** & **Figure 45**) have increased on Aotea over the last few decades are supported by more objective bird counts. Both the Windy Hill bird counts, and comparison of the GBICT and ABC island-wide counts, support this (**Figure 46**) (Ogden, 2019, 2020). Several factors may be involved. Tūī are highly mobile and increased breeding success at Windy Hill has probably contributed to the expansion of tūī to other areas, such as gardens in Tryphena.

FIGURE 45

Tūī - Prosthemadera novaeseelandiae (illustrated by Erin Forsyth)

Tūī respond well to pest mammal control (Fitzgerald et al., 2019; Miskelly, 2018), and community rat control projects throughout the island, along with increased planting of suitable food plants (flax, pūriri, pōhutukawa and some exotic species), have probably benefitted this species. Tūī are sufficiently well-known, common, and conspicuous, that these trends have been noticed; however, this may not be the case for less common and less well-known species. Assuming that tūī are present at a density c. 1.0/ha in all forested and garden areas except the successional forest, this gives a population of c. 10,000 for Aotea, but it could be up to twice this figure. The tūī is secure nationally and is listed as 'Not Threatened' (Robertson et al., 2021).

FIGURE 46

Comparison of tūī increase in rat-managed area compared with unmanaged control at Windy Hill Sanctuary 2008-2018. The solid line ('managed') indicates a statistically significant trend. (r = 0.6919; n =11; P <0.02). The suggested increasing trend (dotted line, non-significant) in the control area (dark green) may be a result of 'spill-over' from adjacent managed areas.

6.3.3 Bellbird/Korimako

Bellbirds (**Figure 47**) were noted as common by Hutton (1868). However, 20 years later they were rare (Weetman, 1889), and by 1964 they were seen only on Rakitū (Bell & Brathwaite, 1964). They were still present on Rakitū in 1981 (Bellingham et al., 1982) but have not been recorded since then. However, occasional vagrants are seen at various locations on Aotea, probably originating from other nearby islands where bellbirds are abundant such as Hauturu, the Hen and Chickens, Cuvier, the Mercury Group, and Tiritiri Mātangi. Following the kiore eradication on Hauturu in 2004 there was a major influx of bellbirds in March and April 2005, with records from Port Fitzroy, Whangaparapara, Okiwi, Awana, Harataonga, Tryphena, and Windy Hill. In February 2005, bellbirds also arrived *en masse*

at Tāwharanui, colonising the park shortly after the pest-proof fence was completed and most predatory mammals eradicated (Wade & Veitch, 2019). In the pest-free environment the population expanded quickly, and the bellbird is now one of the most conspicuous bush birds at Tāwharanui. On Aotea, a few of the 2005 influx survived into 2006 or longer at Okiwi (Halema Jamieson, personal communication), but they did not establish a breeding population. However, in September 2005 a pair were observed feeding young on Cooper's Castle; this is the only recent observation of breeding on Aotea (GBICT (2010) Appendix 2). There have been several records of bellbirds from Okiwi and Port Fitzroy since 2020, but still no evidence of breeding. Bellbirds are vulnerable to ship rats at their nests and roosts, so it is unlikely that they will re-establish successfully on Aotea while ship rat numbers remain high over the greater part of the island. The bellbird is secure nationally and is especially common on the mainland in the South Island. It is listed as 'Not Threatened' (Robertson et al., 2021).

FIGURE 47

Korimako – Anthornis melanura

(illustrated by Erin Forsyth)

6.3.4 Kererū

Kererū (**Figure 48** & **Figure 49**), also known as Kūkupa in some northern areas, is a large (c. 650 g), endemic fruit-pigeon, which was formerly very widespread and abundant in New Zealand. It was hunted for food by both Māori and Europeans. Its decline on Aotea mirrors that elsewhere in the country. Since protection (1921), there is evidence of a slow

FIGURE 48

Kererū about to commence diving display flight near Windy Hill (photo by John Ogden)

recovery throughout New Zealand, but illegal hunting, the species' low fecundity and vulnerability to predation of the single egg and chick puts it at some risk. A study on the mainland at Wenderholm Regional Park showed that nests were very vulnerable to predation by ship rats and possums and nesting success improved when these predators were controlled (James & Clout, 1996). Elsewhere, kererū have recovered well where predatory mammals have been controlled or removed (Miskelly, 2018). Kererū is secure nationally and is listed as 'Not Threatened' (Robertson et al., 2021). In modified landscapes kererū feed on the foliage and fruit of a wide range of exotic food plants including willow, poplar, tree lucerne, broom, and plum. It may be a disperser of some weedy species (Wotton & McAlpine, 2015).

In contrast with former times, flocks of more than ten birds are rarely seen now on Aotea. The status of kererū is hard to assess because unless one hears its noisy, whirring flight or sees its characteristic display flight, it can remain well hidden in the canopy and be easily overlooked. Bell and Brathwaite (1964) noted that in 1957 single birds were often seen in the bush, and a flock of 23 was seen flying high near Tryphena. In the same year the number of kererū on Rakitū was estimated at between 25 and 50. It was recorded as "common in forested areas" on Rakitū by (Bellingham et al., 1982) and the largest flock seen was "up to 11 birds".

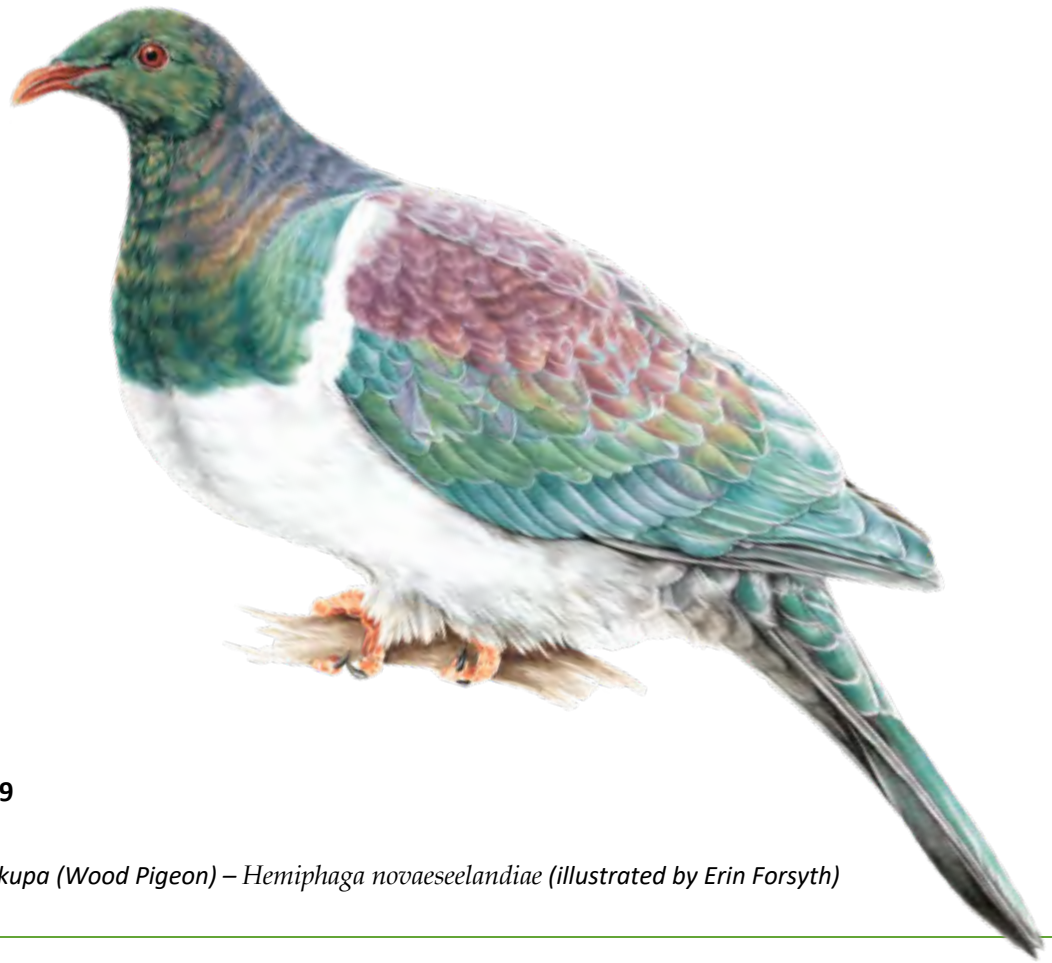


FIGURE 49

Kererū/Kūkupa (Wood Pigeon) – Hemiphaga novaeseelandiae (illustrated by Erin Forsyth)

FIGURE 50

Comparison of kererū densities in rat-managed area compared with unmanaged control at Windy Hill Sanctuary 2008-2018. The possible increase in the managed area is not statistically significant, but contrasts with the unmanaged trend.

The overall impression gained from locals involved in the 2006-2008 GBICT surveys, was that kererū were then in decline. At that time, average frequencies of 20-25% were recorded in areas where there was some mature forest, but much lower frequencies in mānuka and kānuka bush (5%) and open paddocks (1%). However, since then, counts at Windy Hill, and the ABC counts (2019) suggest a gradual increase, at least in areas where rats are being controlled (**Figure 50**). The species was recorded on 14 of the 16 ABC transect lines in 2019, with an estimated mean density of 1.02 individuals/ha. in the surveyed areas (Simmonds, 2020). This is similar to the estimated density currently in the rat-managed area at Windy Hill.

The kererū is regarded as a 'keystone species' of the Oceanic Temperate Forest ecosystem because of its role in dispersing the seeds of large-fruited tree species, such as miro, tawa, taraire, pūriri and karaka, which are often too large to be readily dispersed by other birds (Clout & Hay, 1989), although this ecosystem function may have been over-emphasised (Kelly et al., 2010). Kererū congregate in flocks to exploit these fruits, especially when they are abundant. The largest reported flock on Aotea comprised c. 50, which gathered at Windy Hill in 2021 to eat the abundant taraire fruit. Kererū may be particularly important on Aotea, where remnant patches of mature forest containing these species cannot easily extend from gullies or lowland sites to replace the ubiquitous kānuka stands, without such 'up-hill' assistance. At 1.0 kererū/10 ha. of mature forest the population would be c. 950 birds, but this is possibly an overestimate.

6.3.5 *Morepork/Ruru*

Ruru (**Figure 51** & **Figure 52**) are found throughout New Zealand, and have close relatives in Australia, southern New Guinea, and the Solomon Islands. The only other owls known from New Zealand are the extinct laughing owl (whēkau, *Sceloglaux* (*Ninox*) *albifacies*), the introduced little owl (*Athene noctua)* and the barn owl (*Tyto alba*), which has recently been found breeding in Northland (Hyde et al., 2009). Laughing owls were formerly widespread across NZ but became extinct in the early twentieth century (Tennyson & Martinson, 2006). There is no evidence that laughing owls occurred on Aotea. The morepork on the other hand, was present on Aotea in 1868 and remains abundant. It may be one of the few New Zealand birds to have benefitted from the presence of rats and mice, which form part of the diet on Aotea. Ruru are sometimes killed as a consequence of eating poisoned rats, although large insects, such as wētā and moths are its main prey.

In late summer ruru can be heard at night everywhere on Aotea, from sea level to the summit of Hirakimatā. Presumably this is a time for reaffirming territorial boundaries. Diurnal 5-minute bird counts are clearly not suitable for this species, but auditory triangulation could establish densities/ha. Although ruru will use ground cavities such as abandoned petrel burrows, nesting is predominantly in tree hollows, suggesting the

FIGURE 51

Ruru (Morepork) – Ninox novaeseelandiae (illustrated by Erin Forsyth)

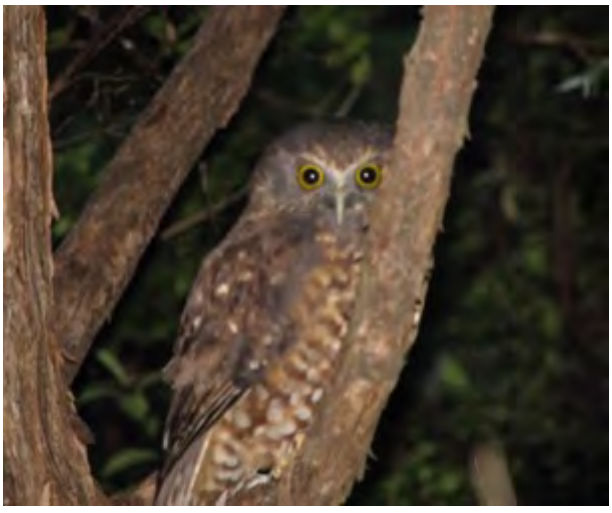


FIGURE 52

Morepork roosting in tree during day at Awana (photo by Jenni Ogden)

presence of mature trees is important. There are c. 10,000 ha of indigenous forest on Aotea and if the hunting territory of a pair is c. 5 ha (Imboden, 1975), this suggests an upper bound of c. 2000 pairs island-wide. However, the average territory on Aotea might be greater, making this a maximum figure.

6.3.6 Long-tailed cuckoo/Koekoeā

Two species of cuckoo occur on Aotea, the larger long-tailed cuckoo/koekoeā, which passes through on migration and the smaller shining cuckoo/pīpīwharauroa, which breeds locally and parasitises the nests of grey warblers/riroriro. Both species were noted by Hutton (1868). The long-tailed cuckoo was not certainly recorded again until 1980 (Ogle, 1981). However, this was perhaps a function of brief visits at the wrong season, since the species is now heard most years, both on its southward migration from the Pacific Islands in spring and on its northern migration, usually in March (**Figure 53**). Their harsh calls are sometimes heard in the central forest block, Hirakimatā, the Wairahi Valley, and Windy Hill at other times, so it is possible that a few remain on Aotea throughout the summer. However, their North Island host species, the whitehead/pōpokotea, is now extinct on Aotea, so presumably they are no longer breeding on the island. Long-tailed cuckoos are common on Hauturu where whiteheads are abundant, so it is assumed they would have been common on Aotea when whiteheads were still present. The long-tailed cuckoo is uncommon and is listed as 'Nationally Vulnerable' (Robertson et al., 2021). Because long-tailed cuckoos are thought to move between specific locations in the Pacific Islands in their migration, the loss of the Aotea sub-population not only implies loss somewhere else (their wintering islands or islands), but also suggests that, even if whiteheads are successfully returned to Aotea in future, long-tailed cuckoos may not return without human intervention to move their eggs to whitehead nests (Gill, 2010).

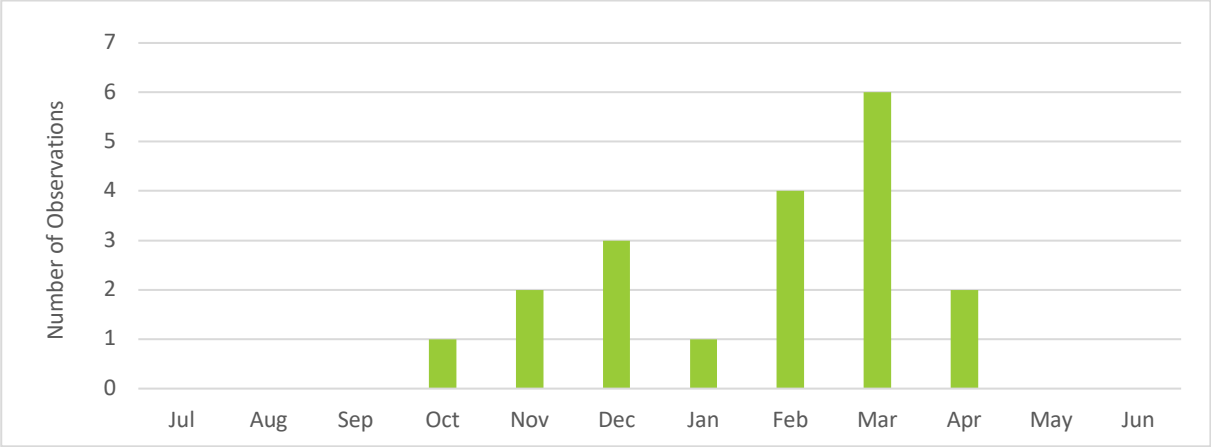


FIGURE 53

Records of long-tailed cuckoo on Aotea, 2001-2021. The two peaks possibly represent southward and northward-migrating birds.

7 THE SUCCESSIONAL FOREST: MĀNUKA/KĀNUKA SCRUB

7.1 The Successional Forest Habitat

FIGURE 54

Successional kānuka forest at Windy Hill Sanctuary (photo by John Ogden)

Successional forest types (**Figure 54**), often referred to as 'scrub', are those developing following a large disturbance to the canopy of former mature forest (usually by fire/wind). Mānuka-kānuka scrub blankets the hills over most of the island (54%). Throughout this area, forest stature is increasing and its composition changing, as one assemblage of species is succeeded by another. Areas burned or cleared for farming during the period of European colonisation, are now often dominated by mānuka (*Leptospermum scoparium*), and introduced 'weed' trees (*Pinus, Hakea, Ulex* etc.). Forests originating from earlier (pre-European) fires, are now dominated by kānuka (*Kunzea ericoides*) and some small broad-leaved trees (*Coprosma arborea, Myrsine australis, Pseudopanax* and *Pittosporum* species).

The successional forests are less diverse and of simpler structure than the mature forest, with relatively few fruit- or nectar-bearing trees. Consequently, they have lower bird diversity, favouring a few insectivorous species. For example, grey warbler/riroriro had an average frequency of 72% in this type

of forest, compared to 51% in more mature bush. GBICT surveys recorded a total of only 16 species in mānuka-kānuka stands, and seasonal differences were more marked than in the mature lowland forests, with only five species found at all seasons.

Grey warbler/riroriro, fantail/pīwakawaka and silvereye/tauhou are widespread species characteristic of this forest (**Table 1**). These three small insectivores feed in different ways and, although there is broad overlap, have slightly different preferred habitats. However, in winter especially, mixed flocks comprising mainly silvereyes but with 'following' grey warblers and fantails, are frequent in lowland kānuka forest and gardens.

Kingfishers/kōtare are prominent only in the summer months. The only introduced birds regularly found in native vegetation, chaffinch (*Fringilla coelebs*) and blackbird (*Turdus merula*), are more frequent in the successional forest (37% and 22% respectively) than in more mature forest (2% and 11% respectively). Forests currently dominated by kānuka are changing rapidly as the old kānuka trees die and are replaced by the understorey of regenerating trees, which are often more attractive to birds. As the vegetation changes, so too does the suite of associated birds.

7.2 Status of Birds in Successional Forest

7.2.1 Grey Warbler/Riroriro

The genus *Gerygone* is diverse and widespread in Australia, and species very similar to the New Zealand one occurs in New Caledonia, the Chathams and Norfolk Island. The species is common throughout New Zealand, and it is one of the few endemic bush birds to have adapted well to human modification of the landscape (Heather & Robertson, 1996).

Data from Windy Hill (**Figure 55**) suggests a possible increase in grey warbler density over the past decade. Rat predation not only appears to reduce grey warbler abundance, but also imposes high annual variability, which renders population trends more difficult to identify statistically. However, the Aotea Great Barrier Environmental Trust (AGBET) (2019) counts (Simmonds, 2020) also showed an increased frequency compared to the 2007 GBICT data (Ogden 2020), so the increasing trend is supported. Density/ha. data may be more reliable than for some other species because grey warblers are less likely to be seen or heard if they are more than 25 m distant from the observer. A mean density between that for unmanaged areas at Windy Hill (c. 1.5/ha.) and that recorded in the 2019 AGBET counts (c. 2.2/ha), applied to all mānuka-kānuka scrub areas on the island (14,742ha) suggests a total population of 20-30,000 grey warblers (Simmonds, 2020). The large breeding population of grey warblers supports shining cuckoos, which lay their eggs in the nests of this species.

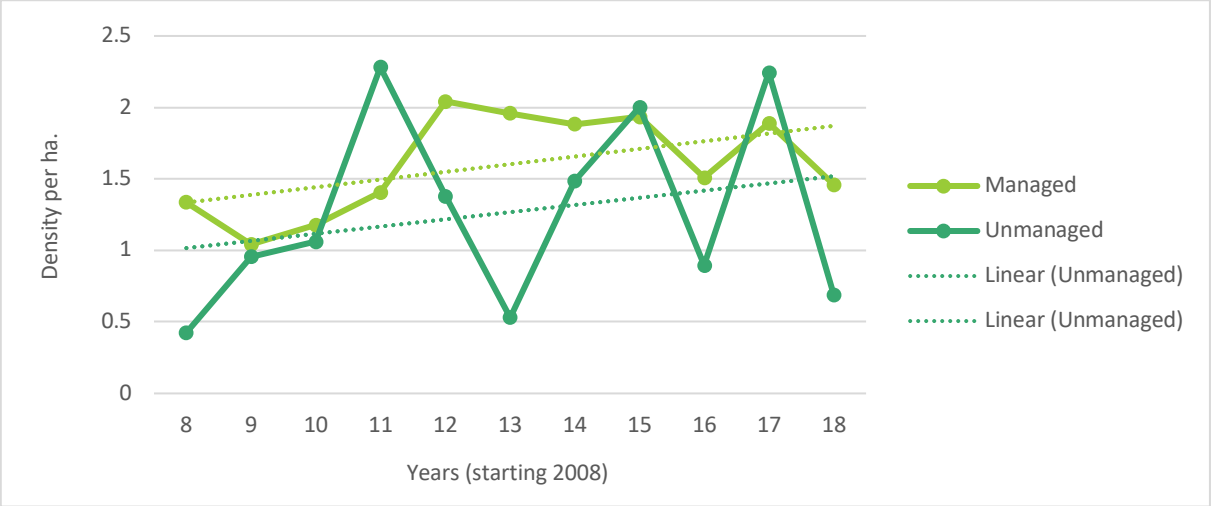


FIGURE 55

Trends in density/ha. for grey warbler over 2008-2018 at Windy Hill Sanctuary. Managed areas are shown in light green, unmanaged controls in dark green. Dashed linear trend lines are not statistically significant.

7.2.2 Shining Cuckoo/Pīpīwharauroa

Shining cuckoos (**Figure 56**) are migrants that breed in New Zealand (and Australia) and winter in the Solomon Islands and Bismarck archipelago (Melanesia) (Gill, 2010). While they occur in all habitats with trees, they are most common in kānuka-dominated successional forest. Shining cuckoos are sociable and vocal on arriving on Aotea in September. Over the last 20 years the earliest recorded arrival date noted on Aotea was 7th September (2012) and the latest 27th October (2018), with a median of 26th September. Shining cuckoos are brood parasites of grey warblers. Young shining cuckoos give penetrating begging calls, making them quite easy to find in December-January. The adults are very silent after January. The dates of departure or routes to their wintering grounds are unknown.

FIGURE 56

Pīpīwharauroa (Shining Cuckoo) –

Chrysococcyx lucidus (illustrated by Erin Forsyth)

7.2.3 Fantail/Pīwakawaka

Like *Gerygone*, the genus *Rhipidura* also has several Australian species, and one of these (grey fantail) has forms considered conspecific with New Zealand's *R. fuliginosa* (Heather & Robertson, 1996).

Fantails (**Figure 57** & **Figure 58**) are one of the most conspicuous and widespread birds on the island. However, their abundance is easily over-estimated because of their habit of approaching and following observers (who presumably disturb flying insects making them available to the birds). Data from Windy Hill (**Figure 59**) indicate an increasing (non-significant) trend for this species, but other longer-term comparisons (2007-2019, (Ogden, 2020); 2000-2011, (Ogden, 2021b), (Ogden, 2011b)) imply the opposite.

The estimated density is c. 1/ha. from the Windy Hill counts in unmanaged bush, while the Aotea Great Barrier Environmental Trust (2019) estimate was 2.5/ha (Simmonds, 2020). These estimates imply that fantail and grey warbler have total island-wide populations of a similar size (likely in excess of 20,000 each). The fantail is more inclined to occupy wetter gully forest than grey warbler, which prefers the drier slopes and ridges. Consequently, as kānuka forest is succeeded by larger angiosperm trees, a shift in the relative proportions of the two species seems likely.

FIGURE 57

Pīwakawaka (Fantail) – Rhipidura fuliginosa (illustrated by Erin Forsyth)

FIGURE 58

Pīwakawaka (Fantail) (photo by Shaun Lee)

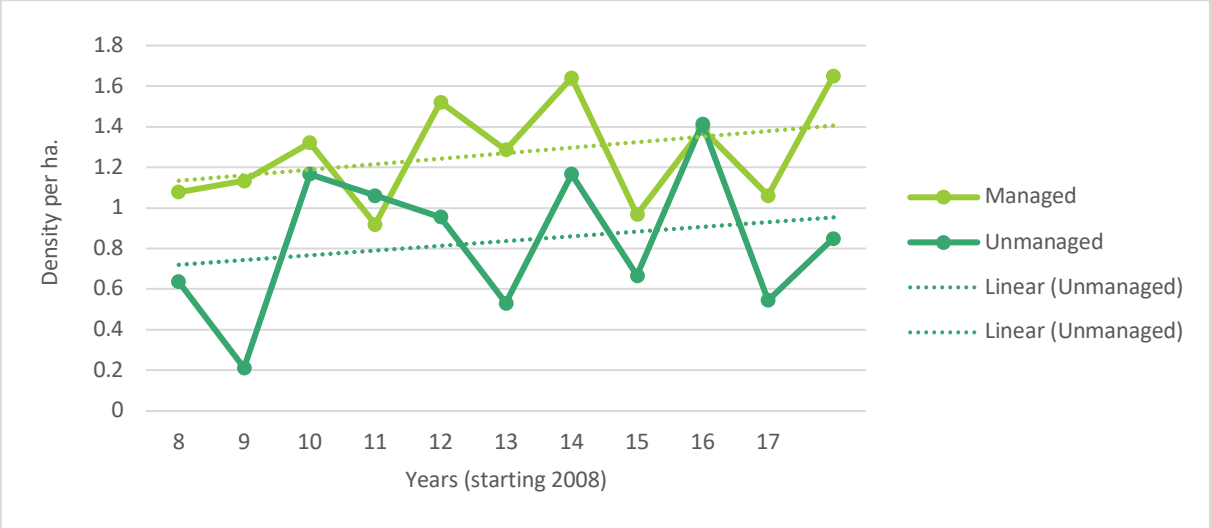


FIGURE 59

Trends in density/ha. for fantail over 2008-2018 at Windy Hill Sanctuary.

7.2.4 Silvereye/Tauhou

The silvereye (**Figure 61**) is a member of the widespread genus *Zosterops*, which has species in Africa, southern Asia, Australasia and the Pacific (Heather & Robertson, 1996). The Tasmanian form of *Z. lateralis* arrived in New Zealand naturally, probably between 1832 and 1856, and had reached Aotea by 1864 (Bell & Brathwaite, 1964). After welcome swallow (*Hirundo neoxena*) it was probably the species that spread most rapidly from the mainland.

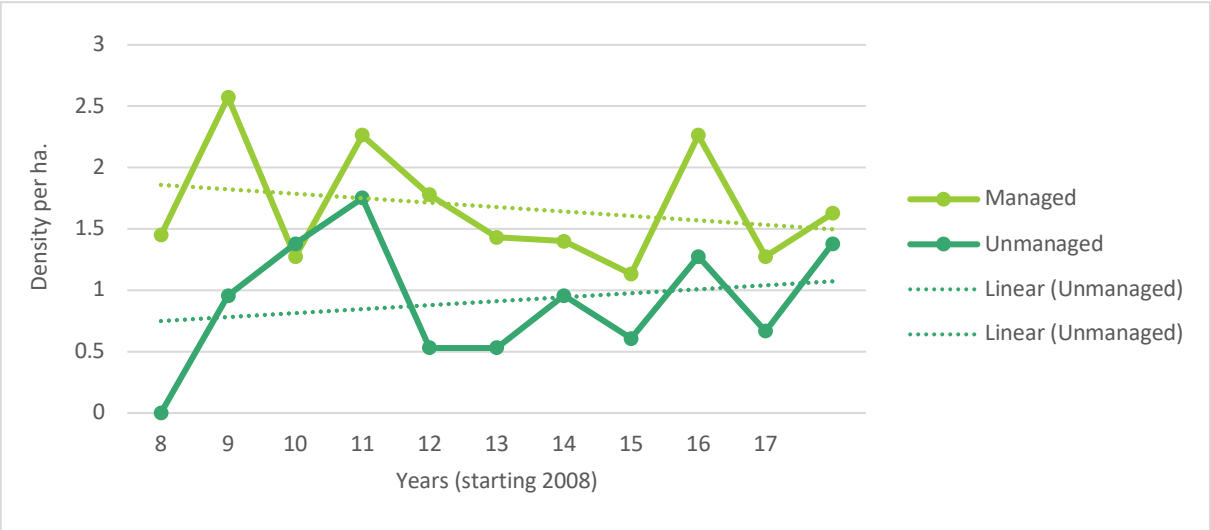


FIGURE 60

Trends in density/ha. for silvereye over 2008-2018 at Windy Hill Sanctuary. Dashed linear trend lines are statistically non-significant but indicate no overall changes in population density.

FIGURE 61

Tauhou (Silvereye) (photo by Shaun Lee)

It is now one of New Zealand's most abundant birds. Although it is insectivorous it also eats fruit and nectar, and due to its abundance, possibly competes with some larger species more dependent on these foods.

In the 2006-2008 GBICT counts, silvereye was one of the most frequent species, occurring in all of the five vegetation groups and in all seasons. Silvereyes were generally more conspicuous in winter, when flocking occurs, but higher frequencies occurred in summer in mānuka-kānuka stands. Flocks of up to 50 birds have been recorded in March, April, and May at Awana. In the summer 2019 counts by AGBET, silvereye occurred frequently in all 16 transects. Point frequency values averaged between 40-50% in both data sets, but with wide variability. As in the Windy Hill data (**Figure 60**), no temporal trends could be established. The species has clearly increased since 1864 (cf. Bell and Brathwaite (1964)) and may have reached a plateau in equilibrium with food supplies, varying climate and predation pressure, but with wide annual fluctuations. Due to its flocking habit, true density is difficult to estimate, but an average of c. 1.6/ha and a maximum of 3.8 (ABC 2019, Simmonds (2020)) seem plausible. However, these estimates are difficult to extrapolate to larger areas because, even more so than the other small species in this group, silvereyes are locally and seasonally mobile.

8 BIRDS OF THE CLOUD FOREST

8.1 The Cloud Forest of Hirakimatā

FIGURE 62

Cloud forest c. 400 m at Hirakimatā. Kauri and juvenile rimu in gap (photo by John Ogden)

This distinctive forest type (**Figure 62**) is found only above 400 m on Hirakimatā. The low canopy is predominantly composed of coniferous trees; yellow silver pine (*Lepidothamnus intermedius*), toatoa (*Phyllocladus glaucus*), monoao (*Halocarpus kirkii*), kauri (*Agathis australis*), rimu (*Dacrydium cupressinum*) tōtara kōtukutuku (*Podocarpus laetus/P. hallii*). Angiosperm trees are southern rātā (*Metrosideros umbellata*), tāwari (*Ixerba brexioides*) and tāwheowheo (*Quintinia serrata*), and the shrubs *Pittosporum kirkii, Archeria racemosa* and *Coprosma dodonaeifolia.* This flora covers an area of only c. 110 ha above 400 m altitude on Hirakimatā and is not found on other summits on the island (such as Tataweka) with areas above 400m (Ogden & Perry, 2023). The cloud forest is composed of low, twisted, often semi-prostrate trees, covered in epiphytic monocotyledons, orchids, filmy ferns, and mosses, giving a characteristic physiognomy. Currently a few bird species (North Island tomtit/miromiro, North Island robin/toutouwai and kākāriki), which were formerly found throughout Aotea, are almost entirely restricted to this small area and nearby patches of mature forest.

Many species of burrowing seabirds once nested in forests throughout Aotea, serving an important ecosystem function by mixing and aerating the soil with their annual burrowing, and adding important fertiliser such as nitrates and phosphates in their guano and food debris (Bellingham et al., 2010). Loss of this ecosystem over much of Aotea, because of widespread fires following arrival of humans, and the effects of predatory mammals on the seabirds, has fundamentally changed the nature of the forest

cover and the habitats and food supplies available for terrestrial birds. The unburned remnant cloud forest and adjacent areas of Hirakimatā now support most of the remaining nesting population of black petrels (*Procellaria parkinsoni*) in New Zealand, along with smaller numbers of Cook's petrels (*Pterodroma cookii*).

8.2 Status of Birds in Cloud and Adjacent Forest

8.2.1 North Island Tomtit/Miromiro

As with the genus *Cyanoramphus* (kākāriki), two members of the genus *Petroica* (North Island tomtit and robin) were present on Aotea at the time of Hutton's visit (1868), but only the tomtit survived habitat reduction and introduced predators. Tomtits (**Figure 63** & **Figure 64**) and robins have overlapping forest habitat and feeding niches, though robins favour lower altitudes and spend more time foraging in leaf litter on the ground than tomtits. Tomtits are more inclined to pick insects from foliage or bark or catch them on the wing (Heather & Robertson, 1996). The wholesale forest destruction of the mining and logging era on Aotea, probably removed much of the best robin habitat but possibly left small tomtit populations on the undisturbed forested summits. Alternatively, tomtits could have disappeared but then recolonised Aotea, as they have much stronger dispersal ability than robins, especially over open water, as shown by a translocated tomtit caught in the

FIGURE 63

Miromiro (Tomtit) – Petroica macrocephala
(illustrated by Erin Forsyth)

FIGURE 64

Tomtit on Hirakimatā, January 2021
(photo by Biz Bell, WMIL)

Hunua Ranges and released on Tiritiri Mātangi, which then flew back to the spot where it was caught in the Hunua Ranges (Parker et al., 2004). Tomtits usually nest more frequently and lay more eggs than robins, so high fecundity may be another reason for their persistence. Both species nest in spring to early summer when rat numbers are usually lowest. Currently, the tomtit population is predominantly above c. 400 m in the remnant conifer forest on Hirakimatā and a few adjacent summits, where the density is about one individual per hectare. The total population was estimated between 37-82 birds in 2013 (Cook, 2013). Tomtits are rarely encountered in kānuka forest, or away from areas of 'old growth' with kauri and/or podocarps. Ongoing presence on Hirakimatā has been noted by a recent survey by Kevin Parker and in the 2021 Aotea Bird Count (Parker, 2022; Perry, 2022).

8.2.2 North Island Robin/Toutouwai

The North Island robin (**Figure 65** & **Figure 67**), or toutouwai, became extinct on Aotea, possibly during the period of most extreme forest destruction early in the twentieth century. The spread of ship rats across the island during the late 19th century probably also took a heavy toll. However, roughly a century later, attempts have been made to reintroduce robins, despite initial uncertainty, they are now established in the same area as tomtits. The coincidence in the habitats is note-worthy because the robins were *not* introduced there. Between 2004 and 2012 there were four translocations of robins to Windy Hill and Glenfern Sanctuaries from three different source populations (**Table 5**). Both Sanctuaries are predominantly covered by mature kānuka forest, with small pockets of broadleaf, podocarp (at Glenfern, kauri forest). Successful breeding occurred in kānuka-dominated areas in both pest-managed sanctuaries, but the number of pairs at each sanctuary declined in successive years so that neither currently has any robins.

FIGURE 65

Toutouwai (North Island Robin) – Petroica longipes (illustrated by Erin Forsyth)

FIGURE 66

Robins from Pureora being released by children from the Aotea community, Windy Hill Sanctuary, April 2012 (photo by John Ogden)

FIGURE 67

North Island Robin feeding chicks at Glenfern Sanctuary, 2009 (photo by Tony Bouzaid)

Despite good adult survivorship (one of the original Tiritiri birds survived at least 10 years), and high nesting and fledging success at Windy Hill, fecundity averaged only 2.6 eggs/nest and the juvenile birds dispersed out of the sanctuary, where their chances of successful breeding were expected to be much reduced by predation. However, in 2006 a Windy Hill banded bird was recorded on Hirakimatā. In subsequent years, banded Windy Hill and Glenfern birds, along with un-banded birds were recorded on Hirakimatā, suggestive of breeding there. Following the release of the Mokoia birds, there were several records from the Tryphena and Kaitoke areas in 2010. An un-banded bird, probably from Glenfern, was seen at the Kaiarara hut in 2011.

Robins were apparently breeding above 400m on Hirakimatā between 2010 and 2012. In 2012 two 'Pureora' birds were observed on Hirakimatā just a week after their release at Windy Hill (**Figure 66**)! It may be noteworthy that this observation was made in April, when rat numbers probably peaked at Windy Hill. By 2015 there were at least three active nests on Hirakimatā, and fledglings were observed. In subsequent years the number and spread of sightings increased, so it appears that there is now a small but expanding robin population on Hirakimatā (**Figure 68**). In four days in March 2022 Kevin Parker saw 20 robins on Hirakimatā and was able to trap and band 12 (Parker, 2022).

TABLE 5

Year	To Windy Hill Sanctuary	To Glenfern Sanctuary	From
2004	30		Tiritiri Mātangi
2005		30	Tiritiri Mātangi
2009	25	25	Mokoia Island
2012	25	25	Pureora
Totals	**80**	**80**	

Table 5*: Introductions of North Island Robins to Aotea. Years birds were translocated, and numbers introduced.*

The apparent success of robins on Hirakimatā contrasts with their failure at both Windy Hill and Glenfern, especially because rats are certainly present, probably at densities of c. 4 individuals/ha, on Hirakimatā. Two years of rat trapping on the summit and at Windy Canyon showed no statistical difference between rat numbers in these locations (Ogden, 2018). However, a slightly lower density on the summit could have been hidden by the seasonal variability, which in one year was markedly out of synchrony with the 'usual' rat abundance cycle (lowest December-February and highest March-April). The possibility that the abundance of rats on Hirakimatā follows a different annual cycle to that elsewhere on the island, or that periodic rat reductions due to cold, wet weather are a factor, should be investigated with regard to robin and tomtit population dynamics.

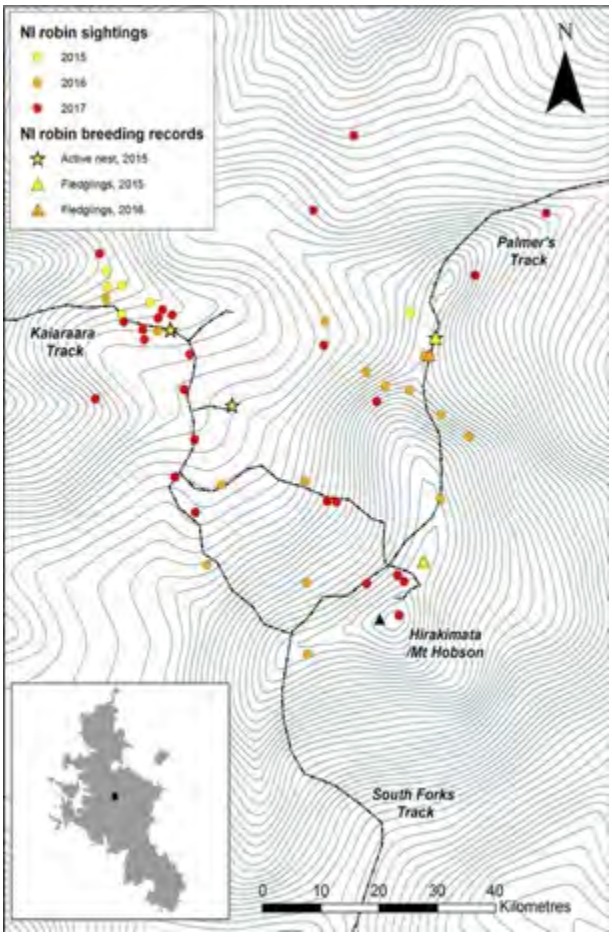


FIGURE 68

Sightings of North Island Robins on Hirakimatā 2015-2017 (Nikki McArthur, WMIL)

The results from the Windy Hill translocations do not clearly implicate *nest predation by rats* as a factor in the failure of translocated robins to become established in the sanctuaries. Rather, juveniles may have moved to areas where they found a richer litter fauna. This outcome implies that *competition with rats for a limited food resource* might have been significant. If the podocarp-dominated litter of Hirakimatā provides better pickings, and the rat population is lower and/or more variable, this might account for the increasing numbers of the colonising robins. Also, in contrast to Windy Hill and Glenfern, kiore and mice may be less frequent on Hirakimatā summit (Ogden, 2018). The annual cycles of kiore and mice are similar to that of the ship rat but displaced by about a month (cf. Ogden (2005)). Consequently, if competition for litter-dwelling insects is indeed a factor, then this competition will be more intense and prolonged where both rat species (and mice) are present, as in the sanctuaries.

8.2.3 Kākāriki/Parakeet spp.

Two species of parakeet were present on Aotea when Hutton (1868) visited Aotea. The red-crowned kākāriki (**Figure 69** & **Figure 70**) is now much reduced in numbers and rarely seen outside the central forest block surrounding Hirakimatā (including the Okiwi Reserve). As with the other species in this section, red-crowned kākāriki is not restricted to cloud forest and would probably be present throughout the mature forest at all altitudes

FIGURE 69

Kākāriki (Red-crowned Parakeet) – Cyanoramphus novaezelandiae (illustrated by Erin Forsyth)

FIGURE 70

Red-crowned kākāriki near Okiwi reserve, February 2022 (photo by Rylie Arnell)

in the absence of mammalian pests. Curiously, the red-crowned has survived while the yellow-crowned has not, although the situation is almost reversed on the mainland, where yellow-crowned has persisted much longer, especially in larger forest areas. The two species can interbreed, but have slightly different ecological niches, with red-crowned favouring fruit, seeds, and nectar, while yellow is more general, taking more invertebrates (Greene, 1998). The red-crowned also spends a lot of time feeding on fallen seed on the ground, where it is vulnerable to predators such as cats. Kākāriki were very abundant in early European times and regarded as pests in orchards. Red-crowned kākāriki (**Figure 71**) both nest and roost in tree holes, making their reduced population very vulnerable to predation by stoats on the mainland, and ship rats on Aotea. Red-crowed kākāriki is currently listed as 'At Risk Relict' and yellow-crowned kākāriki as 'At Risk Declining' (Robertson et al., 2021).

FIGURE 71

Kākāriki Chick

(photo by Luis Ortiz-Catedral)

Hutton (1868) reported both species as common on the island. Subsequent reports are equivocal about yellow-crowned but confirm the presence of a few red-crowned. Red-crowned were reported to be present on Rakitū in 1957 (Bell & Brathwaite, 1964) but could not be found there in 1980 (Bellingham et al., 1982). However, a year later (Ogle, 1981) saw 13 red-crowned kākāriki during a 3-week visit. In 2013 Asher Cook attempted to estimate the abundance of kākāriki on Aotea (Cook, 2013). The scattered distribution and mobility of the birds meant that his estimate of fewer than 20 pairs was little better than an informed guess. An overall density of 0.023 kākāriki/ha. was estimated for the Hirakimatā/Okiwi area. Up to seven birds were seen together in the Okiwi Reserve in 2013 and observations of flocks around that number seem not to have changed until c. 2020. In 2022 there was a report of 15-20 kākāriki, and another flock of 10 - 13 on the ground in Okiwi Reserve. These could be immigrant birds from other islands, but there were also additional sightings of single birds and pairs at

Awana, Medlands, Port Fitzroy and near the highest point of the Okiwi–Claris road. This apparent increase may be due to effective rat control in the Okiwi Reserve by the local school, and a reduction of cats in the area through Department of Conservation trapping and a local community initiative (Okiwi Community Ecology Project, Thomas Daly, Personal communication (July 2022)). Surveys by Serena Simmonds in 2017 and 2018 found evidence of several nests in cavities of old pūriri (**gbiet.org/kakariki**). Simmonds recorded observations of one to four birds, which is consistent with local observations (Kate Waterhouse, personal communication). At least one kākāriki was fledged at Okiwi in the 2021-22 summer (David Speir, personal communication).

Birds presumably from the kākāriki population in the central forest block (Okiwi-Hirakimatā-Mt. Young-Kaiarara), move to other parts of the island following food resources in winter, but no off-island movement has been observed. Single birds or pairs have been seen in the last few years at Oruawharo/Medlands, Awana, and on the Hot Springs Track. Sightings in the settled area at Medlands have occurred since 2018, with up to four birds present in olive trees in May 2020. The species is also present on the Mokohinau Islands and is abundant on Hauturu and the Hen and Chicken Islands and the outer Mercury Islands. There are also thriving populations on Cuvier (Repanga) and Tiritiri Mātangi Islands, where it has been reintroduced.

The overall picture is of the probable loss of yellow-crowned kākāriki soon after Hutton's visit, and a decline of red-crowned during the twentieth century, with numbers now at critically low levels. Some breeding occurs in the pūriri trees at Okiwi Reserve, and probably in the Kaiarara Valley and on The Hogsback. Single birds or small groups move briefly to other parts of the island with no obvious pattern. There is evidence of a recent increase following more intensive rat and cat control in the Okiwi area, but little prospect for a substantial Aotea-wide increase of kākāriki until these pests are much reduced throughout. When that is achieved, the population should expand rapidly (as on Tiritiri, for example), although it is possible that scarce winter food supplies could limit any population increase. As seen on Macaulay Island in the Kermadecs, red crowned kākāriki can be a 'boom and bust' species depending on food supplies (Greene, 2013).

8.2.4 Petrels and Shearwaters

Petrels, shearwaters, prions, diving-petrels, and storm petrels (*Procellariformes*) are oceanic seabirds that nest mainly on islands around the New Zealand coast. At least three species of petrel (black/tākoketai, Cook's/tītī and grey-faced/oī), one species of shearwater (fluttering/pakahā), and common diving petrel/kuaka nest on Aotea or its outliers. These species have spatially and temporally separated nesting, so interspecific competition, especially for breeding burrows, is minimal (**Table 6**).

TABLE 6

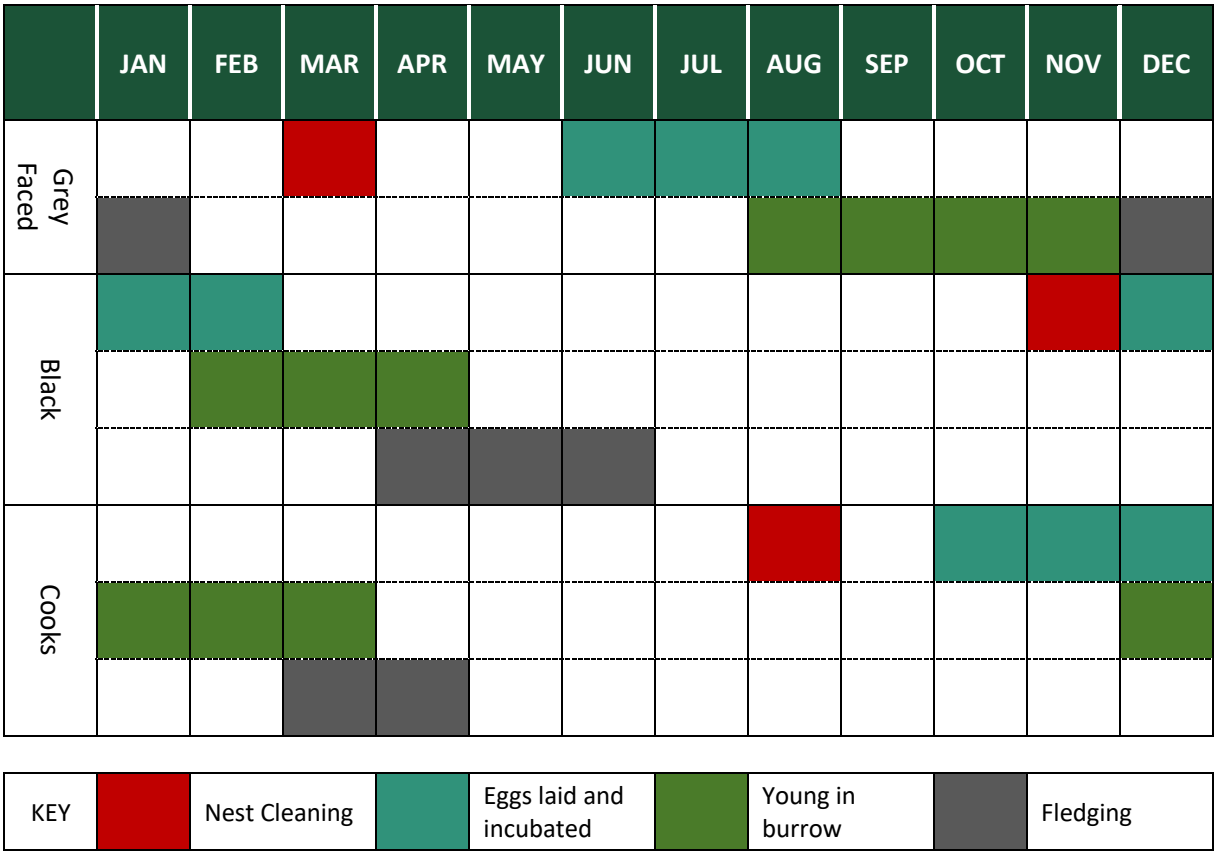


Table 6*: Petrel breeding schedules. Approximate annual activity patterns of larger burrow-nesting petrels on Aotea (From data in Heather and Robertson (1996).*

8.2.4.1 Black Petrel/Tākoketai

Black petrels (**Figure 72** & **Figure 73**) are medium-sized (700 g) sooty-black petrels, which are declining and currently listed as 'Nationally Vulnerable' (Robertson et al., 2021). Although this species formerly bred on many inland mountain ranges on the North Island, the only surviving breeding colonies are on Aotea and Hauturu (Bell, 2021; Heather & Robertson, 1996). It is recognised as the seabird most at-risk from commercial long-line fishing in New Zealand's Exclusive Economic Zone (Richard et al., 2015). Its main nesting colony on Aotea is also at risk from disturbance and predation by feral pigs and cats.

Black petrels breed from October to July. Nesting burrows are cleaned out in October and the single egg, laid from mid-November to late January, takes 57 days to hatch. The chick fledges at 96-122 days old. Both parents share incubation and care of the chick (Bell, 2021). These demographic parameters render the species particularly vulnerable to any increase in adult mortality.

FIGURE 72

Tākoketai (Black Petrel) – Procellaria parkinsoni (illustrated by Erin Forsyth)

FIGURE 73

Fledgeling Black petrel outside burrow on Hirakimatā (photo by Biz Bell, WMIL)

The breeding colony on Hirakimatā and surrounding areas was confirmed by B.D. Bell and D.V. Merton in 1960 (Bell & Brathwaite, 1964). The status of this population has been monitored closely since 1996, so there is a substantial database describing its dynamics (E.A. Bell, WMIL, personal communication). Information on fecundity, adult and fledgling survivorship, migration routes, feeding, and other population parameters has been gathered. The total breeding population within the 1000 ha core habitat around Hirakimatā is estimated at 4336 breeding pairs in 2022 (Bell et al., 2022), with approximately 2000 breeding pairs in the 35ha study area. However, these population estimates are bedevilled by uncertainties arising from the difficult terrain and changes in detection probabilities as the area studied has changed over time (Bell et al., 2018). Black petrels migrate to the eastern Pacific Ocean where counts suggest a population of c. 38.000 birds (Bell, 2013). The numerical discrepancy with the only known breeding colony counts on Aotea and Hauturu is unexplained, but if confirmed, would indicate a large non-breeding (juvenile) fraction in the population. Annual counts on Hirakimatā and population models suggest a continued gradual decline within the monitored area. This decline may be associated with competition with fisheries, both while foraging for their young in New Zealand waters, and while in international waters

when they migrate to the tropical eastern Pacific during winter (**Figure 74** & **Figure 75**). Low recruitment into the population is also a concern, but the reason(s) for this are unknown. Predation of eggs and chicks by rats (up to 6%), and losses of nesting adults to cats and pigs are known to occur on Aotea but are unquantified. Tiny remnant populations elsewhere on the island, for example at Windy Hill and Glenfern Sanctuaries, and on Te Ahumata, probably suffer severe predation. The Windy Hill population has been monitored since 2001, when five active burrows were found. Wider searches (c. 30 ha) with dogs located seven active burrows in 2014. A small population on Cooper's Castle (Bell & Brathwaite, 1964) has scattered burrows amongst the roots of pūriri trees that pigs cannot reach. There was probably a colony on Tataweka before goats devastated the summit vegetation and trampled the soil; a few remained in the 1990s, but none was found in a survey in 2020/21 (E. A. Bell, WMIL, personal communication). Recovery of these small, isolated populations will probably require an increase at the main colony, along with removal of predatory mammals from Aotea.

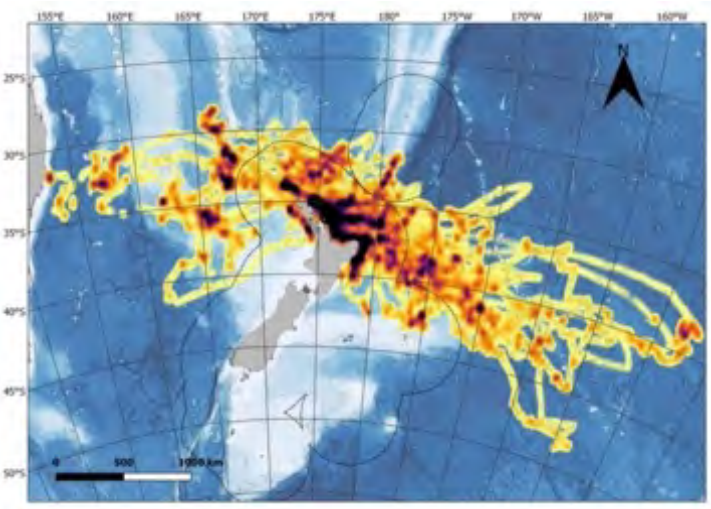


FIGURE 74

Black petrel foraging - Density maps of at-sea distribution of adult black petrels from Hirakimatā. Global Positioning Systems (GPS) tracked during chick rearing in 2018 and incubation in January and February 2019. Darker areas represent greater concentrations, and the black dashed line is the boundary of the New Zealand EEZ (E. A. Bell, WMIL, personal communication).

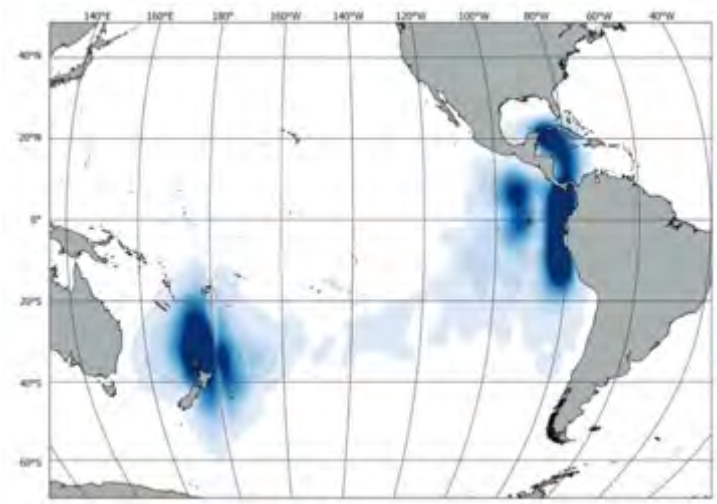


FIGURE 75

Black petrel migration - Migration to South America - Density map of Global Location Sensing (GLS) points for adult black petrels from Hirakimatā between March 2018 and January 2019. Darker areas represent greater concentrations of black petrel activity around Aotea during the nesting period and off South America during winter (E. A. Bell, WMIL, personal communication).

The black petrel was the 9th most frequent bird found dead on Aotea beaches from 1994-2019, with 29 recovered. Most beach wrecks occurred between March to May, when adults are feeding young, and fledglings begin to leave Aotea to winter in South America.

8.2.4.2 Cook's Petrel/Tītī

This small (180 g) grey and white petrel (**Figure 76** & **Figure 77**) breeds only in New Zealand and migrates in winter to the North Pacific Ocean off the coasts of California. Breeding is between September and April. The single egg is usually laid in November, after burrow-cleaning, courtship, and a pre-laying exodus from the colony for about a month. Eggs hatch after c. 47 days and the young fledge at c. 88 days, about 10 days after the adults have already departed on migration (Taylor & Rayner, 2013). Cook's petrel formerly bred abundantly on the mainland but was wiped out by predatory mammals. There are now just two main colonies, on Hauturu in the north and Whenua Hou/Codfish Island in the south. The species is currently listed as 'At Risk/Relict' (Robertson et al., 2021). While the colony on Hauturu has been described in some detail and showed a strong increase following the removal of kiore in 2004 (Rayner et al., 2007), data on numbers and breeding success on Aotea are mainly anecdotal. There are burrows within the black petrel nesting area on Hirakimatā, others are probably scattered across the island. Most of the 'breeding'

FIGURE 76

Cook's Petrel chick stunned after collision with house window in Okupu
(photo by John Ogden/Amelia Geary)

FIGURE 77

Tītī (Cook's Petrel) – Pterodroma cookii
(illustrated by Erin Forsyth)

evidence comes from finding the wings of birds preyed on by cats. Four such birds were reported in Tryphena in 2004, and they are found every year on Hirakimatā. Birds are heard calling as they fly over Aotea in summer, but how many of these are returning to burrows on Aotea and how many are passing over to the large colony on Hauturu is not known. Some successful breeding does occur on Hirakimatā, in Glenfern Sanctuary and elsewhere, but most attempts at places with no predator control probably fail due to predation. The Cook's petrel is the seventh most frequent species found dead on Aotea's eastern beaches, with 34 recorded 1994-2019. Beach-wreck mortality is greatest in January.

8.3 Summary of the Status of the Forest Species

In the Mature Forest, and throughout the island, the abundance of the three common large forest species tūī, kākā and kererū appears to be either stable or increasing (**Figure 78** & **Figure 79**, from independent studies). This trend is probably the result of both pest management (rats), and possibly the planting of suitable flowering and fruiting species in gardens and restoration areas. Tūī have increased in frequency and density, while both kākā and kererū show trends of increase in more than one study. The kākā population on Aotea is probably c. 300-400 birds. About half the population leaves the island between April/May and September/October and visits the mainland (and/or other islands). Principal foods are from native tree species in the summer but introduced trees become more important in winter. Kererū are enigmatic: while some observers claim a decline, the data are more suggestive of a slight increase.

Red-crowned kākāriki are effectively restricted to Okiwi, and the slopes, valleys, and peaks of the Hirakimatā region, and the population may comprise fewer than 20 pairs. Recent observations of small flocks at Okiwi and winter sightings in gardens at Medlands may be a positive sign, but this species must be regarded as critically endangered on the island. The locally extinct kōkako may yet be returned to Te Paparahi, but this will depend on removal of great reductions in rodents and feral cats.

The remaining seabird colonies of the forest, i.e. black petrel/tākoketai and Cook's petrel/tītī, are much depleted. Much is known about breeding success, international migration and feeding in black petrel, but while all causes of the gradual decline are not yet pinpointed, fisheries bycatch is a major concern. No adequate numerical data are available for Cook's Petrel on Aotea, but observations suggest widespread cat predation of adult birds during breeding, and the loss of eggs and chicks to rats.

The three small forest insectivores, grey warbler, fantail, and silvereye are all relatively recent arrivals in New Zealand (silvereye since European arrival) and thrive in the successional scrub forest communities created by forest clearance last century. All were present on Aotea at the time of Hutton's (1868) visit, and all are currently abundant with total populations probably in the tens of

thousands. All three species are subject to predation by rats but have high fecundity, so that despite annual fluctuations, their numbers appear to be stable. Grey warbler, which often nests early in the season thus avoiding the peak in rat numbers and parasitism by shining cuckoo, may be increasing. Introduced North Island robins have established a small population on Hirakimatā, where there is also a small remnant population of tomtits. Vagrant bellbirds arrive from surrounding rat-free islands most years, and may occasionally breed, but they remain 'functionally extinct'.

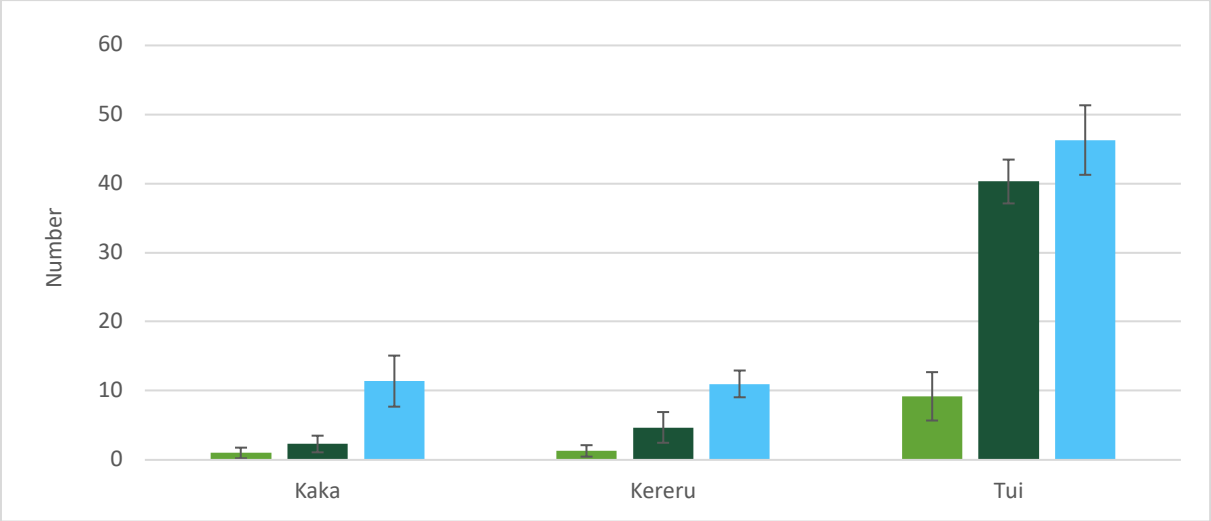


FIGURE 78

Trends for three large frugivorous species at Windy Hill Sanctuary over 20 years. Counts for 2000 (light green) 2011 (dark green) and 2021 (blue). Mean number with 95% confidence limits on ten counts on different days at ten sites in May (Ogden, 2021b)

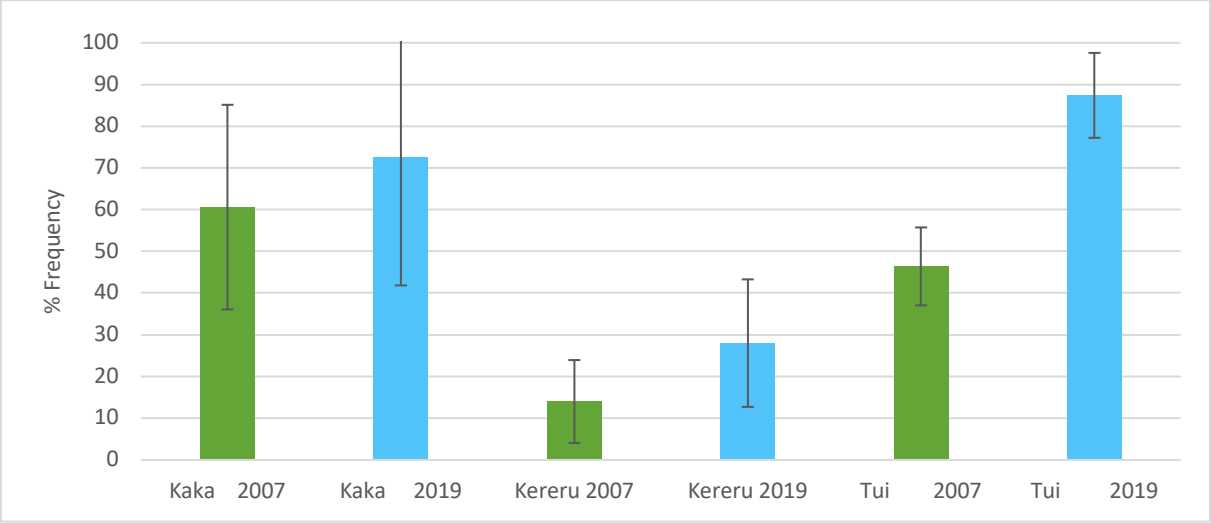


FIGURE 79

Overall (all habitats) average % frequencies for key forest species. Frequency for 2007 (green) and 2019 (blue). Means and 95% confidence limits (Ogden, 2020)

In relation to predation by introduced mammals, the forest species fall into three categories: (1) those which have become locally extinct following forest clearance and the introduction of predatory mammals; (2) those which persist but with small populations that seem unable to increase, probably because of predation, and (3) species with stable or increasing numbers. If mammalian predators can be removed or greatly reduced, birds in the first category might be considered for re-introduction, while birds in the second category are almost certain to increase. The third category includes abundant species, which (with the current rate of predator control), will continue to flourish as the forest structure shifts from kānuka-dominated to a more diverse mix of fleshy-fruited tree species. However, if predatory mammals are removed and locally extinct endemic species are reintroduced, some species in category 3, such as grey warbler, fantail and silvereye could decline and become a smaller proportion of the total avifauna, as seen in sanctuary projects elsewhere (Binny et al., 2021; Miskelly, 2018) (**Table 7**, **Table 8**, & **Table 9**).

8.3.1 Population Status Estimates and Trends for Forest Birds

TABLE 7

Species	Population Estimates for Aotea	Current Trends
Tūī	1000 – 15,000	Increasing
Morepork	150 – 2,000	Stable
Kererū	150 – 1,000	Stable/Increasing
Kākā	100 - 400	Increasing
Bellbird	0 – 20 p.a.	Vagrant
Long-tailed Cuckoo	2 – 5 p.a.	Migrant
Falcon	0	Vagrant
Rifleman	?	? Status Unknown
Kōkako	0	Absent

Table 7*: Population estimates and trends for indigenous species characterising mature forest (p.a. = per annum, for records of vagrants or migrants).*

TABLE 8

Species	Population Estimates for Aotea	Current Trends
Silvereye	> 20,000	Stable/Variable
Grey Warbler	> 20,000	Increasing/Variable
Fantail	> 20,000	Stable/Variable
Shining Cuckoo	? 250	Migrant

Table 8: *Population estimates and trends for indigenous species of successional forest.*

TABLE 9

Species	Population Estimates for Aotea	Current Trends
Black Petrel	> 12,000	Declining
Cook's Petrel	< 400	Declining
North Island Tomtit	< 100	? Stable
Red-crowned Kākāriki	< 60	? Stable
North Island Robin	< 50	Increasing

Table 9: *Population estimates and trends for indigenous species of the cloud forest of Hirakimatā.*

PART 3: BIRDS OF THE WETLANDS

FIGURE 80

Oruawharo wetland restoration project area in 2021, habitat for Australasian Bittern (photo by Lotte McIntyre)

9 THE WETLANDS

9.1 The Wetland Habitat

Wetlands (**Figure 80** & **Figure 81**) may be defined as areas where the dominant environmental factor is water (Hunt, 2007). The wetlands of Aotea comprise two large and varied areas, Kaitoke Swamp and Whangapoua Estuary, along with numerous smaller ponds, seepages, and wet hollows. Kaitoke swamp and the Whangapoua Estuary are the largest areas of wetland in the Auckland region and contain a variety of successional habitats ranging from freshwater semi-forest to estuarine flats with tidal influence. Other formerly extensive wetland areas behind the dunes at Oruawharo Bay, the southern end of Kaitoke, and at Awana, were all drained in the twentieth century and are now seasonally wet or flooded paddocks (alluvial flats). Their avifauna is now distinct from that formerly present and is considered separately under 'Farmlands'.

The current area of herbaceous freshwater vegetation (226 ha. Landcare Database 2) probably represents between 10 and 20% of the pre-European situation. As a consequence here has been a large loss of habitat for the original wetland birds, all of which have declined. A few new species use wetlands but are predominantly found in the former wetland areas, now damp paddocks.

An important feature of wetlands is that they are temporary. Lakes or coastal lagoons become gradually filled with sediments and surrounding vegetation encroaches. This history of change, over thousands of years, has been documented for both Kaitoke and Whangapoua (Deng et al., 2004; Horrocks et al., 2000a, 2000b; Ogden et al., 2006). Another important feature is high productivity, resulting in rapid accumulation of biomass (carbon) as both living and dead matter (Pegman & Ogden, 2005, 2006). Newly formed (young) wetlands are often nutrient-rich (eutrophic) and support a variety of invertebrate food for birds. Over time the vegetation changes, with different plant species occupying different zones and spreading as the water areas become shallower through siltation and accumulation of dead organic matter. Different bird species are adapted for feeding in these changing zones. For example, diving ducks occupy the deeper water near the centre of a lake, dabbling ducks and geese feed nearer the shore or in damp vegetation around the margins, long-legged herons and stilts wade shallower water, while other species inhabit the encroaching reed-beds (such as bittern/matuku, fernbird/mātātā, spotless crake/pūweto).

Plants and their debris comprise the first trophic level in the wetlands. Invertebrates feeding on plants, other invertebrates, microorganisms etc. are an important food source for birds, which constitute the higher trophic levels. The different species have different ecological niches, so that, even when they occur together in the same wetland area, competition between them is reduced. For example, spotless crake and fernbird are both predominantly insectivorous, but they collect their food at different heights above the wet surface and with different methods: the crake picks insects, worms and spiders from leaf litter or shallow water, while the fernbird hunts spiders, caterpillars, moths, and flies in the standing vegetation.

FIGURE 81

Whangapoua Estuary from above (photo by Andrew Macdonald)

Wetlands were not included in the first general bird survey of Aotea by the GBICT, although a targeted study of bittern was undertaken (Geary et al., 2012). The birds of Kaitoke wetland and Whangapoua estuary (**Figure 81**, **Figure 82** & **Figure 83**) were annotated by Ogle (1980) and both areas were classified as having "Outstanding" wildlife values. The avifauna of the Kaitoke wetland was described by Anderson and Ogden (2003). The Whangapoua estuary is of significance due to its clear zonation from freshwater to tidal estuarine habitats (Deng et al., 2004), and the adjacent dunes and coastal habitats. The tidal area of the estuary is the most important feeding ground for several indigenous waders (New Zealand dotterel/tūturiwhatu, wrybill/ngutu pare, variable oystercatcher/tōrea-pango) and a stop-over point for long-distant migrants (Pacific golden plover/kuriri, bar-tailed godwit/kuaka). These waders are discussed under 'The Coastal Zone'.

9.2 Status of Wetland Bird Species

The secretive (cryptic) or nocturnal nature of most of the wetland birds makes assessment of their status on the island speculative. Their breeding success on the mainland is low, probably due to predation, and this must also be a factor on Aotea. Better information on the relative roles of predation and food availability in determining survival is necessary for sustainable management of all the endangered wetland birds in the Kaitoke and Whangapoua wetlands (Anderson & Ogden, 2003).

TABLE 10

Common Name English/Māori	Scientific Name	Conservation Status
Brown Teal/Pāteke*	*Anas chlorotis*	Threatened Nationally Increasing
Grey duck/Pārera	*Anas superciliosa*	Threatened Nationally Vulnerable
Australasian Bittern/Matuku-hūrepo*	*Botaurus poiciloptilus*	Threatened Nationally Critical
Spotless Crake/Pūweto*	*Porzana tabuensis*	At Risk Declining
Banded Rail/Moho pererū*	*Rallus philippensis*	At Risk Declining
Fernbird/Mātātā*	*Bowdleria punctata*	At Risk Declining

Table 10*: Threatened and At Risk wetland birds present on Aotea. Conservation Status from Robertson et al. (2021). *Birds emphasised as wetland specialists at high risk of predation by O'Donnell et al. (2015). Pāteke -* **Figure 82,** *Moho pererū* **Figure 83**

Many bird species that frequently visit wetlands— silvereye, grey warbler, and introduced finches, are not 'wetland birds', although they were in the ten most frequently observed birds on Kaitoke Swamp (Anderson & Ogden, 2003). Other 'Not Threatened' species found in wetlands include mallard, paradise shelduck, white-faced heron, welcome swallow, pūkeko, Australasian harrier and pied stilt. Little black shag (*Phalacrocorax sulcirostris*), although often seen in wetlands, is treated here with other shag species in Part 4. These species are all widespread in New Zealand and occupy a variety of open habitat types on Aotea. Of these species, only the harrier was recorded by Hutton (1868). Pūkeko possibly colonised Aotea in the mid-nineteenth century and mallard and welcome swallow reached Aotea during the twentieth century. Paradise shelduck, white-faced heron, little black shag and pied stilt could also be twentieth century immigrants from the mainland. These new arrivals may have had some impact on populations of existing swamp inhabitants through competition for food resources, but one of them, mallard, can be directly ascribed to the probable loss of another species, the grey duck/pārera.

Key wetland birds for present purposes are listed in **Table 10**. Five of the six species are wetland specialists at risk from predation (O'Donnell & Williams, 2015). Nationally all six species are listed as 'Threatened' or 'At Risk'

FIGURE 82

Pāteke flock in wetland (photo by Lotte McIntyre)

FIGURE 83

Moho pererū and chicks (photo by Ecology Vision)

(Robertson et al., 2021). The remaining wetland areas of the island support a vulnerable avifauna deserving protection. In some cases, a wealth of data is available on the species from elsewhere, but emphasis here is on information relevant to their status on Aotea. Where reliable data are available from Aotea, it shows that populations are declining (pāteke, grey duck, and bittern).

9.2.1 Brown Teal/Pāteke

The brown teal or pāteke (**Figure 82**, **Figure 85** & **Figure 87**) is a semi-nocturnal 'dabbling' duck that feeds in shallow water and on short, damp pasture. It nests in rushes and dense vegetation close to water. Pāteke can be counted at traditional 'flock sites' where they congregate after breeding. Not all birds attend the flocks, so these counts underestimate the total population by an unknown (and variable) amount, nevertheless flock site counts (**Figure 84**) presumably reflect long-term total population trends on Aotea (Ferreira & Taylor, 2003).

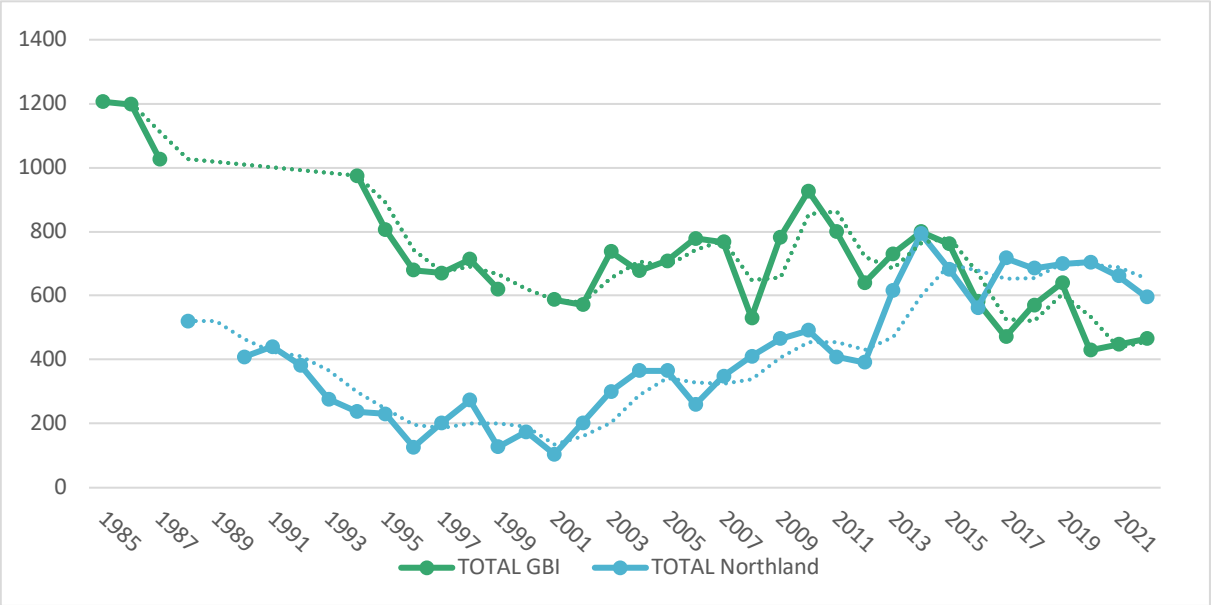


FIGURE 84

Pāteke population estimates at flock sites on Aotea and eastern Northland. Vertical axis is total of average number of pāteke counted with two or three counts at all sites in February or March each year. Dotted lines are three-point moving averages. (Data from: Mack (2020), Okiwi DoC Annual Pāteke Monitoring Report 2019-2020; Mike Camm and Nigel Miller, DoC Whangarei.)

The species was once widespread throughout New Zealand, and it is the most frequent Anatid in Quaternary deposits from lacustrine environments (Worthy & Holdaway, 2002), but was almost exterminated by habitat destruction, mammalian predators and duck-shooting. Pāteke were not recorded by Hutton (1868) on Aotea, who commented particularly that the grey duck (*Anas*

superciliosa) was the only duck present on the island. This suggests that pāteke were in very low numbers at that time. The species was not frequent in counts before 1954 (Bell & Brathwaite, 1964). A population of at least 700 was counted in 1960, and by 1996 a "stable population of c. 1200" was thought to be present (Williams & Dumbell, 1996). These high pāteke counts in the late 20th century may have resulted from the passing of the Wildlife Act 1953 under which it became a protected species. Also, by 1964 the residents were "protection-minded in relation to this species" and numbers were increasing, though predation by feral cats and dogs continued (Bell & Brathwaite, 1964). Flocks of up to 200 were recorded in 1972 (Reed, 1972). The decline since the 1980s may reflect increased predation by these animals (and others including rats, pūkeko and harriers), but various causes can be postulated.

The rapid national decline of pāteke led to the Department of Conservation (DoC) developing a recovery plan in 1996 (updated since), with the integrity of the Aotea population regarded as "paramount" (Williams & Dumbell, 1996). Aotea birds were collected and bred, and transported to other places in New Zealand, establishing some populations in predator-protected areas (e.g., Tiritiri Mātangi Island, Mana Island, Port Charles, Mayor Island, Tāwharanui) where they have multiplied. Pest control for nest predators, where present (mustelids, cats,

FIGURE 85

Pāteke in Kaitoke wetland
(photo by John Ogden)

FIGURE 86

Pāteke nest (photo by DoC Aotea)

rats) was carried out at these sites, and the positive effects in Northland since the year 2000 are clear (**Figure 84**). Cats, harriers, pūkeko and rabbits have all been culled when resources have been available on Aotea, but regular targeted pest control has not been conducted systematically, and Aotea's pivotal population has declined, with the lowest monitored number (429) in 2019-20. This decline since 2000 appears erratic (**Figure 84**), punctuated by runs of years with increasing numbers prompting short-lived optimism, but the over-all trend is downwards. The two data sets in **Figure 84** are broadly in synchrony until, 2010 - 11, when the Aotea population started to decline again, when Northland populations were still increasing.

Analysis of the monitored decline in flock counts was further corroborated by data on nesting success (**Figure 86**), and fledgling and adult survivorship (Barker, 1998; Barker & Williams, 2002; Ferreira & Taylor, 2003). This predicted that the pāteke population would halve every 4.1 years, leading to extinction by c. 2025. The 2019-20 season had the lowest total since flock-site counts began in 1985 (Mack, 2020), apparently supporting this dire prediction. The anomaly between brown teal's current revised conservation status (Threatened Nationally Increasing: **Table 10**) and the ongoing decline on Aotea, is notable. Presumably the revised 2021 status reflects what is happening nationally with predator managed and translocated populations, which are increasing, but it fails to recognise the declining trend on Aotea – formerly pāteke's most important stronghold.

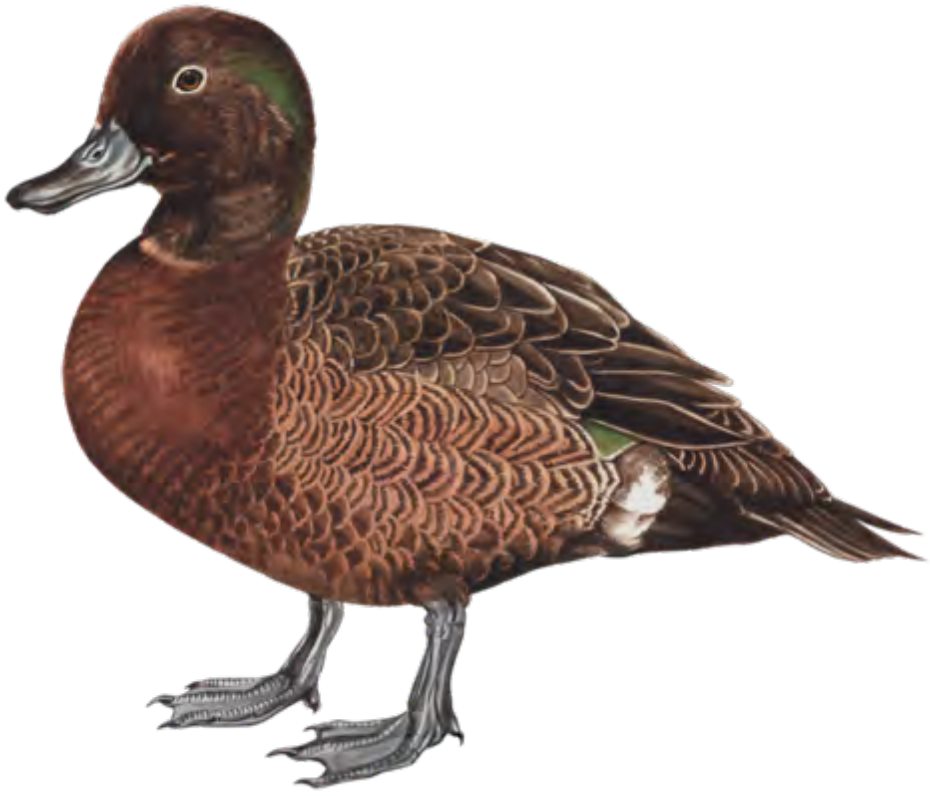


FIGURE 87

Pāteke (Brown Teal) - Anas chlorotis (illustrated by Erin Forsyth

The 1996 Recovery Plan emphasised that local pāteke populations on Aotea are distinct and should be managed as separate entities. However, conservation resources have been focussed on the Okiwi Basin, where, despite two decades of monitoring pāteke, culling cats, pūkeko and rabbits, and improving pāteke habitat, the causes of the decline remain unknown. The amount and variety of the work done at Okiwi contributes to the difficulty of attributing causal factors. Comparative experimental manipulations elsewhere are required, as apparently envisaged by the authors of the Recovery Plan.

Nest predation on pāteke by rats has been observed (Bell & Brathwaite, 1964), and on many other ground nesting birds throughout New Zealand (Innes et al., 2010). In view of pāteke increases where rats are controlled such as at Mimiwhangata (Watts et al., 2016), the effect of predation should be investigated at some of the main breeding areas on the island, allowing comparative data collection. Such research would require emphasis on nesting areas, rather than flocking sites or adult feeding locations. However, 'obvious' chick predation is probably much less important in the population decline than mortality of young adults.

The Aotea pāteke are slightly smaller and lighter than mainland populations, and some mortality may be a result of food shortages stemming from habitat (grazing) changes and drought (Moore & Battley, 2003), but the overall nature of the decline warrants comprehensive study of the whole food-web of which pāteke is a component. The reality is that multiple causes are probably at work, and that predator control and habitat improvement at Okiwi have failed to halt the downwards trend or even provide an unequivocal explanation for it. It is to be hoped that the recent appointment of a DoC ranger with responsibility for pāteke recovery will extend the study to other catchments as implied in the 1996 Recovery Plan. Numerical correlations between flock sites could be used to choose locations.

9.2.2 Grey Duck/Pārera and Mallard

These two closely related species in the genus *Anas* are discussed together here because they hybridise and occupy similar ecological niches. Since mallards (**Figure 88**) were introduced to New Zealand from 1870, the native grey duck/pārera has been greatly reduced through hybridisation (Williams, 2017).

Grey duck were the only duck species on Aotea according to Hutton (1868). Bell and Brathwaite (1964) estimated a grey duck population of c. 100 birds but saw only one mallard. Mallard were introduced to New Zealand numerous times during the first half of the twentieth century (M. J. Williams, 2013), and by the 1960s were numerous. Natural spread to Aotea before this date is likely (small flocks arrive on Aotea most years at the start of the shooting season in May). The arrival of mallard spelled the end for grey duck, with grey drakes pairing with the exotic female mallards (Caithness, 1985). The resulting hybrids usually resemble grey duck more than they do mallard.

In 2008 only one 'definite' grey duck was seen on Oruawharo Creek, and currently all resident pairs there appear to be hybrids. Thus, the grey duck, as a genetically distinct species, probably became extinct on Aotea between about 1960 and 2010, although two grey duck were recorded by Colin Miskelly (personal communication) on Kaitoke wetland in 2010, and a 'grey duck' with brown/orange legs was seen at Oruawharo wetland in 2022 (J. Ogden). Hybrid mallard/domestic duck can be seen elsewhere on the island, and hybrids between mallard and pāteke have been reported. Ian McLean reported hybridisation between these species on Motutapu Island, supported by photographs by Trina Smith (Ian McLean, personal communication). This hybridisation could be an added threat to the pāteke population on Aotea, especially if mallards were to increase markedly to levels greater than the historic grey duck population.

FIGURE 88

Mallard ducks and domestic goose occupying pāteke habitat, Kaitoke Stream (photo by John Ogden)

9.2.3 Australasian Bittern/Matuku-hūrepo

This endangered native species (**Figure 89** & **Figure 90**) has suffered a marked decline throughout New Zealand due to habitat loss following wetland drainage. There could be fewer than 800 nationally, and possibly fewer than 1000 in Australia (E. Williams, 2013). Studies initiated by GBICT in 2006 (Ogden, 2006) were extended by Geary et al. (2012), who concluded that up to six birds may be present on Aotea with possible breeding in the Kaitoke wetland and/or surrounding areas. In its normal habitat of rush and raupō this large

FIGURE 89

Australasian Bittern/Matuku-hūrepo at Waitematuku, March 2020 (photo by B. Martindale)

bird (>900g) is superbly camouflaged, so most sightings are of birds away from their preferred habitat (see photo). Protocols for detecting and enumerating bittern have been published (O'Donnell & Williams, 2015).

Bittern was recorded in the first account of the birds of Aotea (Hutton, 1868). The number of bitterns found in subsequent studies has been small; Bell and Brathwaite (1964) indicated at least eight birds in 1960, seen or heard at Whangapoua Swamp, Sugarloaf Creek and Kaitoke, while Ogle (1981) records birds at five locations (Kaitoke Swamp, Whangapoua Estuary margin, near Motairehe, swampy pastures in central Oruawharo Bay, and near Okiwi airstrip). Bitterns were present at Awana before the swamp was drained (Muriel Curreen, personal communication, 1998). Overall, these earlier reports suggest that bittern were once more widespread and more commonly seen than is the case now.

FIGURE 90

Matuku-hūrepo (Australasian Bittern) –
Botaurus poiciloptilus (illustrated by Erin Forsyth)

A bittern database compiled by Ogden and the Department of Conservation currently comprises 148 separate observations on Aotea since 1997 and appears to show an increasing trend. However, some areas have received more observer effort in some years than others. For example, the Kaitoke area (comprising Kaitoke swamp and Estuary, the Golf Course and Police Station wetlands and areas between) received more attention before 2008, when the GBICT was actively seeking bittern observations, while DoC observations at Okiwi commenced in 2008. The peaks in **Figure 91** probably reflect this activity rather than real increases in bittern numbers. The Okiwi area includes the Okiwi Station, Airfield, the Waikaro (Mabey's) block in the north, and the extensive wetlands surrounding the Whangapoua Estuary. Some observations in close sequence in the same area are probably of the same bird, for example several sightings in the Medlands/Oruawharo area in 2020. The number of observations in the wetland at Medlands/Oruawharo has certainly increased since 2018, but, with the formation of the Oruawharo Medlands Ecovision Group, so has the number of observers.

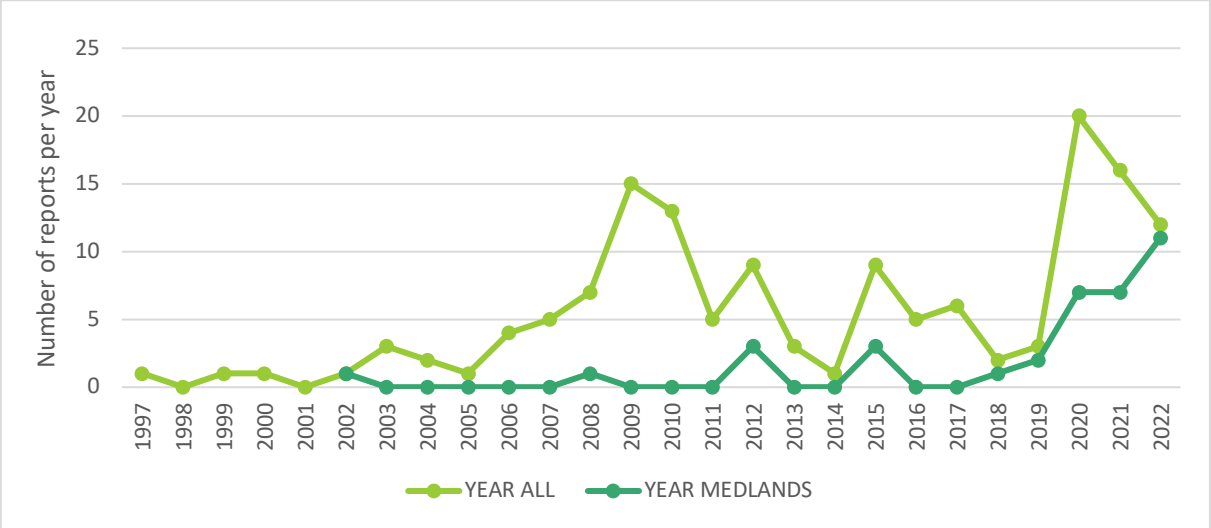


FIGURE 91

Observations of bittern on Aotea reported by the community between 1997 – 2022.

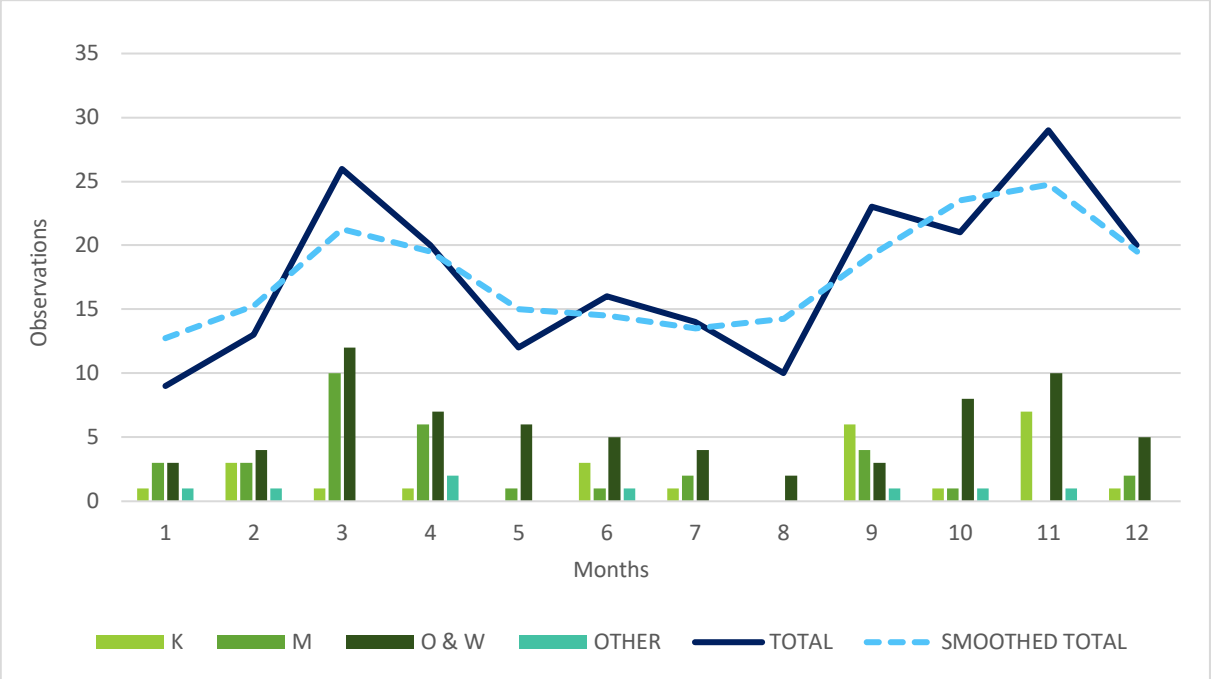


FIGURE 92

Observations of bittern by months (1997-2022). K indicates the Kaitoke area (Kaitoke wetland, golf course, police-station swamp and adjacent areas), M indicates Medlands including Oruawharo wetland and adjacent areas, O & W includes the DoC Okiwi area and all the Whangapoua estuary and adjacent wetlands.

Overall, there have been c. 5 observations per year since 2000, with most at Okiwi/Whangapoua (especially close to the DoC headquarters since 2008). As observations have come from different areas

in the same month and year, it is possible that different birds were involved, especially in 2009 when sightings were made at Okiwi and Kaitoke on the same day. However, bitterns can readily fly the distance between these wetlands on Aotea, and probably do so as one area dries up or another is flooded. It is also possible that some of the birds observed are vagrants from the large wetlands on the Hauraki Plains. The estimate of six birds on Aotea in 2012 by Geary et al. (2012) seems reasonable, but it is no cause for complacency.

Until 2020 the Okiwi observations were predominantly in the post-breeding period (March-April), while those at Kaitoke were mainly during the breeding season (September-December). Most booming, and the only recorded young birds (2003, 2013) have been from this area. The pattern could have resulted from confounding observation intensity and location, but it suggested breeding in the Kaitoke region and fledged young dispersing north to Okiwi. However, an acoustic survey in spring 2020, recorded only one male booming at Kaitoke swamp but two in the Whangapoua area (Stewart, 2021). The paucity of acoustic records supports the numerical estimate of Geary et al. (2012). Pairs and a foursome of bittern were reported from the Whangapoua area in 2020, implying breeding. Historical records indicate breeding in both areas (and Medlands/Oruawharo). The monthly observations (**Figure 92**) certainly suggest a booming/breeding period in Spring, followed by dispersal of one or two young adults in March.

The bittern is currently listed as 'Critically Endangered' (Robertson et al., 2021). Their large size, extensive territories, secretive behaviour and deep, nocturnal booming calls, give them an iconic status. It is a 'keystone species', sitting near the top of the trophic pyramid in the marshlands. More than any other factor, the presence of this large, regal bird, defines a healthy wetland.

FIGURE 93

Hot Springs track wetland, fernbird habitat looking towards Hirakimatā (photo by Kate Waterhouse)

9.2.4 Rails (Rallidae)

The three, or possibly four, species of rails on Aotea all occur in or close to wetlands, although they differ greatly in their ecological niches and their conspicuousness. Hutton (1868) specifically commented on the

absence of the family Rallidae on Aotea, although Weetman (1889) reported pūkeko a few years later. Rails suffered massive declines following island colonisation by humans throughout the Pacific (Steadman, 2006). Spotless crake/pūweto and marsh crake/koitareke are considered here. Pūkeko and banded rail/moho pererū (**Figure 83**) are more characteristic of the paddocks and inhabited areas and are discussed in that section.

9.2.5 Fernbird/Mātātā

This small (35 g), cryptic passerine (**Figure 94** & **Figure 95**) prefers the drier end of the vegetation sequence in wetlands (**Figure 93**) and may also occur in upland scrubby vegetation such as gumland scrub. It is a weak flyer with a long drooping tail, and generally remains hidden from view in the reeds, although its distinctive metallic 'tchick' call indicates its presence. The bursting raupō seed head is infected with larvae of the shy cosmet moth (*Limnaecia phragmitella*) which may be important food for young fernbirds. The genus *Bowdleria* is endemic to New Zealand but is related to the Australian grassbirds (*Megalurus* spp.) (Gill et al., 2010), which occupy a similar ecological niche.

In areas with low cover of sedges and tangle-fern (*Gleichenia dicarpa*), fernbird was one of the most conspicuous species on Kaitoke wetland in 2000 (Anderson & Ogden, 2003). However, this is no cause for complacency, as

FIGURE 94

Mātātā (Fernbird) –

Bowdleria punctata (illustrated by Erin Forsyth)

FIGURE 95

Fernbird collecting moth larvae from raupō seed head (photo credit unknown)

the species is listed as 'At Risk Declining' on mainland New Zealand (Robertson et al., 2021). Rats and feral cats are present around and throughout Kaitoke wetland and are probably a threat to breeding fernbirds (O'Donnell et al., 2015). Sparse populations of fernbirds occur in the Whangapoua estuarine-freshwater wetland sequence, and a few individuals occur in gumland scrub on Te Ahumata and in scrub on the Mount Heale-South Fork track. Although single birds have been heard elsewhere, it is possible the species is declining on the island. Predation by rats, and loss of suitable habitat as the open fern land and low scrub reverts to forest, are probable causes (Ogle, 1981). Unfortunately, suitable habitat is not present in any of the currently rat-managed areas, so translocations are not feasible, though Rakitū could be a possible candidate home in future.

9.2.6 Spotless Crake/Pūweto and Marsh Crake/Koitareke

The spotless crake is a small (45 g), dark rail of freshwater wetlands, where it often remains hidden in reeds and raupo making it difficult to observe. Although it is semi-nocturnal and secretive, its clucking contact calls and explosive territorial *puuuur* often reveal its presence. It was first recorded by Ogle (1980) on Kaitoke swamp, when it was also found in the upper Whangapoua and peripheral freshwater raupo swamps, where it still occurs (T. Lovegrove personal communication, and Stewart (2021)). In the freshwater reaches of Kaitoke swamp, spotless crakes were relatively frequent, with a detection probability of 4% (calls) in 2000 (Anderson & Ogden, 2003), and have subsequently been heard in the remnant swamp at Awana. Overall, their abundance and range across the island is unknown. They are possibly quite widespread, but overlooked, where suitable habitat exists, because they occur in many raupō swamps on the mainland. It is not known whether their nests are preyed on by rats, but adults and probably young are vulnerable to cat predation. The marsh crake (*Porzana pusilla*) has never been certainly recorded on Aotea but could be present on Kaitoke swamp. In New Zealand, this species is more numerous in the South Island; however, in the Auckland region, it has recently been found in freshwater wetlands at Whatipū and Te Henga, and around the Kaipara Harbour, where it has been found in wetlands at the interface between fresh and saline habitats. Finding it on Aotea will require a dedicated team familiar with the species and its calls. Survey methods could employ recorded calls, automatic recording devices as used for the bittern surveys, and possibly, camera traps.

9.3 Wetland Bird Arrivals in the 20th Century

9.3.1 White-faced Heron/Matuku Moana

The white-faced heron is a self-introduced species from Australia, first reported breeding in New Zealand in 1941 (Heather & Robertson, 1996). It has colonised the whole country since then, occupying vacant niches along the coast, in wetlands and open country, and probably benefitting from the

conversion of forest to farmland. The species was probably present on Aotea in the early 1960s, established by the 1970s, and was common and widespread by 1980 (Bell, 1976; Bell & Brathwaite, 1964; Ogle, 1981). Now it is present in most estuaries, and especially in wet paddocks and tidal areas around the Whangapoua Estuary, where aggregations of a dozen or more birds can be seen; Miskelly & McAlpine recorded 20 there in 2010 (C. Miskelly personal communication). The total Aotea population is probably c. 100. The white-faced heron hunts fish and invertebrates in shallow water. It is less frequently seen in wetland areas with extensive reed or raupo beds. On rocky coasts it could potentially compete with reef herons, and in dense reeds with bitterns, but it has successfully commandeered modified landscapes with open pasture, wetlands and drains.

9.3.2 Pied Stilt/Poaka

These delicate, long-legged waders (**Figure 96**) frequent shallow water and use their long bills to catch aquatic insects, crustaceans and worms. They are conspicuous and noisy. Pied stilts may have colonised New Zealand from Australia in the early 1800s, since when they have contributed to the demise of black stilts (*Himantopus novaezelandiae*) by hybridisation (Heather & Robertson, 1996). It was not recorded on Aotea by Hutton (1868).

FIGURE 96

Pied Stilt/Poaka in Whangapoua Harbour, 2011 (photo by John Ogden)

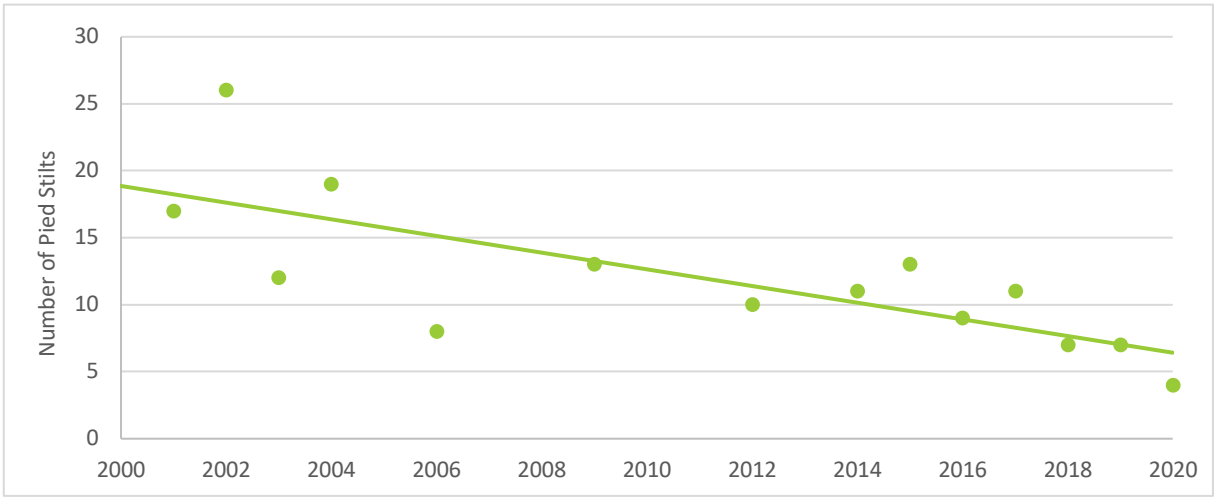


FIGURE 97

Number of pied stilts counted in February-May (post-breeding) in the Whangapoua area (vertical axis). Counts for twenty year period from 2000 to 2020 (r = -0.7492, n = 14, P < 0.01)

A few birds have been recorded since 1934, with perhaps 20 present in the 1960s, mainly at Whangapoua Estuary, but also at Kaitoke Beach, Medlands Beach and in 'the swamp at Sugarloaf Creek' (Bell & Brathwaite, 1964). Breeding was recorded in the Whangapoua area in the 1960s and has been recorded in the wet paddocks to the north of the estuary this century.

However, since 2000 the Aotea population appears to have declined and become almost restricted to the Whangapoua Estuary (**Figure 97**). This species is probably highly dependent on suitable habitat, which may account for its late arrival and apparently vulnerable situation on Aotea.

9.4 Summary of the Status of Wetland Birds

The rarer native wetland birds are all listed as 'Threatened' or 'At Risk' (O'Donnell et al., 2015; Robertson et al., 2021) (**Table 11**). In most cases the reasons are fairly clear: bittern prefer large wetlands, so their small population has been further reduced by drainage; grey duck have been reduced by competition and hybridisation with the introduced mallard; fernbirds are probably susceptible to feral cat and rat predation. However, especially in the case of bittern, movement between wetlands occurs, suggesting that all the remaining wetland areas on Aotea – including some quite small areas - need to be managed as a whole meta-

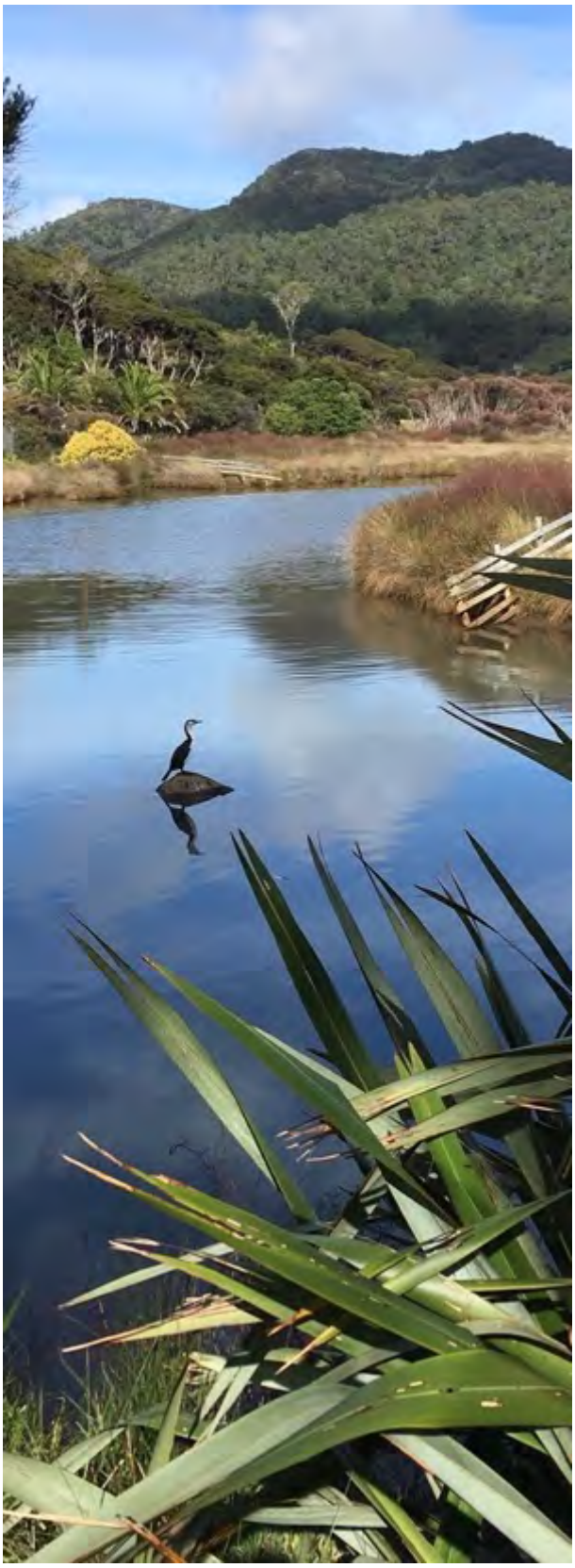


FIGURE 98

Pied shag in Waitematuku Creek (photo by Lotte McIntyre)

ecosystem. Most of the wetlands (**Figure 98**) are in areas managed by the DoC but have had no integrated management or pest control. Invasion of weeds (especially Mexican devil, *Ageratina adenophora*, in Kaitoke Wetland) has altered the vegetation and probably the trophic structure of all the swamps. The net effect is a much-depleted avifauna in wetland ecosystems, which possibly also makes them vulnerable to invasion by, and competition from, more recent arrivals and introduced birds. However, of the more recent arrivals, neither pied stilt nor white faced heron have effectively colonised them, favouring open estuarine mud flats and the damp pasture that forms after swamps have been drained. Even if successful predator control is achieved, and some drained areas re-flooded, it is not clear that the wetland avifauna would increase dramatically. However, the existing sparse wetland bird populations would certainly benefit and the risk of losing them altogether from Aotea could be greatly reduced.

9.4.1 Population Status Estimates and Trends for Wetland Birds

TABLE 11

Species	Population Estimates for Aotea	Current Trends
North Island Fernbird	< 1,000	Stable/Decline
Pāteke	400 - 600	Decline (Managed)
White-faced Heron	< 100	Stable/Increasing
Spotless Crake	? < 100	? Stable
Pied Stilt	< 20	Decline
Australasian Bittern	4 – 8	Decline
Grey Duck	0 – 10	Decline (Hybridisation or Absent)
Marsh Crake	0	? Absent

Table 11*: Population estimates and trends for wetland birds.*

PART 4: BIRDS OF THE COASTAL ZONE

FIGURE 99

Port Fitzroy harbour (photo by Hannah Smith)

10 THE COAST

10.1 Habitat of the Steep Rocky Coasts – The Pōhutukawa Fringe

Hutton's (1868) list of the birds of Aotea includes 20 oceanic birds, four waders, and nine coastal species. While some of these, (albatrosses, mollymawks etc.), might have been seen only in the surrounding waters, several oceanic species nest in colonies in burrows in mature forest and were probably once abundant on Aotea. Currently only two species of petrel (black petrel/tākoketai and Cook's petrel/titi) nest in the inland forest and one petrel (grey-faced petrel/ōi), one shearwater (fluttering/pakahā) and common diving petrel breed in small numbers in the coastal forests and/or on some offshore stacks. Other coastal species, including little penguins, shags, and reef herons also nest in the coastal forest or on the adjacent coast. These species are mentioned here to emphasise the oceanic connections of Aotea's ecosystems, and to draw attention to the important changes in the Oceanic Temperate Forest ecosystem implied by their depletion.

The extensive coastal zone of Aotea is readily divisible into: (1) steep areas with rocky outcrops (**Figure 99** & **Figure 100**) and cliffs and (2) sandy beaches, dunes, estuaries and mangroves (**Figure 101**).

New Zealand does not have the abundant cliff-nesting specialists, the auks (*Alcidae*), characteristic of some Northern Hemisphere countries, and the one endemic cliff nester that does still occur in the Hauraki Gulf in small numbers, the spotted shag, is absent from Aotea. Aotea's cliffs provide few opportunities for nesting seabirds, but the steep, crumbling sandy soil beneath the pōhutukawa (*Metrosideros excelsa*) trees above them is used by a few burrowing petrels and shearwaters. Rocky coastlines, islets, headlands and sandspits provide feeding, and occasionally, nesting sites for shags, reef heron, red-billed gull and white-fronted tern. The status of the wading birds of sandy beaches and estuaries is based mainly on data from Okiwi Spit and Whangapoua Estuary. This large area of intertidal sand and mudflats, mangroves, saltmarshes and dunes comprise by far the most significant habitat for shorebirds on Aotea.

The Okiwi spit (**Figure 101**), enclosing the Whangapoua estuary was formed mainly during the late Holocene (last 7000 years) since sea-level stabilized, although traces of a much earlier spit lie below it. The estuary area was formerly a large lagoon but has been in-filled by sediments from erosion following forest fires about 800 years ago, and later forest clearance by Europeans (Ogden et al., 2006). Most of the vegetation sequence from freshwater swamp with raupō and mānuka to the *Baumea (Machaerina)/Leptocarpus*

FIGURE 100

Nesting site of grey-faced petrel/ōi on south-eastern cliffs at Windy Hill Sanctuary (photo by John Ogden)

FIGURE 101

Okiwi spit from Harataonga coastal walkway (photo by Hannah Smith)

(Apodasmia) salt meadows and mangroves (*Avicennia marina*), occupying c. 3 km^2, is growing on sediments deposited since Māori arrival (Ogden et al., 2006). The remaining muddy sand area exposed at low tide (c. 2.5 km^2) comprises the feeding ground for both migratory and resident waders, especially during the post-breeding period. For additional recent information on the distribution, abundance and conservation status of the seabirds of the Hauraki Gulf see Gaskin & Rayner (2013).

10.2 Status of the Birds of the Steep Rocky Coasts

The steep coastal fringe of Aotea is characterised by pōhutukawa, though it includes other tree and shrub species (Ogden, 2004). Pōhutukawa provide colonial nesting sites for pied shags, while the *Astelia* ground cover below would formerly have been burrowed by nesting fluttering shearwaters/ pakahā and grey-faced petrels/ōi, now very restricted by cat and rat predation. Before European clearance, pōhutukawa forest was present on the stabilised dunes at Medlands, and elsewhere on the east coast dunes.

10.2.1 Shags/Kawau, Kawaupaka, Kawau Tūī, and Kāruhiruhi

Of the five species of shags that breed in the Hauraki Gulf area, at least four occur on Aotea and one, the pied shag, certainly breeds on the island while the others may do so. The pied shag (**Figure 102**, **Figure 103** & **Figure**

FIGURE 102

Kāruhiruhi (Pied Shag) –
Phalacrocorax varius (illustrated by Erin Forsyth)

FIGURE 103

Three species of shag on rock in Kaitoke Stream (L-R: Little Pied with juvenile Black Shag behind, three Little Black and one adult Black Shag)
(Photo by John Ogden)

104) is listed as “At Risk - Recovering” (Robertson et al., 2021). The four species comprise a larger pair: black shag/kawau and pied shag/kāruhiruhi, and a smaller pair: little black shag/kawau tūī and little shag/ kawaupaka. The black shag has a cosmopolitan distribution, while the other species are native to New Zealand but occur in Australasia and Indonesia. According to Gaskin and Rayner (2013) breeding colonies of only the pied shag are known on Aotea. However, it is possible that little shags could breed in some pied shag colonies, where they can easily be overlooked.

On Aotea the pied shag is the most common species, usually nesting in pōhutukawa or other large trees growing beside tidal creeks near the sea. Pōhutukawa on exposed cliffs are more commonly used as resting places and colonial roosts, though nests sometimes occur there also. At least 10 pied shag colonies are known on Aotea, but some of these comprise only a few nests (Gaskin & Rayner, 2013). Pied shag numbers have declined at some colonies: for example, the Awana colony had 30 active nests in 1994, 15 in 2011 and 13 in 2020. The 1994 count at Awana also included a few little black shags, apparently nesting, but not seen doing so subsequently. In 2012, Ogden (unpublished data) counted 108 active pied shag nests in 10 colonies, but the island-wide population must greatly exceed 216 birds. The overall population trend for pied shag seems to be one of decline, but this is hard to assess, because favoured sites appear to change over time, so only counting established colony trees can be misleading. For example, the colony in pōhutukawa at Schooner Bay apparently increased from c. 12 nests in 2012 to 23 in September 2013, occupying additional trees (including one black shag standing on a nest in 2012). Single black shags also occur in the Oruawharo Creek near the pied shag colony. However, breeding of the black shag, little black shag and little shag on Aotea, all require confirmation.

FIGURE 104

Pied Shag nesting in pōhutukawa, Schooner Bay (photo by John Ogden)

10.2.2 Grey-faced Petrel/Ōi

The New Zealand grey-faced petrel (**Figure 105** & **Figure 107**) (*Pterodroma gouldi*) or ōi was formerly recognised as a subspecies of the great-winged petrel (*Pterodroma macroptera*), but it is now regarded as a full species (Wood et al., 2017). It is one of the most common New Zealand petrels and is the sixth most frequent beach wreck on the eastern Aotea beaches. However, it is much less abundant than in pre-human times when it would have bred on many coastal headlands and clifftops around the northern half of the North Island. It almost disappeared from Aotea following the extermination of the colony on Rakitū by ship rats introduced in the 1860s (Hutton & Kirk, 1868; "Native Land Court," 1871). The species is taonga for Māori, and Ngāti Rehua Ngātiwai ki Aotea in particular, so that their restoration and colony protection are culturally significant.

Grey-faced petrels breed during winter (June-July), arriving ashore just after dusk from March onwards. A small colony was found above the cliffs near Awana in 1997 (**Figure 105** & **Figure 106**). Breeding activity at that site has been monitored by members of AGBET, and it is now actively protected by rat and cat traps. Observations suggest that the colony commenced or started to increase in the 1990s, when rats were eradicated from a number of nearby offshore islands (Towns & Broome 2003) with grey-faced petrel colonies. The Awana site, visible from Cuvier Island

FIGURE 105

Grey-faced petrel leaving burrow at night on Awana cliffs, October 2020 (photo by Barry Scott)

FIGURE 106

Grey-faced petrel burrow on Awana cliffs (photo by Barry Scott)

(Repanga), could have been colonised by spill-over from the expanding colony there, following the rat eradication. There has been evidence of rat and cat predation at the Awana colony, but there may also be continued recruitment from other productive island colonies. Monitoring of occupied burrows indicates an increase in active burrows from <10 in 1998 to >50 in 2020 (**Figure 108**).

Grey faced petrels have also been monitored in a scattered cliff top colony in the Windy Hill Sanctuary. In 2020, fourteen burrows were found, of which 11 were probably or definitely active. This is almost certainly an underestimate of active burrows, as only a small area of the suitable terrain was covered. This colony is predated by pigs, cats and rats, and is unlikely to increase until these predators are eliminated from the site.

FIGURE 107

Ōi (Grey-faced Petrel) – Pterodroma macroptera (illustrated by Erin Forsyth)

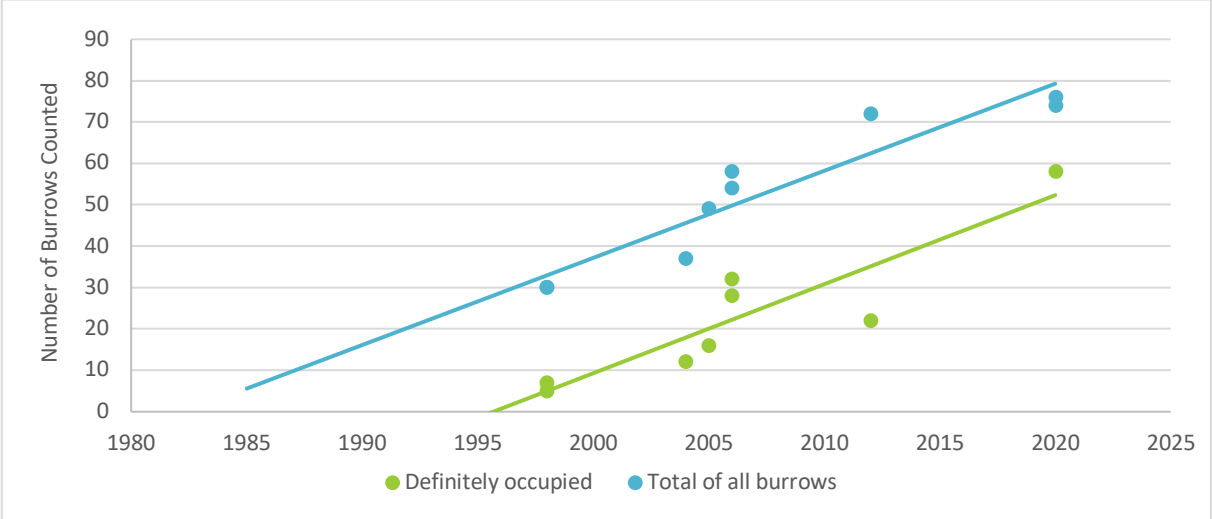


FIGURE 108

Counts of grey faced petrel burrows at Awana 1998-2020. Linear regression trendlines are both statistically significant (total r = 0.9456, n = 8, P <0.001; occupied r =0.8999, n =8, P<0.001).

There are reports of grey faced petrel burrows from Mohunga Peninsula, and there are small colonies in other coastal locations around the main island. In 2022 a few active burrows were also found on private land at the southern end of Oruawharo Bay.

10.2.3 Fluttering Shearwater/Pakahā

Fluttering shearwaters (**Figure 109**) are one of the most common seabirds in the Hauraki Gulf, and nest on many islands in the Gulf and Bay of Plenty that are free of mammalian predators. Their total population may be 100,000+ pairs (Gaskin & Rayner, 2013) and, after penguins, they are the most common beach wreck on the eastern beaches of Aotea. Fluttering shearwaters comprise c. 12% of all beach mortalities (132 from 1994 to 2020). However, despite many dead birds found on beaches, there is only occasional evidence of nesting on mainland Aotea. Possible burrows were reported at the end of the Kotuku Peninsula in 2006 and a nest was monitored near Orama in 2015. A newly fledged bird found exhausted at Awana the following year. A large, active colony with c. 1000 fluttering shearwater burrows was found on an unnamed rat-free stack south of Opakau Island in early 1985 (McCallum, 1985). Assuming this stack has remained rat-free since that time, this colony may still exist. At Rakitū, a fledgling fluttering shearwater was found on an offshore stack along with some burrows (Bellingham et al., 1982). Fluttering

FIGURE 109

Pakahā (Fluttering Shearwater) – Puffinus gavia (illustrated by Erin Forsyth)

FIGURE 110

Storm-wrecked diving petrel (photo by Kate Waterhouse)

shearwaters could recolonise Rakitū now the island is clear of predatory mammals.

10.2.4 Common Diving Petrel/Kuaka

Diving petrels breed on about 30 islands free of mammalian predators in the Hauraki Gulf and Bay of Plenty (Gaskin & Rayner, 2013). A small colony of diving petrel burrows was located on the same rat-free stack where the fluttering shearwaters (see above) were found in early 1985 1985 (McCallum, 1985). Some diving petrel burrows were found in ice plant (*Disphyma australe*) on the lower slopes, and 10-15 burrows were seen on the summit. As with the shearwaters, if this stack has remained rat free since that time, this diving petrel colony should still be present. At Rakitū, diving petrel remains, and empty burrows were found on an offshore stack by Bellingham et al. (1982). Judging by the frequency of beach-wrecked birds on Whangapoua and other east coast beaches, birds may still be present at this colony (**Figure 110**).

10.2.5 Little Penguin/Kororā

The Little penguin/kororā (**Figure 111** & **Figure 112**) is currently listed as 'At Risk Declining' (Robertson et al., 2021) but the data are poor. Both Hutton (1868) and Bell and Brathwaite (1964) regarded little penguins as "very numerous, with much suitable habitat, for both fishing and nesting, around the coast". The species is certainly still common at Aotea, although at one study

FIGURE 111

Kororā (Little Penguin) – Eudyptula minor
(illustrated by Erin Forsyth)

FIGURE 112

Little Penguin/Kororā
(photo by Shaun Lee)

colony in the dunes at Awana may have fallen from c. six pairs in the 1990s to c. three pairs at present. Three nesting boxes placed there have never been occupied. Some penguins have been killed by dogs while moving between the nesting area and the sea. A few pairs breed under houses at Medlands Beach and around other coastal communities on Aotea. Despite their noise and smell, they are generally tolerated by the householders. Much of Aotea's coastline is rocky and difficult to visit, making an island-wide survey challenging. A survey by Jo Sim, funded by Auckland Council in June/July of 2022 found 105 burrows (Sim, 2022). A further intensive community survey would be worthwhile on accessible stretches of coastline to locate study colonies where longer-term trends can be monitored.

Little penguins are the most frequent beach wreck on the eastern beaches of Aotea; over 400 have been counted since 1994. In some years, mortality appears excessive, sparking public concern. Mass mortality occurs as a result of starvation caused by changing oceanic cycles affecting food supplies (Gaskin & Rayner, 2013), and these events may follow periods with low mortality during which the population builds up. The strong correlation (r =0.9117, n = 27, P <0.001) between penguin mortality (as assessed by beach-wrecks) and that of other seabirds (**Figure 113**) implies that stormy years might be causal, perhaps associated with low food supplies for all seabirds. The data provide no evidence for a change in penguin numbers since the 1990s but illustrate the value of long-term monitoring. Had the study concluded in 2008, an increase might have been suggested, and had it commenced in that year, a decrease. It also indicates that beach wreck counts might be a poor measure of abundance. The size of Aotea's little penguin population is hard to estimate because much of the coastline has not been monitored, but there may be hundreds of breeding pairs.

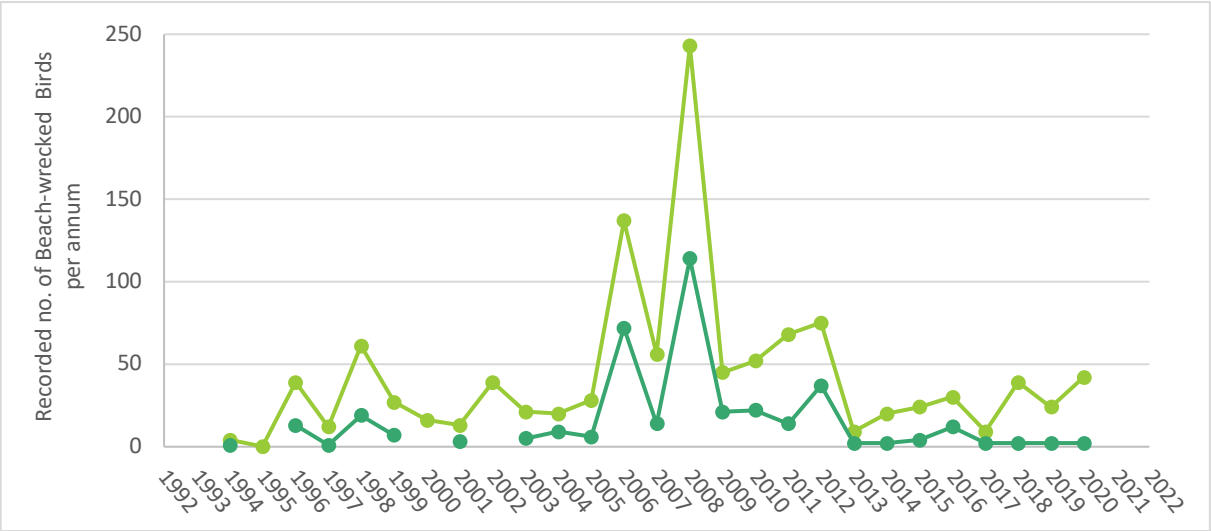


FIGURE 113

Numbers of little penguins and other seabirds washed up on east coast beaches of Aotea, 1994-2020. The light green line is the total number for all beach-wrecked species, the dark green line is the number of little penguins.

10.2.6 Reef Heron/Matuku Moana

The reef heron (**Figure 114**) is a widespread species found in East and South-east Asia, Australasia and the Pacific Islands. There are two main colour morphs: a dark slaty-grey form normally seen in New Zealand, and a white form more frequent in the tropics. In New Zealand, the reef heron is uncommon, and it is listed as 'Nationally Endangered' (Robertson et al., 2021).

On Aotea, the reef heron mostly occurs on the rocky inter-tidal zone, although it occasionally forages in small estuaries and on beaches. There are records from Awana and surrounding rocky islets (Lion Rock) and headlands (Korotiti) since 1999, with usually single birds seen most years during the spring and summer months. Singles have been seen elsewhere on the eastern coastline and at Whangapoua, and along the western side of Aotea at Okupu, Schooner Bay, Shoal Bay and inlets in Port Fitzroy Harbour. Nesting was reported from Schooner Bay in 2012 and probably from the Kaiarara Inlet near Port Fitzroy in 2010. The data suggest a small, stable population, with a pair every 5 – 10 kilometres along the more sheltered rocky coasts and on some islets with reef platforms.

10.2.7 Red-billed gull/Tarāpunga

Red-billed gulls/tarāpunga (**Figure 115** & **Figure 116**) occur everywhere along Aotea's coastline, on rocky headlands, sandy beaches and in estuaries. Despite giving the impression

FIGURE 114

Matuku Moana (Reef Heron) – Egretta sacra (illustrated by Erin Forsyth)

FIGURE 115

Red-billed gull colony on rocks at Awana, 2017 (photo by John Ogden)

of being common, the species is currently listed as 'At Risk Declining' (Robertson et al., 2021), because of significant declines in some formerly large breeding colonies, such as that on Burgess Island in the Mokohinau Group, which since the 1960s has declined from many thousands of pairs to under 60 pairs. Competition with fisheries has been suggested as a cause of this decline (Frost & Taylor, 2016). Red billed gulls are found throughout the Hauraki Gulf, and the Aotea population is a sub-set of this larger population. A colony of 10-100 pairs on The Needles was recorded by Frost and Taylor (2016) and Gaskin and Rayner (2013).

FIGURE 116

Red-billed gull nesting site (photo by John Ogden)

Counts at different times and places along the eastern beaches reveal great variability in both timing and location, with possibly up to 1000 birds in some years on Aotea if birds gather simultaneously at separated breeding sites. However, breeding sites may change annually making trends difficult to assess. Excepting breeding colonies, flocks > 100 are unusual. After breeding, the gulls disperse, probably mostly to the mainland.

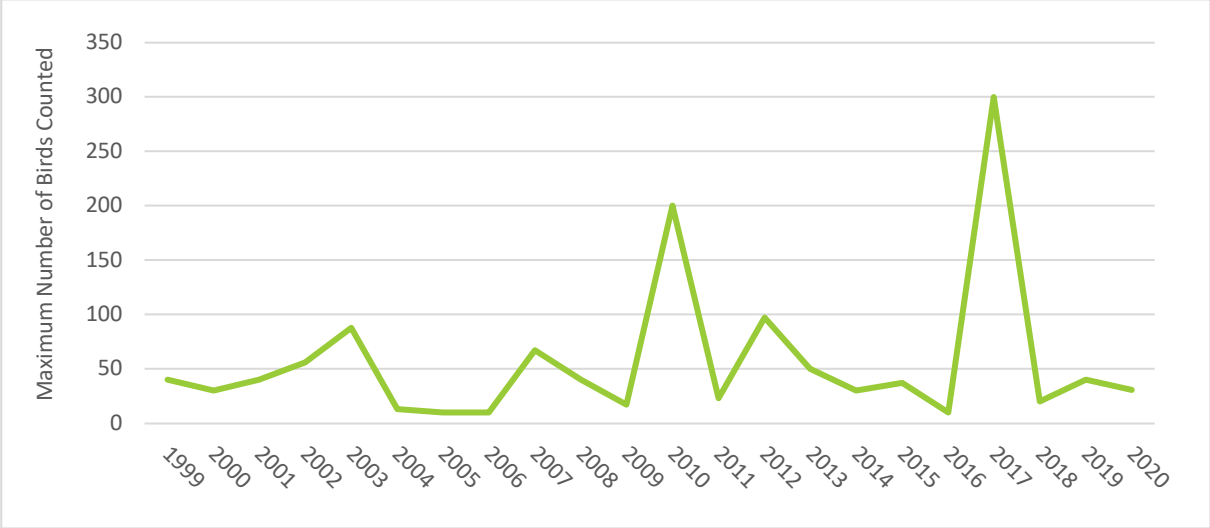


FIGURE 117

Red-billed gull/tarāpunga maximum flock sizes counted (vertical axis) on east coast Aotea 1999-2021. The 2017 count includes an ephemeral breeding colony at Awana.

The 2017 peak in red-billed gull numbers (**Figure 117**) includes a breeding colony on a low headland at Awana. This colony built up very rapidly in October 2017, and by early November there were c. 100-200 nests. However, most of the eggs on the landward edge were eaten by rats, and others were destroyed by a storm. In January 2018 only c. 20 young fledged, representing < 10% of the eggs laid.

10.2.8 Black-backed Gull/Karoro

Although much less abundant on Aotea than the red-billed gull, the larger black-backed gull also fluctuates in numbers in space and time. Black-backed gulls are widespread and common across the Hauraki Gulf and on the mainland. The species is listed as 'Not Threatened' (Robertson et al., 2021). Local changes in numbers on Aotea may reflect movements from island to island or to and from the mainland. There is no clear evidence of a change in numbers this century. On Aotea, black-backed gulls usually nest as single pairs on scattered, isolated rocky sites around the coastline. There are usually three or four brown juveniles with the small flock on Kaitoke Beach in March-April showing that local pairs have nested successfully. Judging from the maximum flock sizes counted (30), the resident population might be c. 100 birds.

10.2.9 Terns/Tara and Taranui

White-fronted and Caspian terns both occur on Aotea; the former is gregarious, while the latter tends to be more solitary and is much less common. The Caspian tern is easily distinguished by its large size and red bill. Hutton (1868) recorded two Caspian terns at Whangapoua and considered white-fronted terns to be abundant. The white-fronted tern is listed as 'At Risk Declining' while the Caspian tern is listed as 'Threatened Nationally Vulnerable' (Robertson et al., 2021). Thus, the numbers of both species on Aotea are of interest nationally. The Okiwi Spit and Whangapoua Estuary provide suitable breeding and feeding habitat for the critically endangered tara iti, or New Zealand fairy tern (*Sternula nereis*). Tara iti nest on the adjacent mainland coast, between Waipu and Pākiri; however, this species has never been recorded on Aotea. Several other tern species occur as vagrants in New Zealand, but their identification requires skill and as yet none have been recorded on Aotea.

10.2.10 White-fronted Tern/Tara

White-fronted terns/tara can be counted either at breeding colonies or in resting flocks on beaches. The two main resting beaches on Aotea are at Okiwi spit and Kaitoke beach. The largest flocks on both these beaches are usually seen in February, March and April following the breeding season (**Figure 118**). Flocks of up to c. 300 birds sometimes occur, but the long-term average (all months in all years) is c. 70 on each beach. White-fronted tern breeding colonies can move from year to year, so numbers fluctuate. Apart from the monthly pattern noted here, there is no clear correlation between numbers

on the two beaches, nor any evidence of trends over 20 years of data (**Figure 119**). Exceptionally large numbers were recorded on Okiwi spit in 2008 and at Kaitoke in 2021. These periodic aggregations may represent birds from a wide area, so, as for other marine species, the Aotea population cannot be considered in isolation from the Hauraki Gulf as a whole. The general absence of white-fronted terns in the winter months might indicate migration of juveniles to Australian waters (Wilson, 2021), but could also be an artifact of reduced sampling during those months. The arrival of small flocks in some years on both Okiwi spit and Kaitoke beach is unexplained.

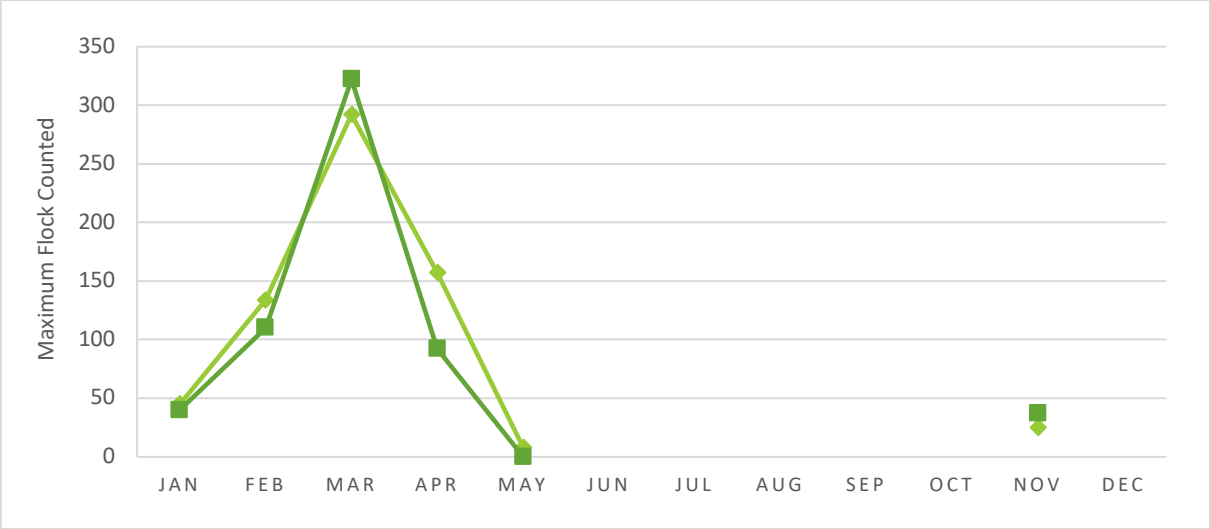


FIGURE 118

Maximum white-fronted tern flock size recorded/month (1999-2021). Dark green squares = Kaitoke Beach, light green diamonds = Okiwi spit.

FIGURE 119

White-fronted tern maximum counts per year (all months) Dark green = Kaitoke Beach, light green = Okiwi spit.

White-fronted terns breed in dense colonies, usually on sandy beaches but sometimes on rock stacks. A breeding colony was recorded on Rakitū by Gaskin and Rayner (2013). Breeding was recorded on the rocky stack off Kaitoke beach in 2007, and a colony of c. 50 pairs nested on Okiwi spit in 2017. In February of 2007 at Kaitoke both young birds and eggs were present in the colony. However, this event seems to have been exceptional, and it is likely that most Aotea birds originate from various smaller colonies around the island, or elsewhere in the Hauraki Gulf region.

10.2.11 Caspian Tern/Taranui

Caspian terns/taranui (**Figure 120** & **Figure 121**) may have increased on Aotea during the 21st century (**Figure 122**). The late summer flock on Kaitoke beach was 16 in 2021. One or two pairs are usually present on Okiwi spit and single birds or pairs are frequently present in Tryphena and Port Fitzroy harbours. The total Aotea population is c. 20 birds.

No breeding attempts have been seen at Kaitoke beach, but there are a few observations of nesting on Okiwi spit and elsewhere. In 2010 a pair laid two eggs on the spit, but these had disappeared by 23rd October. Breeding attempts occurred in 2016, and in 2017 an apparently new fledgling was present in February. In 2018 a nest with one egg was protected by the parents for most of October and November but abandoned later

FIGURE 120

Caspian Tern (Taranui) on the coast of Aotea (photo by Shaun Lee)

FIGURE 121

Taranui (Caspian Tern) – Hydroprogne caspia (illustrated by Erin Forsyth)

that month. Nesting has also been reported from a rocky islet in Fitzroy Harbour, and from Gooseberry Flat (Tryphena).

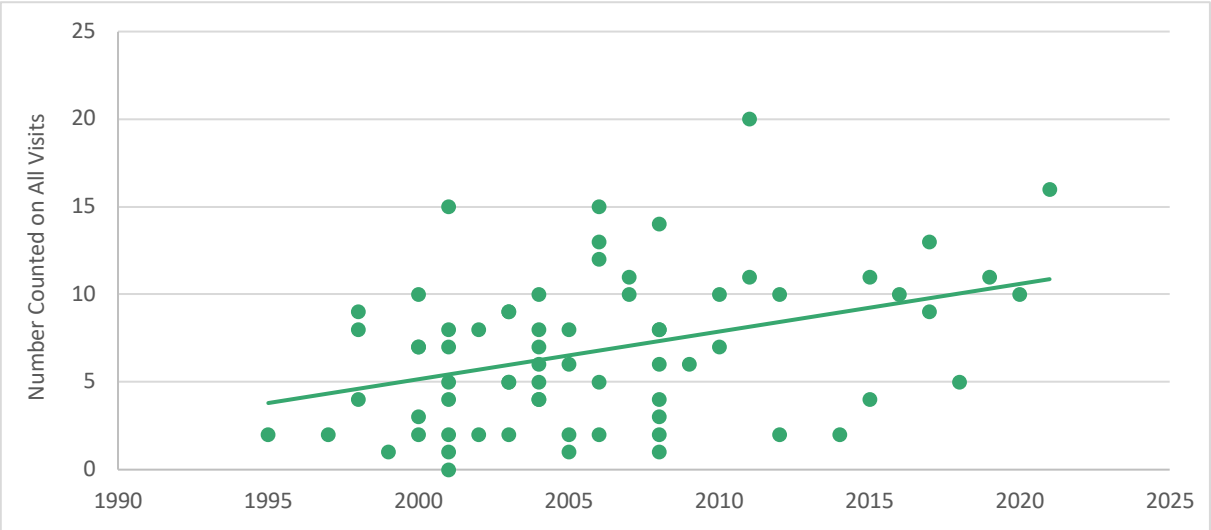


FIGURE 122

Records of Caspian terns on Kaitoke beach 1995-2021. The correlation is statistically significant (r = 0.3788, n = 68, P< 0.01).

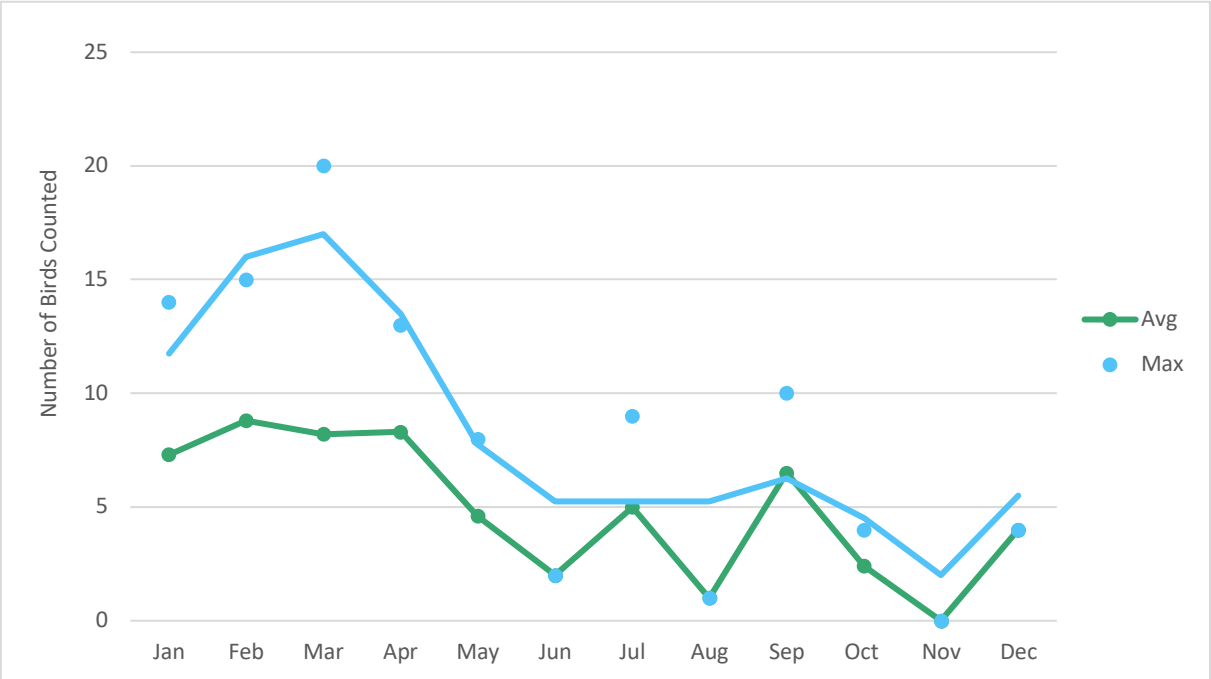


FIGURE 123

Caspian tern/taranui average and maximum number in any month (2001-2021) on Kaitoke beach, dark green line shows the average number, blue line is smoothed average of maximum count (blue dots).

Caspian terns gather in a small roost on Kaitoke Beach between February and April, usually with two or three juveniles. The highest number recorded at any one time was 20 birds (**Figure 123**).

10.2.12 Australasian Gannet/Tākapu

The Australasian gannet/tākapu (**Figure 125** & **Figure 126**) is native to New Zealand and southern Australia, with a high proportion of the population breeding around the North Island. It is not a cliff nester but rather occupies flat topped rocky stacks, in large, closely packed colonies (**Figure 124**). Gannets can often be seen fishing along the coastline of Aotea, especially in summer. The prominent colony on Mahuki, in the Broken Islands off the west coast of Aotea has increased markedly since cattle were removed (Gaskin & Rayner, 2013).

At least 2500 breeding pairs were recorded by Lovegrove in 2004, but in 2017 Adams et al recorded evidence of 6000 nests, and at the same time noting fewer birds breeding at colonies in the inner Hauraki Gulf (Adams, 2020). Gannets forage widely around the Aotea coastline and throughout the Gulf. A stack to the west of Rakitū may have a small colony, but this requires confirmation. Rakitū, now free of cattle, rats and possibly in future, also free of weka, could be a likely location for a new colony to establish if the local expansion of the species continues.

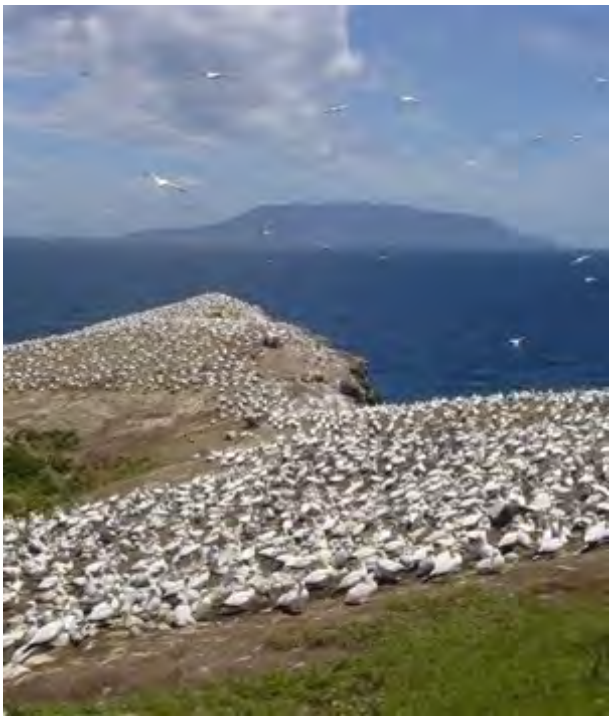


FIGURE 124

Gannets on Mahuki Island with Hauturu/Little Barrier in distance (photo by Halema Jamieson)

FIGURE 125

Tākapu (Australasian Gannet) – Morus serrator (illustrated by Erin Forsyth)

FIGURE 126

Tākapu (Australasian Gannet)
(photo by Sarah Dwyer)

Gannets were the fifth most frequent species found beach-wrecked, perhaps indicating the risk involved in their steep plunges while fishing; however, some mortality results from bycatch in recreational fishing gear (Gaskin & Rayner, 2013). Most of the mortality occurs in autumn (March 30%) and spring (September 16%) with few deaths recorded in the winter months. A proportion of the population is absent in winter because juveniles and some adults have migrated to Australian waters (Heather & Robertson, 1996).

10.2.13 Artic Skua

The Arctic skua is a summer migrant to New Zealand coastal waters from the Northern Hemisphere. It was not noted by Hutton (1868) but has been seen around Aotea by many observers since then. Most observations are at sea in the Hauraki Gulf in December, January or February, but in April 2008 one was observed persistently harassing white fronted terns on Kaitoke beach. A similar and slightly larger species, the pomarine skua *(Coprotheres pomarinus)* visits New Zealand waters during summer and may occur in the seas around Aotea.

10.3 Status of the Birds of the Beaches and Estuaries

FIGURE 127

Whangapoua estuary – front to back: fresh water mānuka/raupō wetland, pale salt-meadow rush zone, green mangroves and open water with mud showing at low tide (photo by John Ogden)

10.3.1 New Zealand Dotterel/Tūturiwhatu

The northern New Zealand dotterel (**Figure 128**, **Figure 129** & **Figure 130**) (*Charadrius obscurus aquilonius*) is one of two subspecies of an endemic shorebird, listed as 'At Risk-Nationally Increasing' (Robertson et al., 2021). The sub-category 'Nationally Increasing' is given to species which are recovering, but whose recovery is dependent on continued conservation actions. The abundance, survivorship and seasonal movements of the Aotea population of dotterels/tūturiwhatu was described by Ogden and Dowding (2013). Post-breeding

FIGURE 128

Tūturiwhatu (New Zealand Dotterel) – Charadrius obscurus (illustrated by Erin Forsyth)

dotterel counts, carried out on the same day at all beaches where dotterels are usually present ('whole-island counts'), have been undertaken since 2000. These counts indicate a gradual rise in the population, with a clear increase from 2016 to 2021 (**Figure 131**). The total population now comprises 60±8 (mean ± standard deviation) individuals. (c. 2% of the total New Zealand population).

For reasons that are unclear, breeding success and longevity in the Aotea population appears to be lower than on the mainland (Ogden & Dowding, 2013). Dogs destroy some nests and chicks on Aotea most years, harriers and black-backed gulls probably also take chicks. Feral cat predation of sitting males (which incubate at night) could also be a factor.

Banding has shown movement of Aotea birds around Aotea and to the Coromandel Peninsula. After breeding, most of the Aotea dotterels join a post-breeding flock at the Whangapoua Estuary and the adjacent spit. Some birds (5-15) remain on Kaitoke Beach, and some move between Whangapoua and Kaitoke (increased numbers at one site being mirrored by decreases at the other). A few also move to and from Coromandel. If the Aotea dotterels are a sub-population of the Coromandel one, the apparent increase on Aotea, especially since c. 2016, may reflect conservation efforts on Coromandel where the population has increased by >250% since 1989 (Dowding, 2020).

FIGURE 129

Tūturiwhatu (photo by Emma Waterhouse)

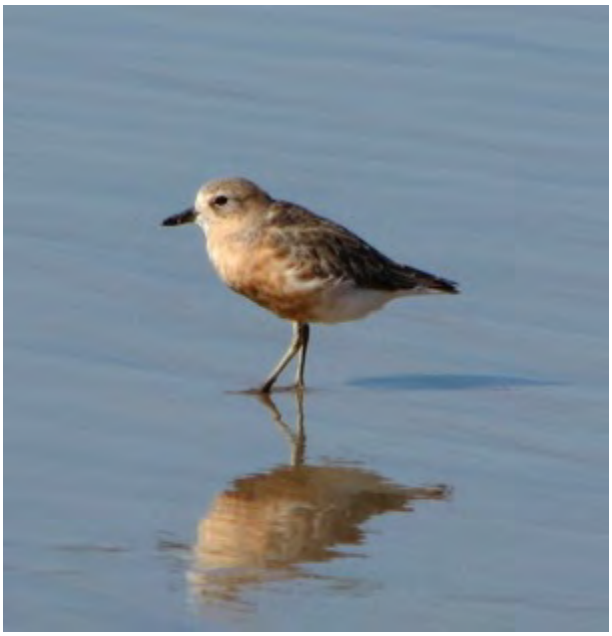


FIGURE 130

Male New Zealand Dotterel in breeding plumage (photo by John Ogden)

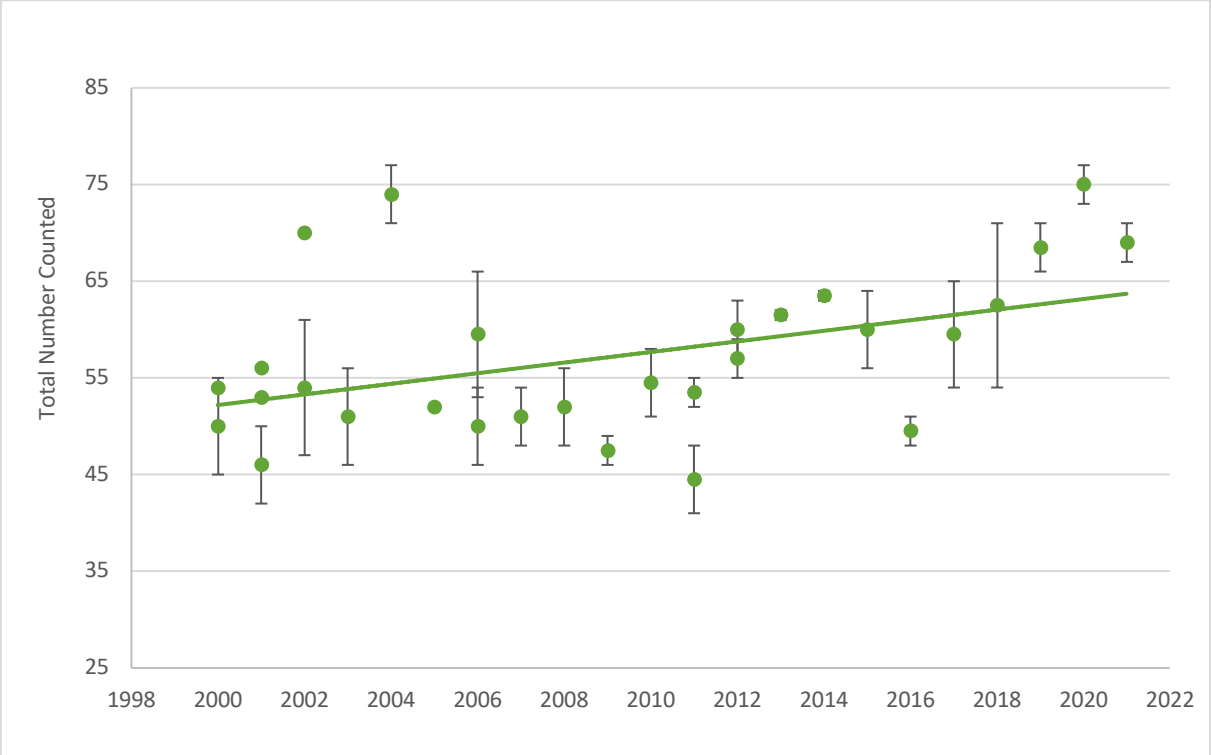


FIGURE 131

Post-breeding New Zealand dotterel/tūturiwhatu population on Aotea from same day counts on all beaches. Independent duplicate counts in a few years. Points are average of maximum and minimum numbers counted as indicated by the error bars. The trendline (including outliers) is statistically significant (r = 0.4409, n = 29, P <0.02). (After Ogden and Dowding (2013) with additional unpublished data).

10.3.2 Shore Plover/Tūturuatu

The shore plover/tūturuatu was recorded at Whangapoua by Hutton (1868), soon after this the species disappeared from Aotea. By about 1870 it had also disappeared from mainland New Zealand and became restricted to the Chatham Islands, where a population persisted on South East/Rangatira Island, which had remained free of predatory mammals (Heather & Robertson, 1996). In recent years, conservation efforts and translocations to mammalian predator-free islands have reduced the risk of extinction, but the current total population of c. 60-70 pairs and its extreme vulnerability to predation, justifies its listing as Threatened Nationally Critical (Robertson et al., 2021).

The shore plover is highly vulnerable to predatory mammals. Tūturuatu nests, often built under coastal vegetation or driftwood, or in a rock crevice, rather than in the open like other dotterels, make them very susceptible to rat predation. Feral cats probably also played a role in its extinction on Aotea, which even pre-dated their extinction from the mainland from the 1880s onwards (King, 1984) due to the spread of mustelids.

FIGURE 132

Male banded dotterel in breeding plumage (photo by Rebecca Bowater)

10.3.3 Banded Dotterel/Pohowera

Nationally, the smaller endemic banded dotterel/pohowera (**Figure 132**) is more numerous and widespread than the New Zealand dotterel. The current nationwide population numbers 5000-20,000, possibly at the upper end of this range (O'Donnell & Monks, 2020), but it is listed as 'At Risk Declining' (Robertson et al., 2021). A large proportion of these birds migrate to eastern Australia in winter. There is also post-breeding migration within New Zealand, with most of the remaining population moving north from its southern North Island and South Island braided-river breeding grounds to the large northern harbours. On Aotea, two to six pairs of banded dotterels breed at Okiwi spit and in the Kaitoke dunes, and this small resident population is augmented by migratory birds every winter.

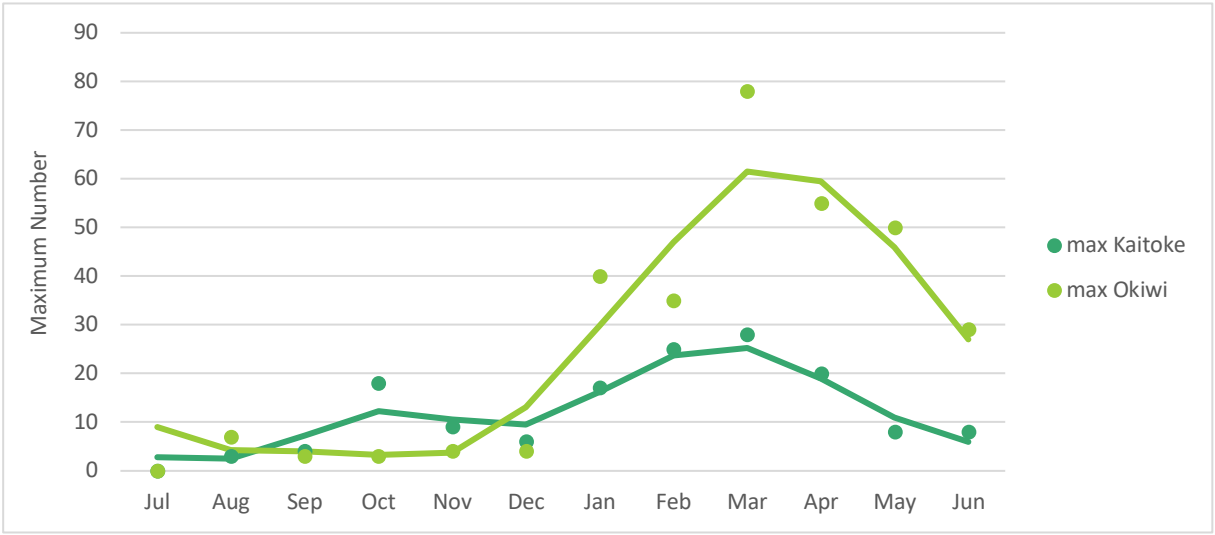


FIGURE 133

Maximum banded dotterel/pohowera numbers recorded at Okiwi spit and Kaitoke beach 1998-2020 by month with smoothed average

These post-breeding migrants start to arrive in January and peak in March or April. Many of them are juveniles. At this time the adults are in non-breeding plumage, having lost their bold black and chestnut breast bands. The migrant birds have mostly departed by July (**Figure 133**).

The abundance of banded dotterel at Okiwi spit varies greatly from year to year, although the mean number of birds remains fairly stable (**Figure 134**). This is probably mainly due to variable counting dates, but the flock frequently disintegrates and some birds feed elsewhere-for example in damp paddocks by the Okiwi airfield. There is no statistically significant trend over the twenty years of observation. Also, unlike New Zealand dotterels resident on Aotea, there is no indication that banded dotterels move between Okiwi and Kaitoke, although this may occur.

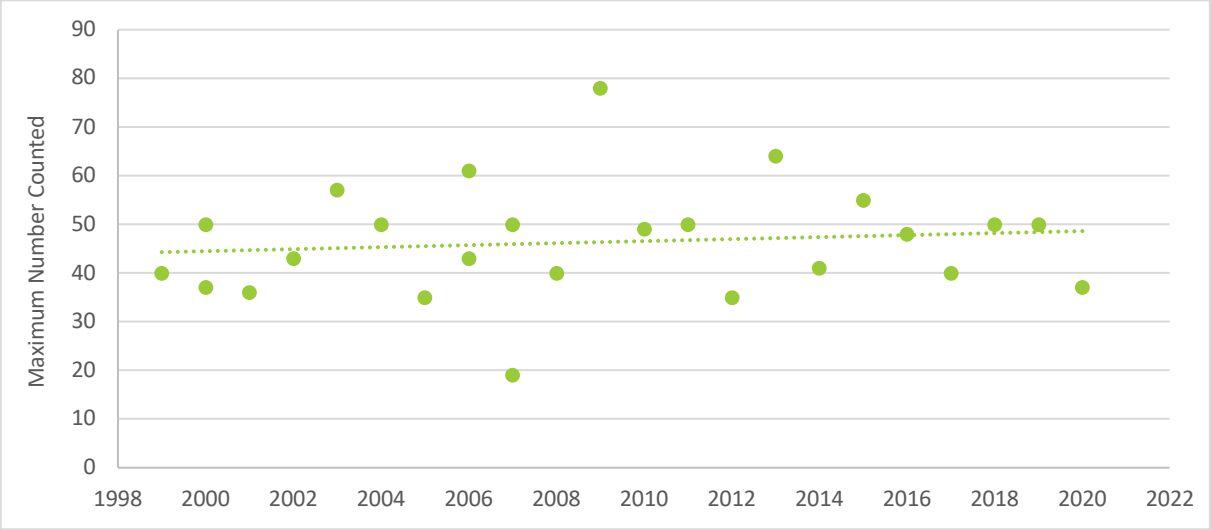


FIGURE 134

Banded dotterel counts showing maxima at Okiwi Spit 1998-2020. No significant trend.

10.3.4 Bar-tailed Godwit/Kuaka

The eastern bar-tailed godwit/kuaka (**Figure 135** & **Figure 136**) is one of the world's great migrants. Approximately 81,000 birds arrive in New Zealand (Schuckard et al., 2020) every September to October after a non-stop trans-Pacific flight of 7-8 days from western Alaska. About 60 (probably as two flocks) usually arrive on Okiwi spit in October and remain feeding on the Whangapoua estuary mud flats until March (**Figure 137**). Occasional larger numbers in November suggest birds are passing through to other New Zealand locations. Single birds or small groups occur temporarily on other Aotea beaches. Their return flight, starting in March, is via the East Asian Flyway (Riegen, 1999), with migration stopover sites in the Yellow Sea (Woodley, 2013a). They reach their breeding grounds in Alaska in May or June.

The average number of' birds arriving at Whangapoua in spring (October) is generally similar to the number departing in the following February and March. A few birds (<10), probably juveniles, remain at Whangapoua most winters. The annual count data (**Figure 138**) indicate no change in the maximum numbers over the past 20 years. If extreme outliers (>85, <30) are removed, there is a weak negative trend. There is other evidence of a decline: Bell and Brathwaite (1964) counted 149 at Whangapoua in 1960 and reported anecdotal evidence of much larger flocks before then. If this trend on Aotea is correct, then it reflects the overall decline across New Zealand over the past 35 years (Schuckard et al., 2020). The eastern bar-tailed godwit is currently listed as 'At Risk-Declining' (Robertson et al., 2021).

FIGURE 135

Bar-tailed godwits/Kuaka. Foreground is male developing breeding plumage
(photo by Rebecca Bowater)

FIGURE 136

Godwits at Whangapoua (photo by Emma Waterhouse)

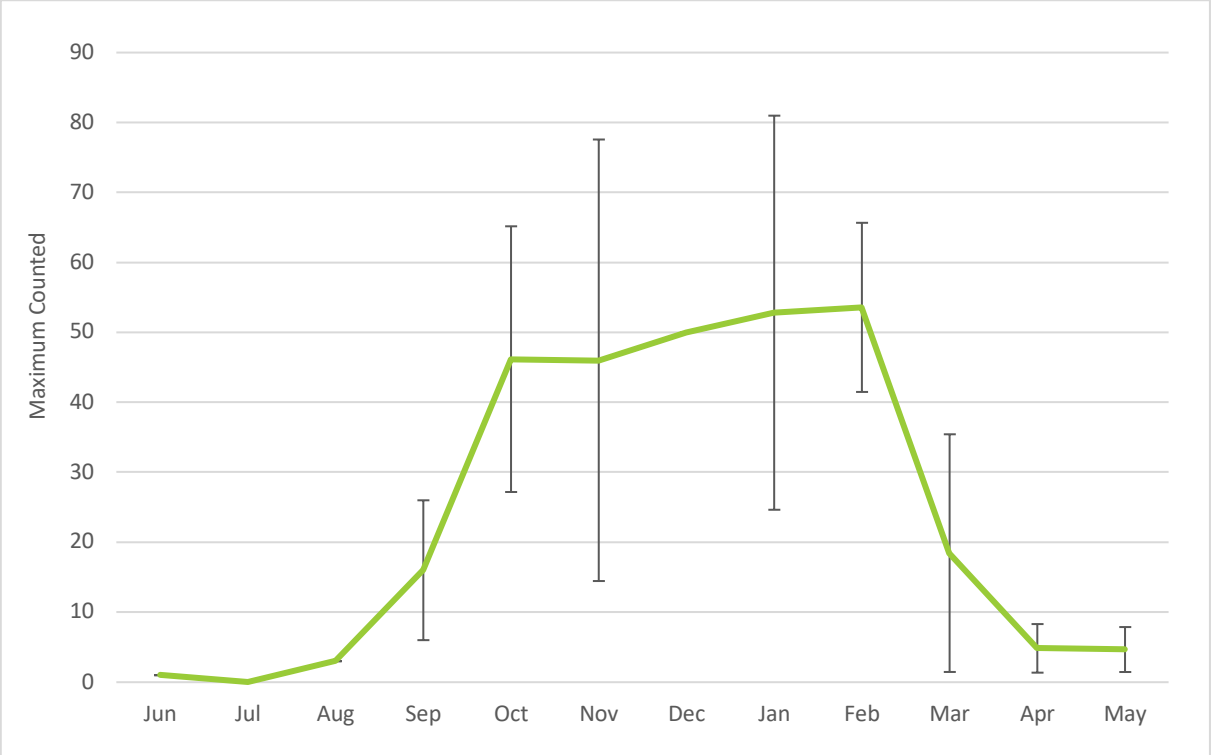


FIGURE 137

Bar-tailed godwit/kuaka. Averages of maximum monthly records (mean ± standard deviation) on Okiwi spit/Whangapoua estuary 1999-2020.

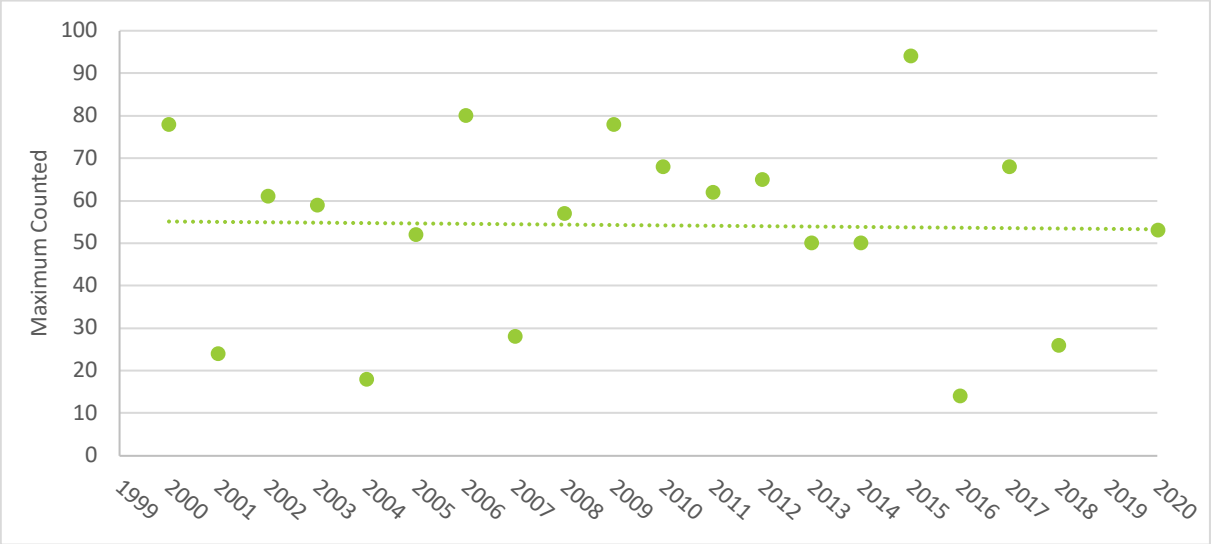


FIGURE 138

Bar-tailed godwit/kuaka, maximum annual records 1999-2020 (excluding 2019) from Okiwi spit showing a non-significant trend during this period. Counts fewer than 30 probably indicate that many birds were out on the mud flats at time of count and not seen.

10.3.5 Pacific Golder Plover/Kuriri

The Pacific golden plover/kuriri (**Figure 139**) is a trans-Pacific migrant, which breeds in Siberia and Alaska and winters in Australia, New Zealand and on many islands in the Pacific (Riegen & Sagar, 2020). They arrive in New Zealand in September-November and depart again in March or April, returning to their Northern Hemisphere breeding grounds via the East Asian-Australasian Flyway. This annual pattern is seen in the Okiwi spit data, with average maxima of c. 14 birds in November-December (**Figure 140**). Bell & Brathwaite (1964) counted six in 1960 and Ogle (1981) recorded 12 in 1980. However, this average, which was fairly stable from 2000 to 2017, dropped dramatically in 2018 and has not recovered since (**Figure 141**).

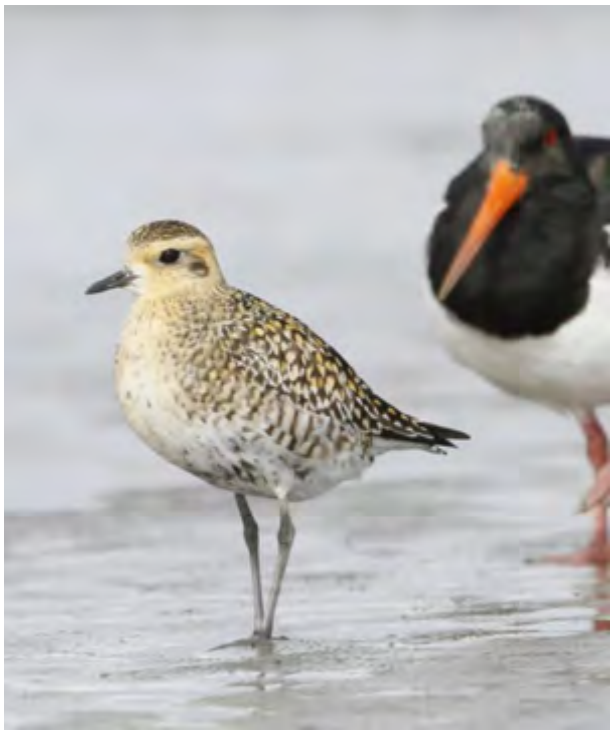


FIGURE 139

Pacific golden plover in winter plumage with South island pied oystercatcher (photo by Phil Battley)

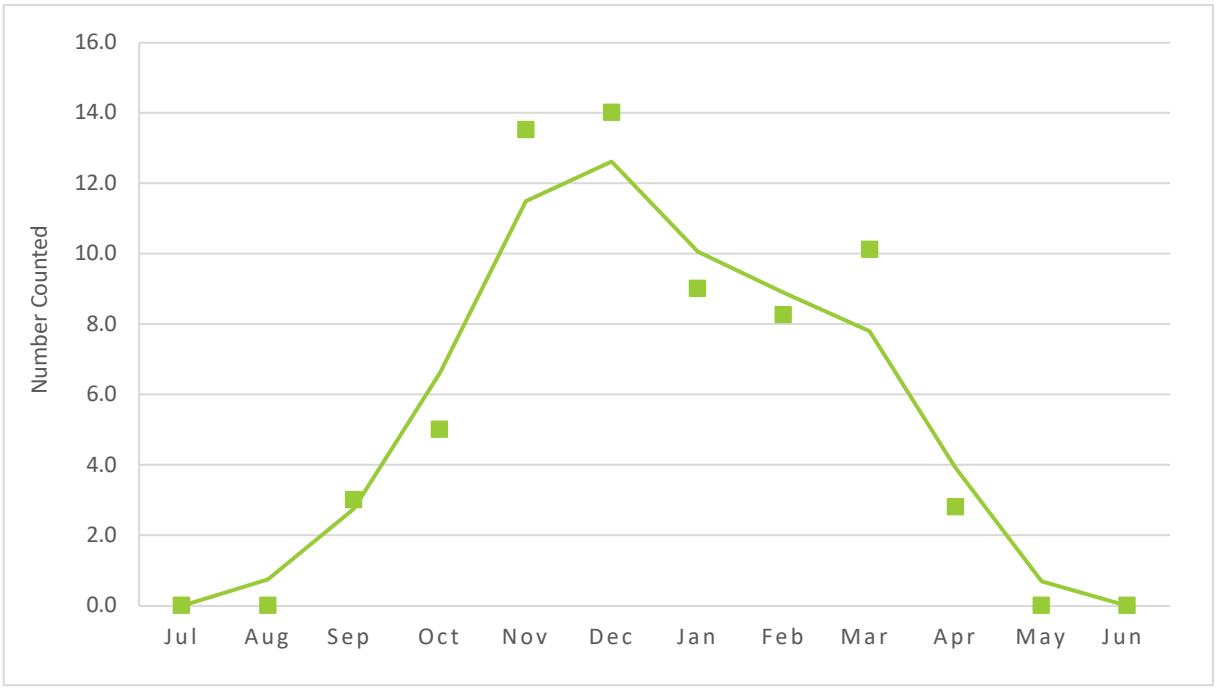


FIGURE 140

Pacific golden plover/kuriri monthly average maxima 2000-2020 on Okiwi Spit

FIGURE 141

Pacific golden plover/kuriri maxima on Okiwi spit 2000-2020

It is not certain whether all the arriving birds remain at Whangapoua until departure, and they may move to other estuaries in New Zealand.

10.3.6 Wrybill/Ngutu Parore

The wrybill (**Figure 142**), or ngutu parore, is a small shorebird, similar in size to a banded dotterel. It is the only bird species with a sideways-curved bill, which always bends to the right. It is endemic to New Zealand, and breeds on the braided rivers of the eastern South Island. Most of the population winters in the North Island, especially in the Manukau Harbour and Firth of Thames. The species is a highly specialised and unusual member of the plover family. Its sideways bill allows it to poke under river pebbles for hidden invertebrate prey on its riverbed breeding grounds, or, in the northern harbours, to scythe through the surface ooze, or probe the mud for marine worms and crustaceans (Woodley, 2012).

FIGURE 142

Wrybill/Ngutu Parore (photo by Tony Whitehead)

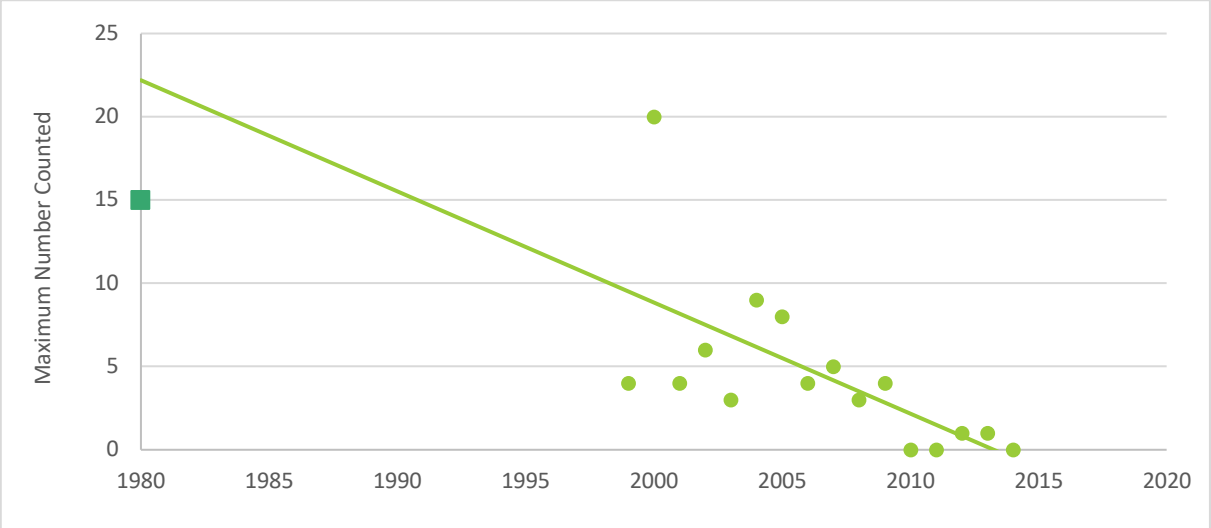


FIGURE 143

Wrybill/ngutu parore, showing highest number counted on Okiwi spit, Whangapoua, 1999-2014 (linear regression), with Ogle's 1980 count included on far left. (r =.667, n=16, P <0.01). All counts at Okiwi spit recorded zero birds since 2014.

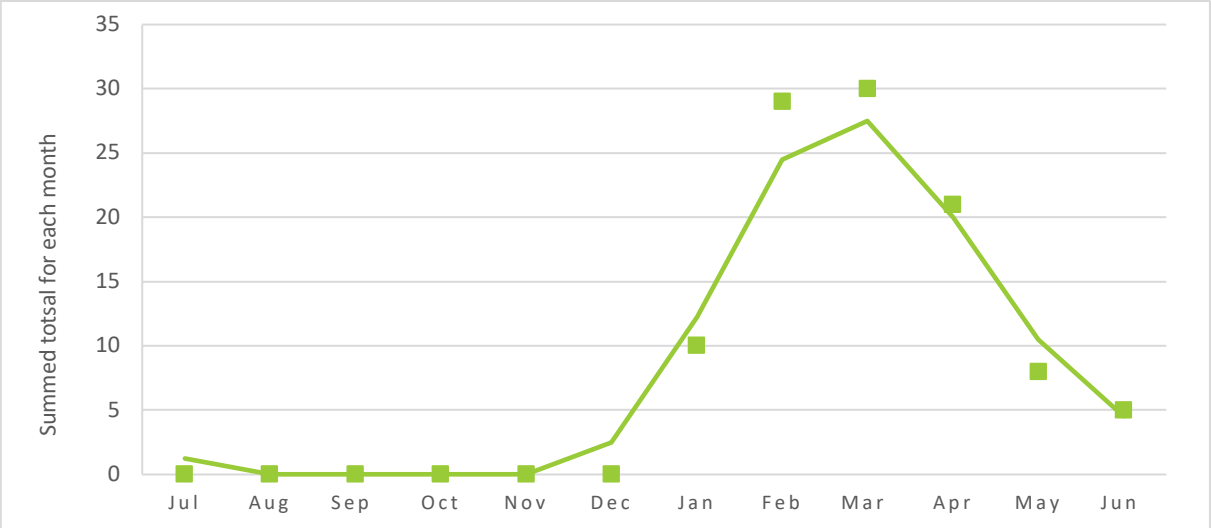


FIGURE 144

Total of wrybills/ngutu parore counted each month summed over the years 1999-2020 at Okiwi spit and Whangapoua estuary.

The wrybill is listed as 'Threatened Nationally Increasing' (Robertson et al., 2021) as a result of a 33% increase in numbers since the early 1980s, following improved predator control and restoration of braided river habitat at some South Island breeding sites (Pūkorokoro Miranda News). The species is conservation dependent, especially on its riverbed breeding grounds, where despite its extraordinary

camouflage among the greywacke shingle, adults and nests are vulnerable to predatory mammals. Along with predation, threats to wrybill include flooding and invasive weeds on the braided riverbeds (Dowding et al., 2020; Rebergen, 2011) and in the northern harbours, mangrove encroachment on roosts and feeding grounds (Woodley, 2012). Aotea has probably always been on the margin of the northern post-breeding migration. Ogle (1980) recorded 15 wrybills at Whangapoua and in February 2000, 20 were recorded. Since then, the numbers wintering on Okiwi spit have declined, and only the odd straggler now visits Aotea's beaches (**Figure 143**). Very few have been seen since 2015 (Ogden, 2015). They formerly arrived after breeding, in February or March, and departed for their breeding grounds again in May-June (**Figure 144**).

10.3.7 Variable Oystercatcher/Tōrea Pango

As indicated by its common name, the variable oystercatcher (**Figure 145** & **Figure 150**) has variable plumage, ranging from completely black to pied. However, in pied birds the white areas are usually blotchy at the edges, rather than clearly defined as they are in the South Island pied oystercatcher. Tōrea pango is common and conspicuous in all coastal areas of Aotea. They are long-lived and pairs remain together and breed in the same territories for many years (Heather & Robertson, 1996; Woodley, 2012). Birds on the eastern beaches move inland to wet paddocks following heavy rain, presumably to eat worms rising from the

FIGURE 145

Variable oystercatchers/tōrea pango nesting amongst sea rocket (Cakile maritima) at Okupu Beach (photo by John Ogden)

FIGURE 146

Variable oystercatcher/tōrea pango egg (photo by Emmy Pratt)

waterlogged soil. As with the New Zealand dotterel, after breeding there is a marked movement of adults and juveniles to a flocking site on Okiwi spit. However, some birds do not move far from their breeding beaches (variable oystercatcher nest shown in **Figure 146**).

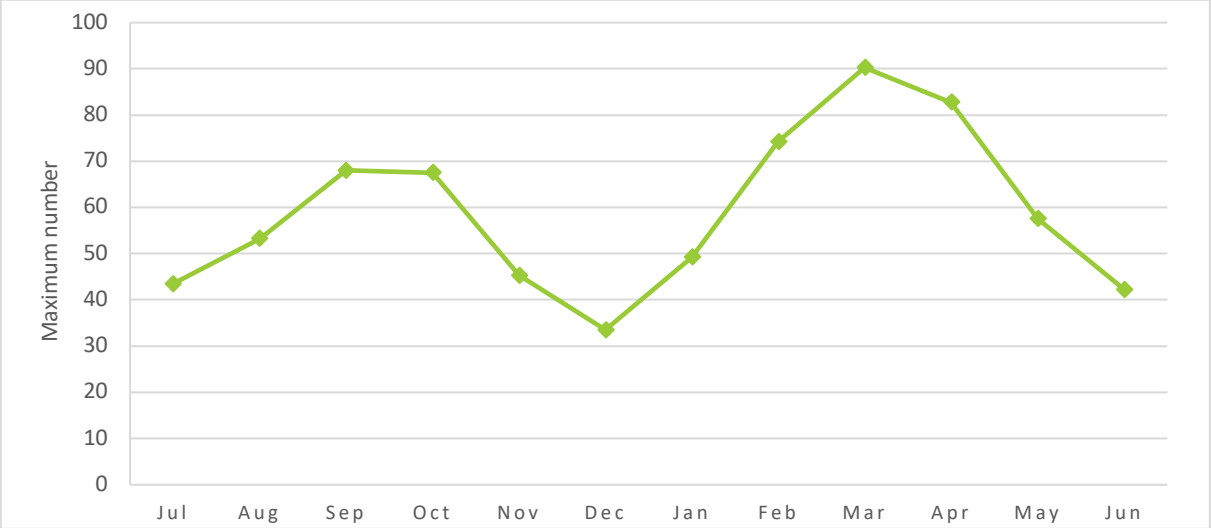


FIGURE 147

Variable oystercatcher/tōrea pango. Maximum smoothed total counts/month from 1999-2021 on Okiwi spit and adjacent Whangapoua estuary.

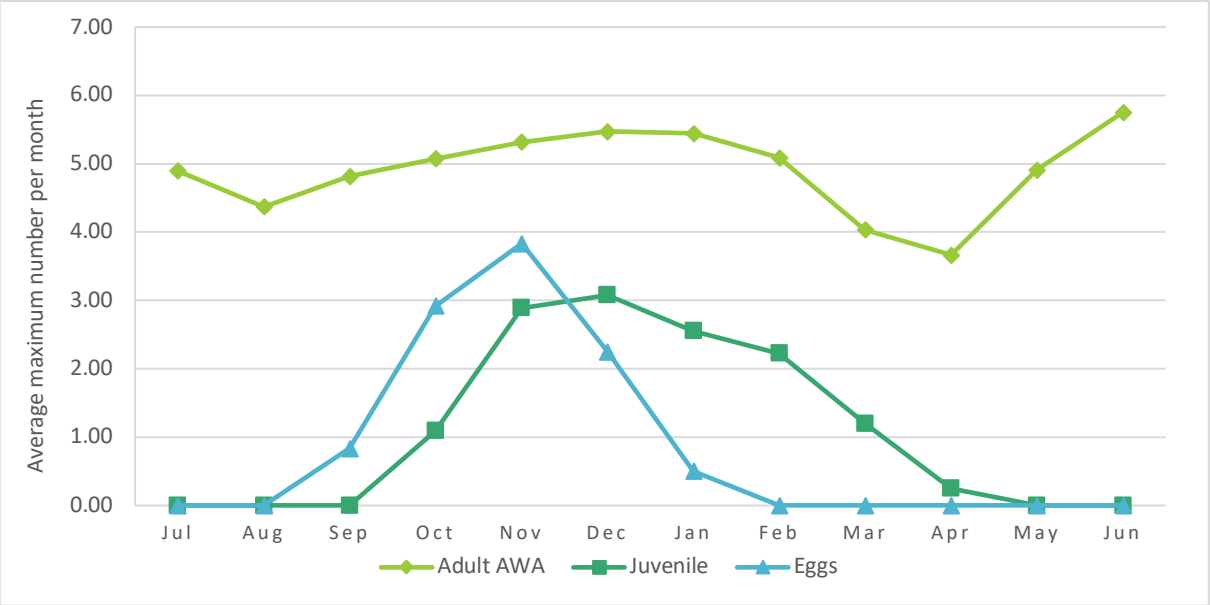


FIGURE 148

Variable oystercatcher/tōrea pango. Monthly numbers of adults, juveniles and nests with eggs at Awana (AWA). Light green diamonds = adults, dark green squares = juveniles, blue triangles = eggs. Numbers are smoothed maxima in each month (1999-2019).

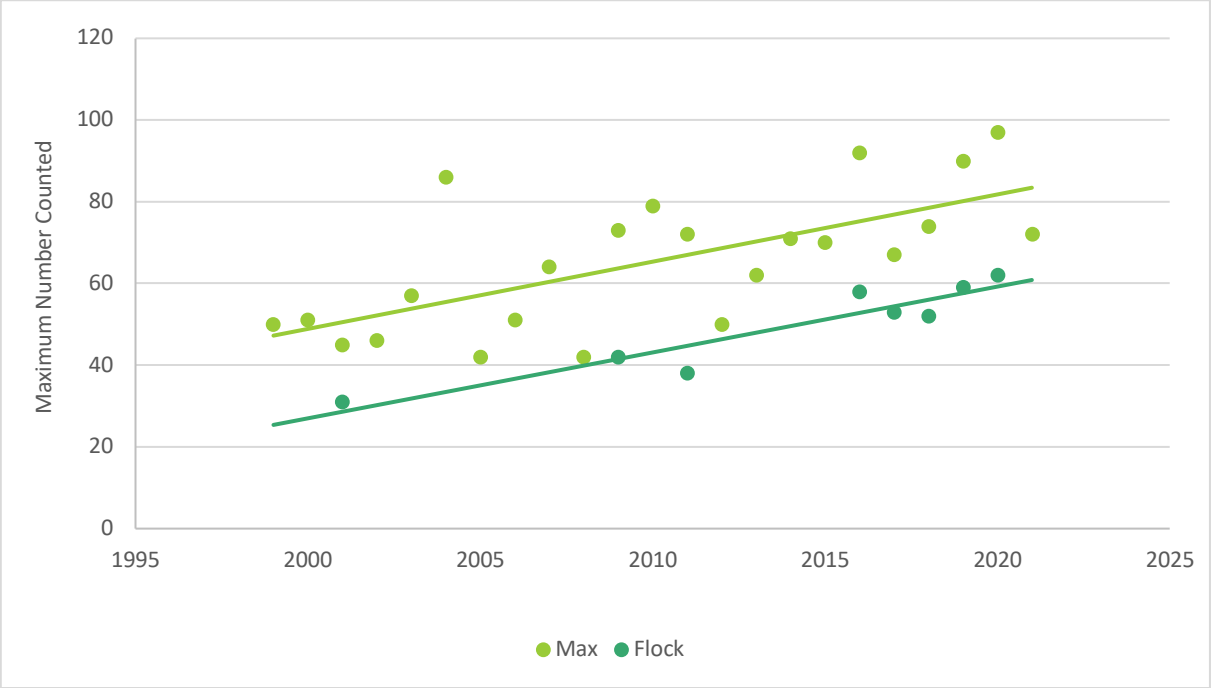


FIGURE 149

Maximum numbers of variable oystercatcher/tōrea pango recorded annually 1999-2021 at Okiwi spit and adjacent Whangapoua estuary. Where the distinct flock count was recorded separately, it is indicated (dark green points). Linear regressions through both data sets are significant: max: r = 0.4529, n= 23, P<0.001; flock r = 0.8779, n = 8, P<0.001.

Variable oystercatcher numbers peak in February-April, when a distinct flock forms at high tide on Okiwi spit (**Figure 147**). This flock comprises adult pairs and juveniles. A pair of adults and any fledged chicks usually leave Awana in March or April (**Figure 148**). Numbers appear to decline at the Okiwi spit in June and July, when there is some movement into wet paddocks. Maximum counts of 25-40 variable oystercatchers were recorded in these months following heavy rain in the paddocks at Kaitoke. Numbers are lowest at Okiwi spit during the breeding season (October- January) when variable oystercatchers have dispersed to their customary nesting beaches.

The overall population trends from 1999-2021 are probably reflected in the counts on Okiwi spit and Whangapoua estuary and indicate a statistically significant increase in maximum counts from 40-60 to 80-100 over this period (**Figure 149**). Variable oystercatchers have increased nationally as a result of protection from predators and human disturbance at their breeding sites (Heather & Robertson, 1996). The distinct flock on Okiwi spit at high tide constitutes c. 60% of total birds present on the spit and estuary and has similarly increased, indicating successful recruitment.

FIGURE 150

Tōrea Pango (Variable Oystercatcher) – Haematopus unicolour (illustrated by Erin Forsyth)

10.3.8 Records of Other Coastal and Pelagic Birds

The Hauraki Gulf is a global seabird hotspot, with twenty-seven species breeding in the region (Gaskin & Rayner, 2013; Wilson, 2021) and a particularly high diversity of breeding petrels (Black petrel, Pycroft's petrel, Buller's shearwater, New Zealand storm petrel and fairy tern breed only in this region). Some of these species have the potential to recolonise Aotea. Information about birds occurring in the seas around Aotea includes reports from fishermen and from birds found dead on beaches. The latter are more reliable in terms of species, because identifying shearwaters and petrels at sea is not easy, whereas a dead bird can usually be correctly identified from measurements or bones, even when little plumage remains.

FIGURE 151

Beach wrecked fairy prion at Awana, 2012 (photo by John Ogden)

Records of beach wrecks (**Figure 151**) have been kept by the author since 1994 and total 1110 individual birds and 28 oceanic species

(**Table 12**). While 25% of the corpses found were terrestrial or freshwater birds blown out to sea and drowned, and 20% were coastal species (little penguins, gannets, gulls, terns and shags), the majority (56% of species) were oceanic (pelagic) birds, some of which nest on Aotea or nearby islands (**Table 12**). While little penguins comprised 36% of all beach-wrecked birds (**Figure 152**), 25 species of pelagic birds formed 53% of the total. Species represented by <5 individuals (**Table 12**) are vagrants, mostly from breeding colonies in the subantarctic.

TABLE 12

Shearwaters	No.	Petrels	No.	Others	No.
Fluttering	**132**	**Grey-faced**	**49**	**Common Diving Petrel**	**126**
Buller's	65	**Cook's**	**38**	**Australasian Gannet**	**57**
Flesh-footed	28	**Black**	**29**	Fairy Prion	38
Sooty	21	Blue	4	White-faced Storm Petrel	13
Short-tailed	14	Black-winged	1	Broad-billed Prion	10
Little	6	Grey	1	Wandering Albatross	4
Hutton's*	1	Mottled	1	Antarctic Prion	4
				Narrow-billed Prion	2
				Royal Albatross*	1
				Black-browed Mollymawk	1
				Salvin's Mollymawk	1
				Mollymawk, unidentified	1
				White-capped Mollymawk*	1
				White-tailed Tropicbird*	1
Total Species **Total Birds**	**7** **267**		**7** **123**		**14** **259**

Table 12*: Seabirds found dead on the east coast beaches of Aotea 1994-2020 (J. Ogden unpublished data). *Species added in 2021 and 2022; other numbers not updated.* ***Green bold text*** *indicates species known to nest on Aotea or Rakitū.*

Fluttering shearwater/pakahā and the northern diving petrel/kuaka were by far the most abundant pelagic species recovered. Some of these may have come from colonies on islets around Aotea and Rakitū, but most probably originate from elsewhere. The greatest mortality in these two species is in September, when fluttering shearwater flocks have been observed off the east coast beaches. Sooty, short-tailed and flesh-footed shearwaters all migrate to the North Pacific during the winter months and return to, or pass through, New Zealand waters in the spring (Heather & Robertson, 1996). Another group of species mostly nest on Subantarctic islands but occur on Aotea beaches as vagrants. Some of these range into northern waters during winter while others are driven north in storms. These species include albatrosses, mollymawks, blue petrels and most species of prions.

Seasonal mortality is difficult to interpret because corpses can persist on beaches for a day or several weeks, and there has been more sampling carried out in summer than in winter. However, it is clear that there is higher mortality for some species in summer, when adults are actively feeding young and young birds are fledging. A second peak in mortality in spring (September) possibly coincides with resumption of activity at some breeding colonies, but August, September and particularly October, are also the windiest months, which might increase mortality risk for some species.

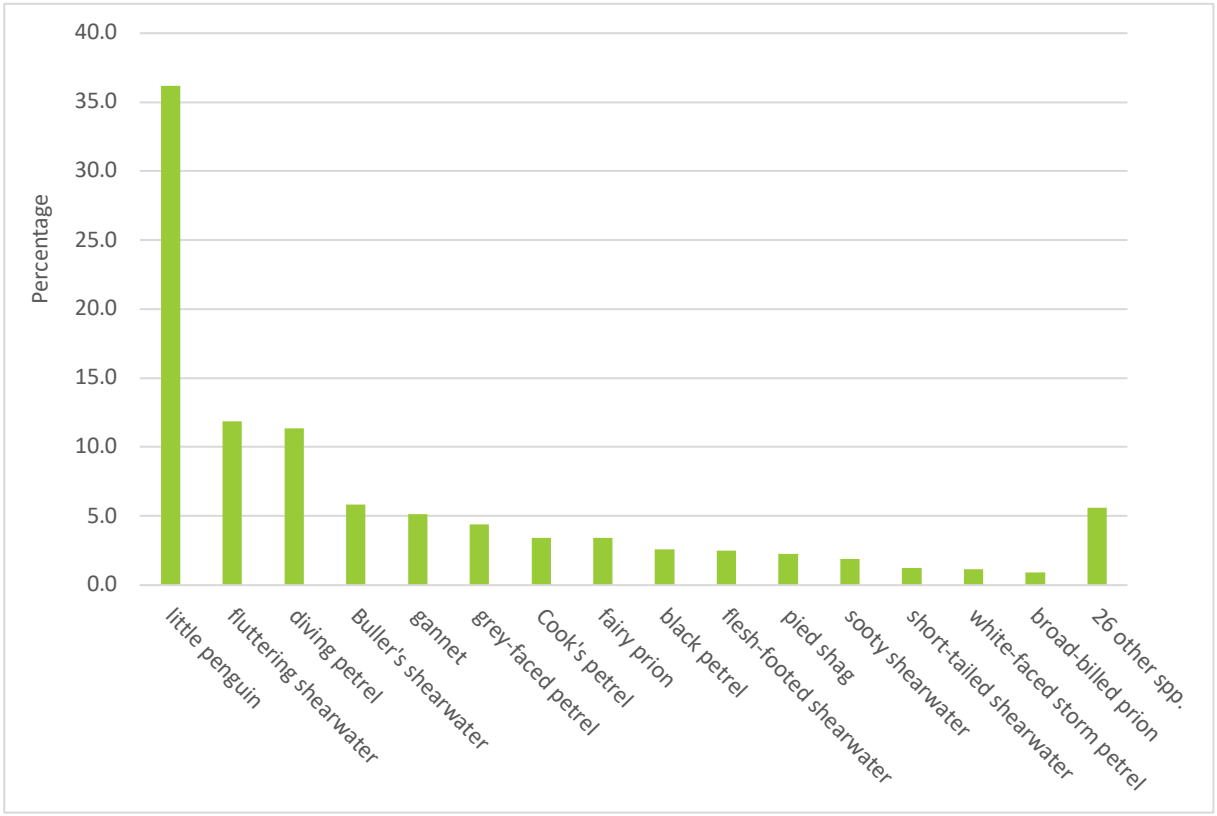


FIGURE 152

Relative abundance of beach-wrecked seabirds on east coast beaches of Aotea, 1994-2020

Occasional large wrecks of one species, or sometimes many species, occur. For example, in 2006 and 2008 there was high mortality of penguins and some other birds (**Figure 113**). There was enormous mortality of broad-billed prions on North Island west coast beaches in July 2011 after south-westerly storms (Miskelly, 2013).

In addition to beach-wrecked birds, a few species occur in small numbers as living individuals on Aotea beaches, especially at Okiwi spit and in the Whangapoua estuary. One or two South Island pied oystercatchers (*Haematopus finschi*) are usually present with the variable oystercatcher flock on Okiwi spit, and small numbers (2-4) have been seen on the wet paddocks at Kaitoke and on the Okiwi Airfield. Bell and Brathwaite (1964) also noted two individuals at Whangapoua in 1957.

Eurasian whimbrel (*Numenius phaeopus*) have been reported occasionally (Bell & Brathwaite, 1964). One was seen at Whangapoua in January 1998 and again in 1999. Another was seen in September 2006 on Kaitoke Beach (J. Ogden *unpublished data*). Scattered, unconfirmed observations of other waders, mostly by the author, are listed below with dates (month/year), locations and number seen (in brackets):

- Sharp tailed sandpiper (*Calidris acuminata*): Oct. 2001. Okiwi Airfield (1).
- Red Knot (*Calidris canutus*): Oct 2003 Awana Estuary (3); April 2014 Whangapoua Estuary (3).
- Greater sand plover (*Charadrius leschenaultii*): April 2004 Okiwi Spit (8); Mar. 2013 Okiwi Spit (1).
- Lesser sand plover (*Charadrius mongolus*): May 2001 Whangapoua Estuary. (c. 10).

There are problems in differentiating the winter-plumaged of greater sand plover from some winter plumaged New Zealand dotterels. To an extent this also applies to the lesser sand plover, which has been recorded by two observers (unpublished observations by Ogden, J. 2001, Pullam, G. 2010) at Whangapoua estuary. These two species should be regarded as uncertainly identified.

Three other conspicuous waterbirds visit Aotea occasionally – black swans, Canada geese and royal spoonbills (**Figure 153**). Black swans/kakīānau were reported as occasional visitors to the island in 1949 (Bell 1949 in Bell and Brathwaite (1964), and residents told Bell & Brathwaite (1964). that they were occasional visitors. Black swans were present in Tryphena Harbour, Kaitoke and Whangapoua Estuaries in 2011, 2012 and 2013, with up to 10 in 2013. Two Canada geese, or kuihi, were present at Schooner Bay in 2012. One or two royal spoonbills, or kōtuku ngutupapa, have been present at Whangaparapara during the summer most years since 2011 and they have also been reported from Whangapoua estuary

and Medlands Beach. Finally, an unusual record of a tropical seabird was that of a lesser frigatebird, seen over Port Fitzroy Harbour after strong north-westerly winds on 7th January 2018 (D. Dolbel. personal communication).

FIGURE 153

Spoonbills and White-faced Heron with mangrove roots in the foreground (photo by Tom Daly)

10.4 Rakitū

The birds of Rakitū (**Figure 155**) are not discussed separately in this report, but the prolonged issues of bird conservation, land ownership and decision making over Rakitū (Ogden and Brookes (2017) and others) illustrates a dilemma of conservation on Aotea. Rakitū is briefly presented as a 'case study'. The demise of seabirds and some forest species on Rakitū has been well documented (summarised in (Bellingham et al., 1982). Following some controversy over the methods used to eradicate rats from the island, Rakitū was officially declared rat – free by the Department of Conservation in 2020 (Department of Conservation, 2020). Although the original proposal for this eradication (Murray, 1993) was justified in terms of re-colonisation by seabirds, no post-eradication management plan was presented, either before or subsequent to the eradication. Ship rats, brought from Australia by Ngāti Wai before 1870 (see transcript of the Native Land Court below), eliminated the formerly abundant

grey-faced petrel colony and settled a dispute over their harvesting (Hutton & Kirk, 1868). Subsequent forest clearance by Europeans, and the introduction of cattle and cats, further reduced biodiversity, and with the ship rats, led to the loss of red-crowned kākāriki, tomtit/miromiro and whitehead/pōpokotea, and a decline in bellbirds/korimako.

The North Island weka (*Gallirallus australis greyi*) is an endemic subspecies currently classified as 'At Risk Relict' (Robertson et al., 2021). In 1951 the Wildlife Service of the Department of Internal Affairs, concerned by the dramatic decline in the mainland weka population at that time, released 13 North Island weka from the East Cape area on Rakitū. In a survey by (Beauchamp et al., 1993), 109-135 weka were estimated to be present; this number had increased to c. 200 by 2002 (Beauchamp et al., 2002). Extrapolating from these and other published figures (Bell & Brathwaite, 1964; Bellingham et al., 1982) suggests that the current weka population could have been c. 450 birds. However, the unmonitored effects of the removal and return of 50 weka during the rat eradication period introduces further uncertainty over the current population size and trend (**Figure 154**). The predicted future weka population size is important because of the detrimental effects of weka on native seabird colonies on islands have been well documented (Carpenter et al., 2021; Harper, 2006) and was specifically mentioned in a survey of Rakitū in 1982 (Bellingham et al., 1982). The consequences of leaving weka on Rakitū were stressed by the Department of Conservation's Principal Science Advisor (Graham Taylor), but his advice was ignored (see section10.4.1).

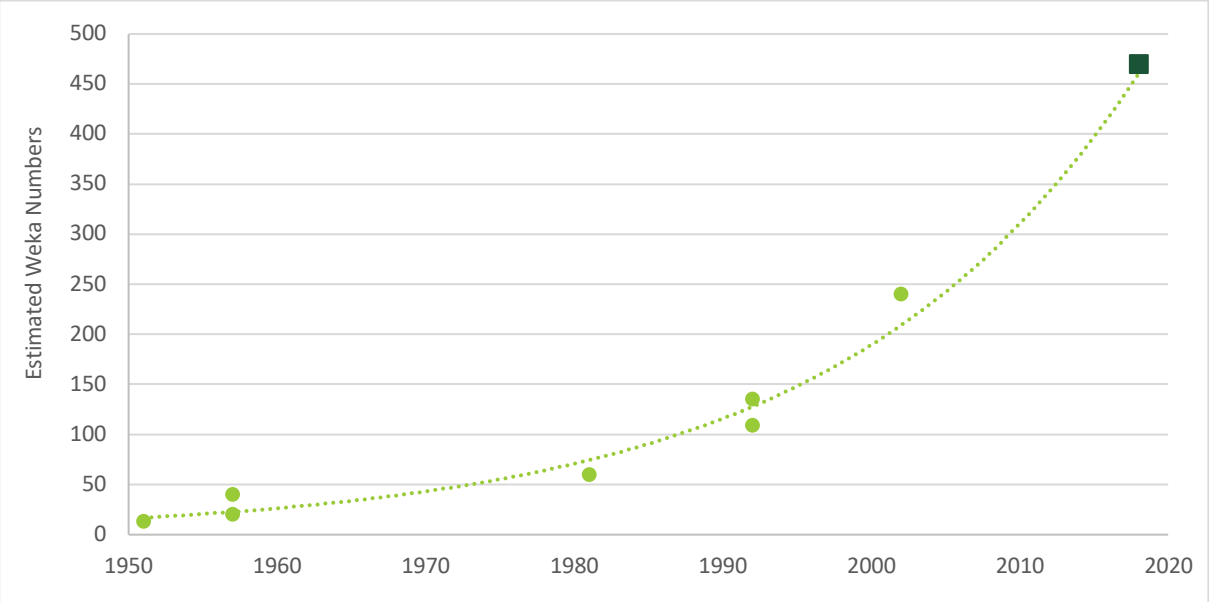


FIGURE 154

Predicted growth in the weka population of Rakitū Island. The fitted exponential curve is based on the 1951-2002 published data and extrapolated to 2020 (Ogden & Brookes, 2017).

FIGURE 155

Rakitū, at 330 hectares, is capable of supporting thousands of seabirds, which in turn would return large amounts of phosphates and nitrates to the land. The continued presence of weka on the island is highly likely to prevent any meaningful restoration of Rakitū, despite its location on the north-eastern New Zealand seabird super highway (Ogden, 2021a) (photo by Emma Waterhouse)

There is clear evidence that, within the historic period, weka were not present naturally on any of New Zealand's offshore islands, and where they have been introduced their presence has been devastating for small petrel populations (Ogden, 2021a, 2021b; Wilson, 2021, p. 43). Weka were probably not present naturally anywhere in the Aotea group or on Rakitū, whereas seabirds certainly were. At the time of writing, some eight years after DoC stated its intention to remove rats from Rakitū, no management strategy has been released and the weka remain. No regular monitoring of the weka population appears to have been conducted since 2002, but it is clear that small numbers of recolonising petrels will be placed at a serious disadvantage by the continued presence of weka on the island.

Bellingham et al. (1982) found a few grey-faced petrel burrows on Rakitū and evidence of breeding fluttering shearwaters and diving petrels on an offshore stack. In the absence of rats, the potential for

natural re-colonisation by these and other seabird species from nearby rat-free islands is very high, evidenced by the rapid return of 9 species to the Mokohinau group following eradication in 1990, and five species to Cuvier and the Mercury Group more recently This would be even more likely to occur if weka are also removed, as they should be. Now free of all mammalian predators, Rakitū is ideally placed to support a diverse seabird community, under the stewardship of mana whenua, Ngāti Rehua Ngātiwai ki Aotea, for whom the island has deep cultural significance. In the absence of a restoration plan, or any indication that properly conducted experimental manipulations of weka will be undertaken (Carpenter et al., 2021), weka are likely to be increasing in numbers.

10.4.1 Rats and Weka: Seabird Predators on Rakitū

The following highlighted paragraphs are transcripts. The first part is of: *Native Land Courts. Before Judges Maning and Munro and Native Assessors Hare Wirikaka and Rawiri (Daily Southern Cross. Volume XXVII issue 4184. 11 January 1871)* ("Native Land Court," 1871). The second highlighted quote is from Taylor (2013), *Rakitū Island pest eradication (Assyst Request R. 33601. Department of Conservation. 19 December 2013).* Rats were successfully eradicated from Rakitū in 2019 by the Department of Conservation

Concerning the arrival of rats:

> ***"Hone Pama, belonging to the Ngātiwai tribe, stated that Raketū originally belonged to Mata, who was murdered. Witness claimed the island through his ancestors who got it as a gift. On Raketū there were originally a great many mutton birds, which enticed neighbouring tribes to come on to it; and his ancestors wished to get rid of this nuisance, and, in order to do so, two casks full of the pakehas' rats were imported from Sydney and let loose on the island to eat the mutton birds. The reason why they got the pakehas' rats was because they were more savage than the Maori rats – they ate the birds and the native rats also. (Great laughter). The rat expedition was undertaken since the pakeha came to reside in the colony. The rats ate all the birds and there are none there now".***

Concerning the continued presence of weka:

> *"Weka are a significant predator of burrow nesting seabirds, and the evidence is firm that by retaining weka on Rakitū, there will be very little recovery in seabird populations and it would be irresponsible to attempt transfers of smaller seabirds to this site. Thus the conservation potential of the island would be significantly diminished by retaining weka on the island as it would be largely a refuge island for weka and perhaps a few native land birds. Seabirds and larger reptiles and invertebrates would be unable to recover on the island".*

10.5 Summary of the Status of Birds in the Coastal Zone

On Aotea, one grey-faced petrel/ōi colony appears to have increased, but other potential colonies of this species (and other shearwaters and petrels) are limited by predation. Grey-faced petrel and probably other burrow-nesting petrels and shearwaters were almost completely eliminated from Rakitū by the introduction of rats. Shags, penguins and reef heron all lack sufficient monitoring data to draw any conclusions about their status. Red-billed gull and white-fronted tern numbers have fluctuated, possibly reflecting changes in their wider populations in the Hauraki Gulf. Favoured sandy beach nesting and roosting sites are suffering increased levels of disturbance by people and dogs in the crucial spring and summer months. The number of Caspian terns on Aotea may have increased, but their population is small (**Table 13** & **Table 14**).

Over a 22-year study (1999-2022) of the eastern beaches of Aotea there has been a significant increase in the abundance of breeding New Zealand dotterels and variable oystercatchers (**Figure 156**). Of the more common migrant shorebirds, banded dotterel, bar-tailed godwit and Pacific golden plover appear to have changed little in numbers, although the last two species may have declined a little. Pied stilts and wrybills (always in small numbers) have clearly declined, and the wrybill is now an infrequent visitor. Other vagrant migratory waders have probably always been infrequent, occurring mainly at Whangapoua estuary/Okiwi spit. This area contains the most significant habitats on Aotea for many coastal species (Ogle, 1980).

FIGURE 156

Variable oystercatcher/tōrea pango (photo by Emma Waterhouse)

10.5.1 Population Status Estimates and Trends for Birds in the Coastal Zone

TABLE 13

Species	Population Estimates for Aotea	Current Trends
Variable Oystercatcher	100 - 150	Increasing
New Zealand Dotterel	50 - 70	Increasing
Banded Dotterel (Migrant)	40 - 80	Migrant. Variable
Banded Dotterel (Resident)	< 10	Stable
Bar-tailed Godwit	30 - 80	Migrant. Stable
S.I. Pied Oystercatcher	2 - 4	Vagrant
Wrybill	0 – 5	Migrant. Decline

Table 13*: Population estimates and trends for waders based on counts on Okiwi spit and Whangapoua estuary (J. Ogden unpublished data).*

TABLE 14

Species	Population Estimates for Aotea	Current Trends
Gannet	> 12,000	Increasing
Red-billed Gull	500 – 1,000	Variable
White-fronted Tern	300 - 350	Variable
Grey-faced Petrel	< 200	Increasing?
Pied Shag	< 200	Stable/Decline?
Black-backed Gull	100 - 150	Stable
Little Shag	< 100	Decline/Stable?
Fluttering Shearwater	< 50 on main island	Stable
Reef Heron	20 - 80	Stable
Little Black Shag	< 70	Decline?
Black Shag	< 20	Decline?
Caspian Tern	15 - 25	Increase

Table 14: *Population estimates and trends for species of the rocky coasts and beaches*

PART 5: BIRDS OF FARMLANDS AND BUILT HABITATS

FIGURE 157

Farmlands (photo by Hannah Smith)

11 THE FARMLANDS AND BUILT HABITATS OF AOTEA

The farmlands (**Figure 157**) and 'urban' areas of Aotea cover c. 2400 ha, or 9% of the island, though this area may be diminishing as formerly grassed slopes revert to scrub. These sparsely inhabited areas are a mosaic of open farmland and trees, resembling the habitats in which many of the species described below thrive in overseas. The farmed and urban areas have a wealth of introduced pasture and garden plants, and weeds, providing food for many species. On the eastern side of Aotea there are two geomorphic units within this habit: the alluvial flats and the lower hillslopes. Across the island, the settled areas constitute a third overlapping unit, but as many common and familiar birds move readily between all three 'sub-units', they are considered together here.

In the 2006-2007 GBICT surveys, the eastern paddocks were the most diverse and most consistent in their species composition, of any of the broad habitat categories studied. Thirty-seven species were recorded in the spring counts (Ogden, 2009). The farmed and urban areas are where most of the introduced species occur, and recent Aotea Bird Count results have confirmed this.

11.1 New Birds in New Habitats

Most of the birds introduced to Aotearoa New Zealand during the 19th century were deliberately brought here from Europe by Acclimatisation Societies, and many of them adapted quickly to the New Zealand landscape (McDowall, 1994). However, some may have taken many years to reach Aotea and establish as breeding species (12 species, **Table 15**). Some species brought to the island intentionally, such as Chinese pheasant and Java sparrow, failed to establish (Hutton, 1868). During the 20th century, the California quail (noted by Reed (1972)) likewise failed, though the ring-necked pheasant has survived. A number of domestic birds, hens, Guineafowl, geese, and turkeys currently have semi-feral populations.

Other new species, such as white-faced heron, spur-winged plover, and welcome swallow, have naturally colonised Aotearoa New Zealand and Aotea over the past century, and are now among the most common species today in open country and along the coast.

Remarkably, about a dozen species have probably established on the island within the living memory of many people. Some of the species that colonised naturally from Australia (**Table 15**) were unable to establish until much of the forest cover had been felled and more suitable open habitats created. Some such as the black swan also use lake habitats that are absent on Aotea, so despite repeated visits, they have failed to establish as a breeding population on the island. Other Australian species are still arriving (royal spoonbill, cattle egret), but have not established breeding populations on Aotea. Of these, the spoonbill has established a number of breeding colonies elsewhere in New Zealand, but the cattle egret is a winter migrant only (Heather & Robertson, 1996). The three most conspicuous species of the eastern paddocks on Aotea, pūkeko, spur-winged plover and kingfisher, also occur in Australia. The pūkeko and kingfisher probably have a fairly short evolutionary history in New Zealand, while the spur-winged plover is a recent arrival, which first bred in Southland in 1932 (Woodley, 2013b).

Many of New Zealand's ancient endemic birds were unable to coexist with introduced predatory mammals and did not adapt well to the new environments of pastureland, gardens, roads and dwellings. However, some species have proved more resilient on Aotea such as kākā, tūī and grey warbler. Native birds that have thrived in modified landscapes on Aotea include pūkeko, moho pererū/ banded rail, ruru/morepork, kotare/kingfisher, piwakawaka/fantail and tauhou/silvereye. Also thriving are many of the introduced species, including blackbird and song thrush, dunnock, yellowhammer, chaffinch, greenfinch, goldfinch, redpoll, starling, magpie and the ubiquitous commensals, the house sparrow and common myna.

TABLE 15

Species	Introduction, Natural Arrival, or 1st Breeding in NZ (earliest)	First Record on Aotea (or Estimate)	Maximum Years in NZ Before Colonisation of Aotea	Maximum Years on Aotea Before 2021	Currently Presumed Breeding on Aotea
Spotted Dove	1920	2020	100	1	
Cattle Egret	1963	2002	39	19	
Brown Quail	1860	1949	89	31*	
Spur-winged Plover	1932	1990	58	31	✓
Welcome Swallow	1958	1973	15	48	✓
Paradise Shelduck	Endemic	1972		49	✓
White-faced Heron	1940	1962	22	59	✓
Common Myna	1870	1959	89	62	✓
Redpoll	1862	1957	95	64	
Greenfinch	1863	1957	94	64	✓
Goldfinch	1862	1949	87	72	✓
Australian Magpie	1864	1949	85	72	✓
Skylark	1866	1949	85	72	✓
House Sparrow	1867	1949	83	72	✓
Dunnock	1842	1949	82	72	✓
Ring-necked Pheasant	1862	1949	107	72	✓
Song Thrush	1862	1934	72	87	✓
Chaffinch	1862	1933	71	88	✓
Blackbird	1862	1933	71	88	✓
Starling	1862	1933	71	88	✓

Species	Introduction, Natural Arrival, or 1st Breeding in NZ (earliest)	First Record on Aotea (or Estimate)	Maximum Years in NZ Before Colonisation of Aotea	Maximum Years on Aotea Before 2021	Currently Presumed Breeding on Aotea
Pūkeko	**1400**	**1888**	**488**	**133**	✓
Silvereye	**1832**	**1864**	**32**	**157**	✓
Royal Spoonbill	**1861**	**2011**	**150**	**10**	
Mallard	1867	1960	93	61	✓
Black Swan	**1864**	**1948**	**84**	**73**	
Pied Stilt	**1800**	**1934**	**134**	**87**	✓

Table 15*: Colonisation of Aotearoa and Aotea by birds, (species arranged according to known or estimated arrival on Aotea). Birds highlighted in green were intentionally introduced from Europe.*

*Species arriving naturally or introduced from Australia are marked in **bold green**.*

Black swans were introduced in 1964 but also may have arrived naturally in 1967 (Heather & Robertson, 1996).

* Note that brown quail was present on Aotea between 1949 and 1980, but there are no subsequent records. New Zealand arrival dates are rarely known with accuracy and the date given is usually the earliest of a range. 'Arrivals' of European species on Aotea are based on earliest records and actual dates are likely to have been earlier. Data from various sources, including Heather and Robertson (1996), various authors in Robertson (1985), and reports in Bell (1976); Bell and Brathwaite (1964); Bellingham et al. (1982) and Ogle (1981). Species mainly associated with farmland are split from mainly wetland species below. Arranged top to bottom in order of years present on Aotea.

11.2 Status of Farmland and Urban Birds

In the GBICT 2006-2007 surveys (Ogden, 2009), pūkeko, spur winged plover and kingfisher were the most characteristic birds of the farmland and grassed areas. Recently introduced species, such as finches, magpies, starlings and mynas were also prominent. Some species which are also found in wetlands (the paradise shelduck, swamp harrier and banded rail) were also recorded. Most of the eastern Aotea paddocks which were formerly wetlands remain damp and frequently flood. For some species there is overlap into adjacent successional scrublands. One infrequent vagrant, the cattle egret, is included, because throughout the world it is characteristic of farmland, where it often associates with livestock.

11.2.1 Pūkeko

The pūkeko is the same (sub)species that occurs in Australia, so in evolutionary terms it is probably a recent colonist in New Zealand. However, it apparently did not spread much until European forest clearance commenced after c. 1840. It may have been a late arrival on Aotea (**Table 15**). Its subsequent rapid expansion on the island is outlined by Bell (1976). It was common in wet paddocks on the eastern side of the island by 1980 (Ogle, 1981). Currently it is regarded as a threat to the declining pāteke population, and pūkeko in the Okiwi Basin are monitored and culled by the Department of Conservation for this reason. Maximum numbers culled are from May-July with counts often > 100 (>1 individual/ha.). From 2002 to 2020 the total annual cull ranged from 133-731 pūkeko, with an average of 351. Consequently, the pūkeko population on Okiwi Station appears to be lower now than it was in 2003 and 2004. Irregular pūkeko counts at Awana (2001-2017) had maximum numbers in March-April and October-November, but no counts were made in June. Maximum numbers in the Awana paddocks were in excess of 100. Based on culling and density estimates at Okiwi, along with other counts at Okiwi, Awana and elsewhere in paddocks on the eastern side of the island, the total population on Aotea is estimated at between 500 and 2000 birds.

11.2.2 Spur-winged Plover

The spur-winged plover is another native species that self-colonised New Zealand from Australia. It first bred in Southland in about 1932 (Heather & Robertson, 1996). Since then, it has spread throughout the country, reaching Aotea in about 1990, and establishing a breeding population, mainly on the eastern paddocks. Since 1999 there is no evidence of an increasing trend (**Figure 158**), suggesting that all suitable habitat has been occupied by territorial pairs.

The number of breeding pairs of spur-winged plovers on the eastern side of the island is probably 25-30. However, conspicuous, noisy flocks of 40-50 birds are present at various times at Whangapoua, Kaitoke and Awana. There is no clear annual monthly pattern to flocking, except that no large flocks were seen in July or August (**Figure 159**) when the plovers are breeding. The largest flock was 55 on Okiwi Spit in October 2010. Flocks move about the island and perhaps to and from the mainland - the annual variability of flock timing and location (**Figure 159**) suggests periodic influxes from elsewhere, although the flock sizes correspond with an aggregation of local birds. Possibly both occur. February flocks might be local post-breeding birds and juveniles, while October flocks could be new arrivals. A more systematic study with banded birds or radio-tracking would be required to understand this.

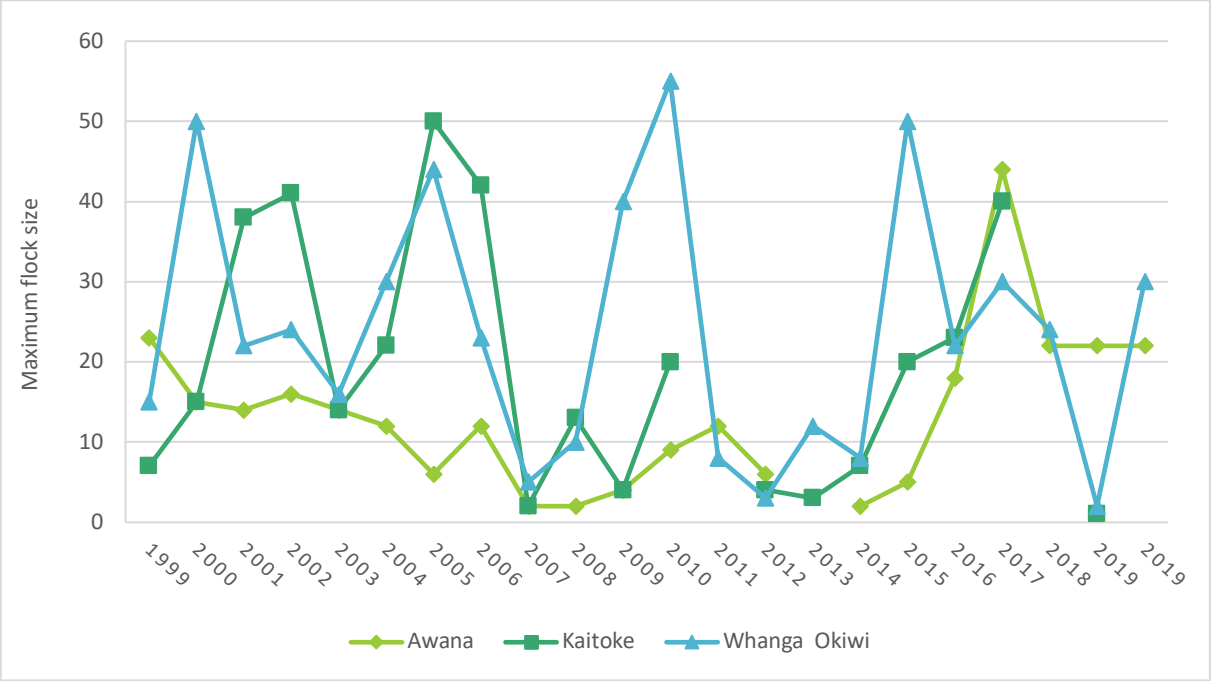


FIGURE 158

Maximum spur-winged plover flock sizes/year at three locations on Aotea: Awana (light green diamonds), Kaitoke (dark green squares) and Whangapoua/Okiwi (blue triangles). Note: these flocks could be the same or different birds at the locations.

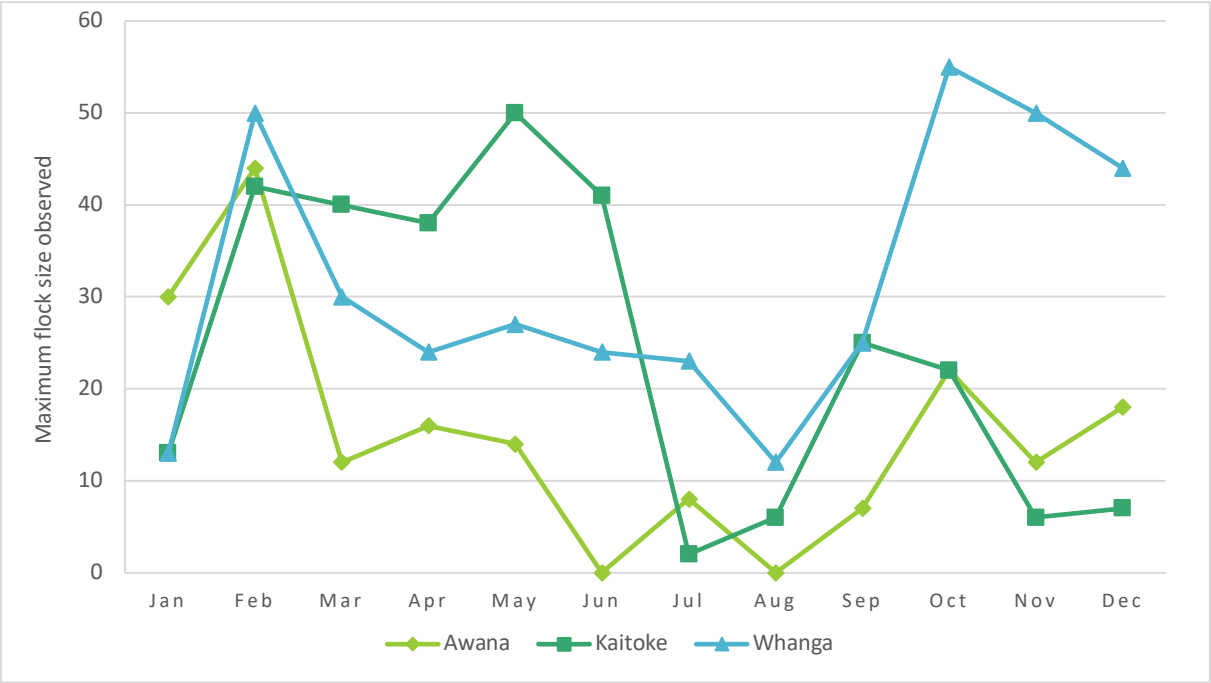


FIGURE 159

Maximum flock sizes of spur-winged plover observed/month (1999-2019) in three locations on Aotea: Awana (light green diamonds), Kaitoke (dark green squares) and Whangapoua (blue triangles).

FIGURE 160

Kōtare (Kingfisher) on Aotea
(photo credited to Ecology Vision)

11.2.3 Kingfisher/Kōtare

The kingfisher/kōtare (**Figure 160**) is an abundant native species with closely related subspecies in Australia, Norfolk Island and New Caledonia (Heather & Robertson, 1996). Hutton (1868) recorded kingfisher on Aotea, and subsequent observers have noted their abundance (Ogle, 1981). The 2006-2008 counts by GBICT (Ogden, 2009), showed that it was most frequent in coastal bush and paddocks and for this reason, it is included here as a bird of the modified landscape of coastal paddocks, bush remnants, road cuttings and dwellings, where it is ubiquitous. In winter, birds from the forested hill country move to the coast. Bird counts and general observations can overestimate the density of kōtare because their loud, persistent calls carry over a wide area, making them very conspicuous. Using 5-minute bird counts with a radius of 25 m, densities of >1 individual/ha. may be obtained. However, given that suitable nesting habitat such as road cuttings and rotted trees are patchy, these estimates cannot be readily extrapolated to the whole island. For monitoring purposes this may not matter for such a common species, because relative change rather than absolute number is what is important. Five-minute bird counts in spring or summer generally place kōtare in the top five most abundant species.

Counting and monitoring nesting holes may give a more accurate estimate of absolute numbers. In a survey of the banks along 34 km of roads carried out by the GBICT in 2007, 359 nest holes were counted, of which only 42 were active or possibly active (Ogden, 2007). The consequence of prolific

new hole excavation every year is that most nesting places have numerous old, inactive holes. The active hole data were used to calculate a provisional figure of 200-300 pairs of kōtare for the whole island, but the total could be 500 pairs.

Detailed observations of kōtare in the lower Awana catchment were made from 2002 to 2019, with a view to assessing its population size and annual numerical fluctuations. Thirty-eight nesting sites (mostly defined areas of road bank, but also natural banks and one tree hole) were monitored from 2002 to 2013. As more sites were found they were added to the database, so not all sites were monitored all years. The data collected were occupancy of a nest hole at a site, rather than nesting success or failure to fledge young, although this was recorded when observed. A total of 287 site/years showed that no site was used for the whole 11 years of study, though some were used for nine years (not necessarily consecutively). The average *consecutive* use of a site was three years, and the maximum was seven years. In most cases, new holes were excavated each year, often more than one at the site. One of the new holes was usually used, but in a few cases the same hole was used for more than one year, in one case for five years (a tree hole). If the holes are dug by the male and chosen by the female, then excavation of multiple holes may indicate the fitness of the male. Non-consecutive site use, and the excavation of new holes, may be a mechanism for preventing the build-up of parasites in the nest.

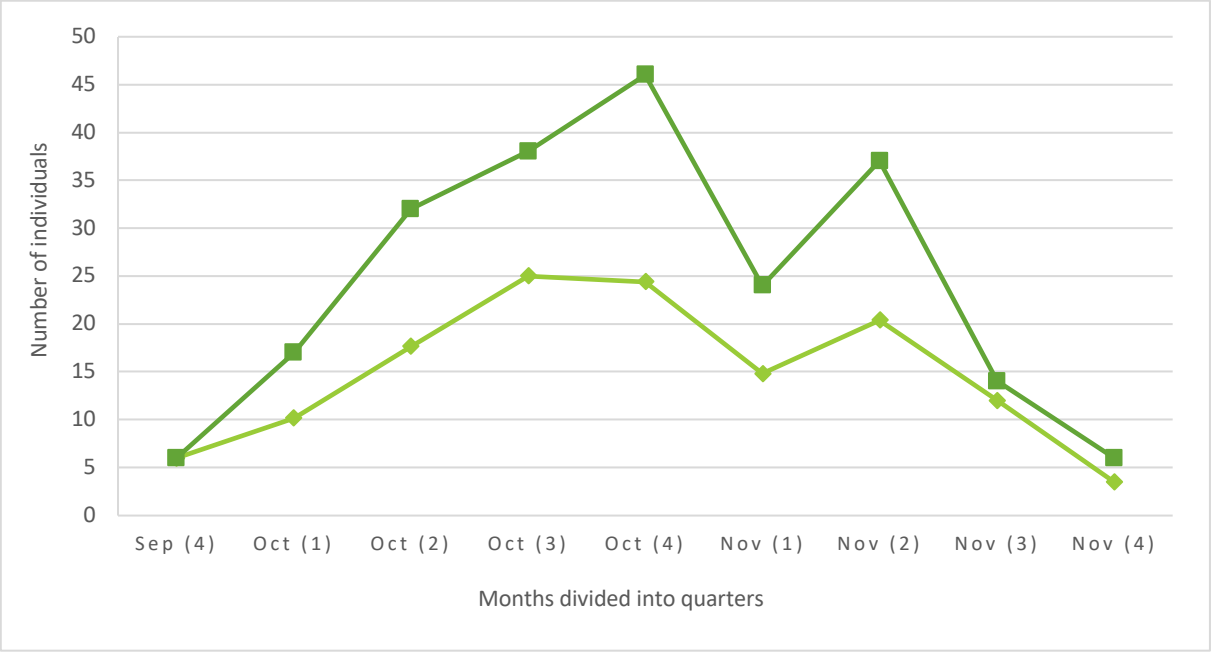


FIGURE 161

Spring kingfisher aggregation at Awana 2010-2019. Average (light green diamonds) and highest (dark green square) counts. Counts carried out four times per month.

As with kākā, there is a marked increase in kōtare on the island in spring, and a decline before the winter, though some birds are present throughout. On the mainland and also on Aotea, birds from the interior move to the coast in winter. However, marked increases in kōtare numbers at some places for a few days in spring suggests birds returning to the island after wintering elsewhere. The Awana aggregation varies in timing from year to year but is commonly seen in late October (**Figure 161**). The loose flocks may be spread over a few hectares, but pairs or trios are often together. Although there was much annual variability, on average the number of pairs in the aggregation at Awana was 12.5, while the average number of active nests in the area c. two months later was 12.7, suggesting that the aggregations subsequently spread out as pairs to claim their previous nesting sites. An excess of numbers in some years may result in pairs moving on to other areas. Similar aggregations have been reported during October at Medlands, and at the Kaitoke Golf Course.

As the study progressed, more nesting sites became known, so the number of active nest holes cannot be read as a numerical trend in the kōtare population. But it is clear that the number of nesting pairs fluctuates considerably from year to year (Figure 9 of Ogden (2009)), something that was also apparent in the spring aggregations.

Nest holes are usually excavated in November or December, and eggs laid in the latter month. Judging by the number of eggshells cleaned from the nest, the average clutch is three or four. Nests with young were recorded from 1st December to 23rd February and fledged (empty) nests from 31st December to 28th February. Thus the majority of nests, have young present in January. About 10% of 87 monitored nests had evidence of egg predation by rats. In at least one case the adults re-laid in the same nest hole. Adult mortality from various causes was also recorded in four of the 87 cases. Assuming that these nests also failed, the failure rate would be c. 15%. There was no evidence of mynas taking over current or old nest holes.

11.2.4 Swamp or Australasian Harrier/Kāhu

The harrier (**Figure 162**) is another self-introduced Australian species, which was probably present on Aotea before 1868. Hutton (1868) regarded it as common, and all subsequent observers have agreed. However, that designation merely implies that it was often seen, which is the case for a bird spending most of its time circling in the sky. The species, as its name suggests, is particularly associated with swamps (where it usually nests). However, it is included here because it is most frequently seen over the farmland or along roads, scavenging roadkill. Its predominant prey species on Aotea are probably rabbits and pūkeko. These species form part of the food-web, which includes pāteke, creating a difficult conservation management problem (Ogden, 2008). In the GBICT 2006-2007 counts (Ogden, 2009)

FIGURE 162

Harrier hunting prey
(photo by Ralph Cooney)

Harriers were seen over all habitat types, but were most consistently present over the paddocks of the east coast, with 33% frequency, and an overall frequency of 15% (All habitats/seasons: percentage presence at 240 counted points). Surprisingly, in the Aotea Bird Count 2019 survey (Simmonds, 2020) it was recorded in only one of the sixteen transects and not at all in the 2020 count (Asena, 2021).

To understand the harrier's role in predation of pāteke, harriers have been actively monitored by the Department of Conservation in the Okiwi Basin. The monthly abundance or activity pattern is illustrated in **Figure 163**. The low counts in October and November are probably because the birds are nesting then. Over the period 2004-2021, on average about 19 harriers per year have been accidentally killed in cat traps, although in some years this figure has been higher. For example in 2005, 15 were killed in June and a further eight in July.

Nesting mainly occurs in well-vegetated wetlands. The clutch size of the harrier is usually 3-4 eggs (occasionally up to 7) (Heather & Robertson, 1996). The October-November counts (with ranges; 5-17, **Figure 163**) indicate that c. 12 birds could be close to the breeding population, which would produce c. 18-24 young per year. As adult longevity is c. 10 years, this level of culling (up to c. 24 birds per annum) is not likely to change the size of the population at Okiwi, though it could reduce dispersal of young to other areas.

Breeding also occurs at Awana (2 pairs) and at Kaitoke Swamp. Including pairs that breed elsewhere, the figures suggest that from 2005-2007 the total population was 12-15 pairs, with a maximum of 20. In view of the lack of observations in the Aotea Bird Count counts in 2019 and 2020 (Asena, 2021; Simmonds, 2020) it is possible that the population has declined.

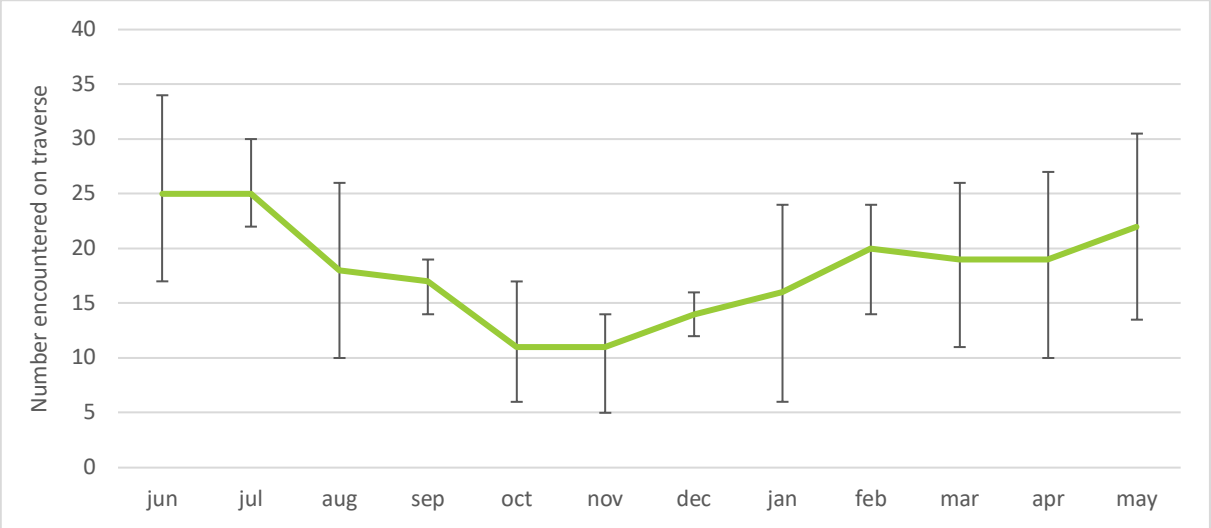


FIGURE 163

Average encounter rates of swamp harriers on weekly traverses of Okiwi Basin, 2005-2006 expressed per month with maxima and minima. Source: Excerpt from Annual Report 2005. Department of Conservation, Okiwi, Aotea (Sarah Giblin personal communication, April 2021).

FIGURE 164

Welcome Swallow/Warou at rest

(photo by Hannah Smith)

11.2.5 Welcome Swallow/Warou

The welcome swallow (**Figure 164**) is another Australian species, which is a recent colonist in New Zealand. They were known as vagrants for about 30 years before they first bred in Northland in 1958 (Heather & Robertson, 1996). Since that time they have spread rapidly, reaching Aotea within 15 years. They are now abundant throughout the year, and conspicuous in Aotea's open paddocks, estuaries and wetlands. In March and April after breeding, they gather in loose flocks, which may number 30-50 birds. In the GBICT 2006-2007 counts (Ogden, 2009), welcome swallow was the fourth most frequently encountered bird on the eastern paddocks. It was found in all lowland locations, where its frequency in the counts averaged 55%. It was

not recorded in montane or successional forest communities. Its overall frequency, including the latter habitats, was 21%. These results can be compared with the ABC 2019 survey (Simmonds, 2020), which likewise found swallows to be common in lowland samples, with an overall frequency of 19%, and an estimated density of 1.66/ha. The estimated density implies an island-wide population perhaps as high as 3000 birds.

11.2.6 Introduced Finches and Buntings

Chaffinch, Greenfinch, Goldfinch, Redpoll and Yellowhammer: these species were introduced into New Zealand by acclimatisation societies mainly in the 1860s (Heather & Robertson, 1996; Thomson, 1922). They quickly became established across the country and most of these species had probably reached Aotea by the late 19th century. Chaffinch were first recorded on Rakitū in 1933 (Falla 1933 *in* Bell and Brathwaite (1964)). Bell and Brathwaite (1964) also recorded goldfinch, greenfinch, redpoll and yellowhammer. All except redpoll are now abundant breeding birds in pastoral areas on the eastern side of the island.

Mixed finch flocks, sometimes with yellowhammers and house sparrows, occur at all times of year, but especially during late winter. All-male chaffinch flocks of up to 20 birds have been seen in spring. The goldfinch is more gregarious than chaffinch or greenfinch and occurs in flocks at all seasons. Large flocks (>100) have been seen at Medlands, Kaitoke, Awana, the Okiwi area, and Mabey's paddocks. Flocks build up through March-June and do not disperse until November. Greenfinches follow a similar flocking pattern, but their flocks are never large (< 60) and usually mixed with other species. In summer, small parties visit beaches to feed on *Spinifex* (kōwhangatara) and *Cackile maritima* (sea rocket) seeds.

In the 2006-2007 GBICT surveys (Ogden, 2009), chaffinch occurred in 10 of the 15 location/season combinations, goldfinch in seven and greenfinch in six. In the locations where they were present, chaffinch had a mean frequency of 26%, goldfinch 18% and greenfinch 11%. The 2019 and 2020 ABC counts (Asena, 2021; Simmonds, 2020) both ranked chaffinch > goldfinch > greenfinch. However, frequency (presence/absence at recording points) fails to account for flocks, so the actual numerical abundance ranking could be different.

Chaffinch was found in all locations but was most frequent in successional forest dominated by mānuka and kānuka, and paddocks reverting to that stage. It is one of the few introduced birds to occur in mature bush also, extending even into montane areas (Heather & Robertson, 1996). Goldfinch on the other hand was most frequent in open paddocks, while greenfinch predominated in dunes and gardens close to the coast.

Preliminary finch population estimates are given in **Table 16**. Allowing for much uncertainty, I conclude that the widespread chaffinch may have a population > 5000 pairs, but goldfinch and greenfinch probably have total populations of < 1000 pairs.

TABLE 16

Species	Density (ind/ha) (a)	Area of Suitable Vegetation Cover (ha) (b)	Population Estimate (a x b)
Chaffinch	0.83	17,130	14,218
Goldfinch	0.22	2,388	525
Greenfinch	0.13	2,848	370

Table 16*: Population estimates for finches: (1) from ABC count 2019 (Simmonds, 2020); (2) derived from Landcare database.*

Lesser redpoll was reported on Aotea in 1957, again in 1975 (Bell, 1976), and has been seen more recently at Kaitoke (1999, 2003) and at Okiwi in 2015 (J. Ogden, unpublished data). It was also recorded in the Aotea Bird Count (Asena, 2021; Simmonds, 2020). In all cases only one or a few birds were seen. Thus, although lesser redpoll may have arrived on Aotea at the same time as greenfinch, it has not established to the same extent, occurring spasmodically in small numbers with other finches.

The available food resources on the island seem to be partitioned between the finches as follows: chaffinch - small to medium seeds and insects; goldfinch - very small grass and weed seeds (especially Asteraceae); greenfinch - larger grass seeds and small fruits. Thus the redpoll may be largely excluded from establishment on the small area of suitable habitat by competition for food with the other finches, especially goldfinch. In Britain, lesser redpolls feed predominantly on small seeds from the catkins of birch (*Betula*) and alder (*Alnus*) trees, which are almost absent on Aotea. On the mainland in the north redpolls are most common in cool, coastal scrublands, such as along Auckland's west coast. There are large areas of similar habitats (i.e., mānuka scrublands on Aotea), and these probably support a sparse breeding population.

11.2.7 House Sparrow/Tiu

House sparrows were introduced to New Zealand in the mid-1860s (Heather & Robertson, 1996; Thomson, 1922). They increased rapidly and became pests of grain crops by the 1880s. They appear to have reached Aotea naturally in the 1940s but were still scarce in 1960 (Bell & Brathwaite, 1964). In

the 2006-2007 GBICT surveys (Ogden, 2009), the house sparrow was not found in montane or successional forest, occurring only in areas close to human habitation, and especially in the eastern paddocks. Its overall frequency was 11%. However, frequencies (based on presence or absence) are a poor measure of abundance for a strongly social species such as the house sparrow, which usually occurs in flocks. This difficulty was demonstrated by the 2019 ABC counts (Simmonds, 2020) where, although sparrows occurred in only 5 of 16 transects, notably at Tryphena and Okiwi, it was present in groups, so its overall density was high (3-53 birds/ha.) and it was ranked as the sixth 'most abundant' bird species in the survey. The overall point frequency in 2019 was 19.6%. These results suggest an increasing trend, which is supported by flock counts of 80 – 150 birds at Medlands in 2020. Applying the average density/ha. (2.6) to the area of grassland and urban areas gives a total of c. 6000 house sparrows, which is almost certainly much too high. Assuming that the maximum flock size counted at Medlands in 2020 (150) is similar around other communities, an overall maximum figure of 750-1000 seems more reasonable.

11.2.8 Dunnock or Hedge Sparrow

This species is neither a sparrow, nor a finch; it is an unrelated insectivorous species belonging to a small passerine family, the Accentors (Heather & Robertson, 1996). However, like the house sparrow it was introduced to New Zealand in the 1860s by acclimatisation societies and had reached Aotea by the 1940s (Bell & Brathwaite, 1964). It is small, inconspicuous, often single and rather secretive. Many people are unfamiliar with its distinctive calls and song, so it is easily overlooked. Bell and Brathwaite (1964) recorded it at various locations across the island, and thought it was "in similar numbers to what would be expected on the mainland". Single birds were observed at Awana on 11 occasions between 2005 and 2017, usually in April or May. In the 2006-2007 surveys it was seen on only 4 of the 16 location-season counts, with an overall average frequency (240 point counts) of 2.1% (Ogden, 2009). In the ABC 2019 counts it was seen on only one of the sixteen transects (Glenfern Sanctuary) (Simmonds, 2020). Using an average density of 0.13/ha., and assuming hedge sparrows are found throughout the mānuka-kānuka scrub and in scrubby habitat around urban areas, the total population could be c. 2000, but without further observation it is impossible to judge. The impression is that dunnocks may have declined on Aotea since the 1960s, and this may also be the case for the Auckland region. Like redpoll, in the north it tends to be most numerous in scrublands. Dunnocks are scarce in the northern North Island but are very abundant in the South Island (Santos, 2013).

11.2.9 Blackbird and Song Thrush

These two related species were introduced in the 1860s predominantly for nostalgic reasons as the original forest of Aotearoa was being transformed into a European pastoral landscape (Heather &

Robertson, 1996; Thomson, 1922). That transformation was also occurring on Aotea in the 1930s, providing habitat for both species to become firmly established. The two species partition their spatial environment and diet, which reduces competition between them: they have distinct (if overlapping) ecological niches.

Blackbirds are widespread and abundant and are one of the most numerous introduced birds in the country. The blackbird is one of the few introduced birds that penetrates deep into mature native forest (Heather & Robertson, 1996). The 2006-2007 GBICT counts recorded blackbirds in 11 of 15 location/season samples, particularly in successional forest (c. 30% frequency) (Ogden, 2009). The annual December counts at Windy Hill, in mature kānuka stands, always include a few blackbirds. In the Auckland region, blackbird evensong begins in June, and they are heard in the dawn chorus from the last week of July. Song continues into mid-summer, and usually ceases during January. Blackbirds are territorial, but after breeding may gather in places with abundant food such as orchards.

The song thrush was described as 'fairly numerous' by Bell and Brathwaite (1964), and it is now widespread but more restricted to garden, pasture and other modified lowland habitats than the blackbird. It was recorded less frequently than blackbird in the 2006-2007 GBICT counts (6 out of 15 location/season combinations) and it was not recorded in montane or successional forest (Ogden, 2009). Song thrush frequency was greatest in the lowland bush and urban sites around Tryphena (30%), but it was also recorded in coastal areas and the eastern paddocks. Thrushes are prominent in the dawn chorus much earlier in the year than blackbirds, starting during April and continuing until December.

In the 2019 Aotea Bird Count (Simmonds, 2020), blackbird was recorded at a higher density (0.96/ha.) than song thrush (0.25/ha.). This estimate, combined with the smaller area of occupied habitat compared with blackbird, suggests that song thrushes are much less abundant. The blackbird population estimate, informed by estimates for different densities in different vegetation types, is c. 2500 pairs, while for song thrush it is <1000 pairs.

11.2.10 Skylark

Skylarks were also introduced to New Zealand from 1864, and the species rapidly became well established across the country (Heather & Robertson, 1996; Thomson, 1922). They were noted as common in suitable habitat on Aotea by Bell and Brathwaite (1964). On the ground, skylarks can be cryptic, so recording them in surveys often depends on seeing them take to the wing and hearing their distinctive trilling song. During the breeding season, skylarks are territorial. Their song is usually heard from August to January, and by February they are very silent. During autumn and winter, they may

form small flocks. Bell and Brathwaite (1964) considered skylark to be "fairly common" on Aotea, although on Rakitū they were less common than pipit. In 1982 both species were still present on Rakitū (Bellingham et al., 1982). The 2006-2007 GBICT surveys showed that skylarks were more frequent in the eastern paddocks and dunes than elsewhere, with an average frequency of 37% in these locations but only 9.9% in all habitats (Ogden, 2009). The 2019 Aotea Bird Count surveys (Simmonds, 2020) gave a similar restricted habitat distribution and an overall frequency in all habitats of 8.7%. The density estimate (0.03 individual/ha) when applied to the area of dunes and grassland on Aotea gives a total population of fewer than 100 birds, which may be too low as the farmland and dunes in the Okiwi basin had only a single transect 10 points). Nevertheless, it is clear that skylarks are well established in suitable open country habits on Aotea and seem to be maintaining their numbers.

11.2.11 Pipit/Pīhoihoi

The New Zealand pipit (**Figure 165**) has a widespread distribution including on the Subantarctic islands and it has close relatives in Australia (Gill et al., 2010; Heather & Robertson, 1996). It was seen on Aotea by Hutton (1868) and has been noted by all subsequent observers. Bell and Brathwaite (1964) regarded pipit as common on Rakitū, but by 1982 it was "occasional" there (Bellingham et al., 1982).

FIGURE 165

Pīhoihoi/New Zealand pipit

(photo by Shaun Lee)

Like the skylark, with which it may be confused, it may be widespread, but nowhere common. Most observations between 2000 and 2008 (at Awana, Kaitoke, Whangapoua, Okiwi and along Aotea Road) were made in March, April and May, when it was usually seen on the beach or the road, which was gravel in those years. Pipits often forage for insects on gravel roads. They were recorded very infrequently in coastal areas and the east coast paddocks in the GBICT 2006-2007 surveys (Ogden, 2009), and were not seen anywhere in the Aotea Bird Count in 2019 and 2020 (Asena, 2021; Simmonds, 2020). Observations between 2008 and 2020 indicate they are still present along the coast, and occasionally in open vegetation at higher altitudes, such as on Te Ahumata. However, the evidence suggests that pipits may be less frequent than they were formerly. Pipit density is certainly lower than for skylarks, suggesting a small resident population of perhaps fewer than 100 birds. Pipits nest on the ground and may be susceptible to predation by introduced mammals such as cats (Beauchamp, 2019).

11.2.12 Common Myna

The common or Indian myna is one of the few tropical species to have been successfully introduced to New Zealand. It only occurs in the northern half of the North Island. It was introduced to New Zealand from1870 to help control invertebrate pasture pests (Heather & Robertson, 1996; Thomson, 1922). Mynas had reached Aotea naturally by about 1959 (Bell & Brathwaite, 1964), possibly from the Coromandel Peninsula, which was completely occupied by mynas by 1960. By 1975 it was "widespread" (Bell, 1976) and by 1980 "almost throughout" (Ogle, 1981).

The myna does not occur in forested areas or at higher elevations. In the 2006-2007 GBICT surveys (Ogden, 2009) it was absent from montane bush and from areas of kānuka dominated successional forest, but frequent in counts (average 34%) in lowland areas, especially the east coast paddocks. Mynas are social outside the breeding season when they are strongly territorial. After the breeding season they form small flocks and fly to large communal roosts, usually trees but also on cliffs. Flocks of 20-30 birds were seen at Awana in 2001 and 2002, and on Mabey's farm in 2006. Larger post-breeding flocks of c. 50 birds were seen at Medlands in 2020 before flying to roosts in nearby eucalypts. Roost sites may be shared with other species, especially starlings, although at nesting time mynas compete with and may displace starlings from nest holes, especially at sites which have entrance holes big enough for the slightly larger mynas to enter. The numbers of mynas on Aotea could be assessed by finding and counting birds at communal roosts. Currently the population is estimated at 500-800 birds. Their population could increase if they start using forest habitats as they do on the mainland, in response to the island's increasing human population, or possibly in response to a warming climate.

11.2.13 Common Starling

Starlings were introduced to New Zealand from 1862, to control insects in pastures (Heather & Robertson, 1996; Thomson, 1922). They spread rapidly through the main islands. They were present on Aotea by the 1930s (Bell & Brathwaite, 1964). Like mynas, in the 2006-2007 GBICT surveys starlings were absent from montane and forest habitats, but were present at frequencies < 22% in areas with paddocks or houses (Ogden, 2009).

This frequency is less than that of myna in the same surveys, but this probably reflects conspicuousness rather than numbers, because flocks of up to 100 have been seen (2001-2014) in paddocks at Awana, Okiwi, Kaitoke and Mabey's farm. In the 2019 Aotea Bird Count (Simmonds, 2020), starlings were recorded at only three sites, compared with six for myna.

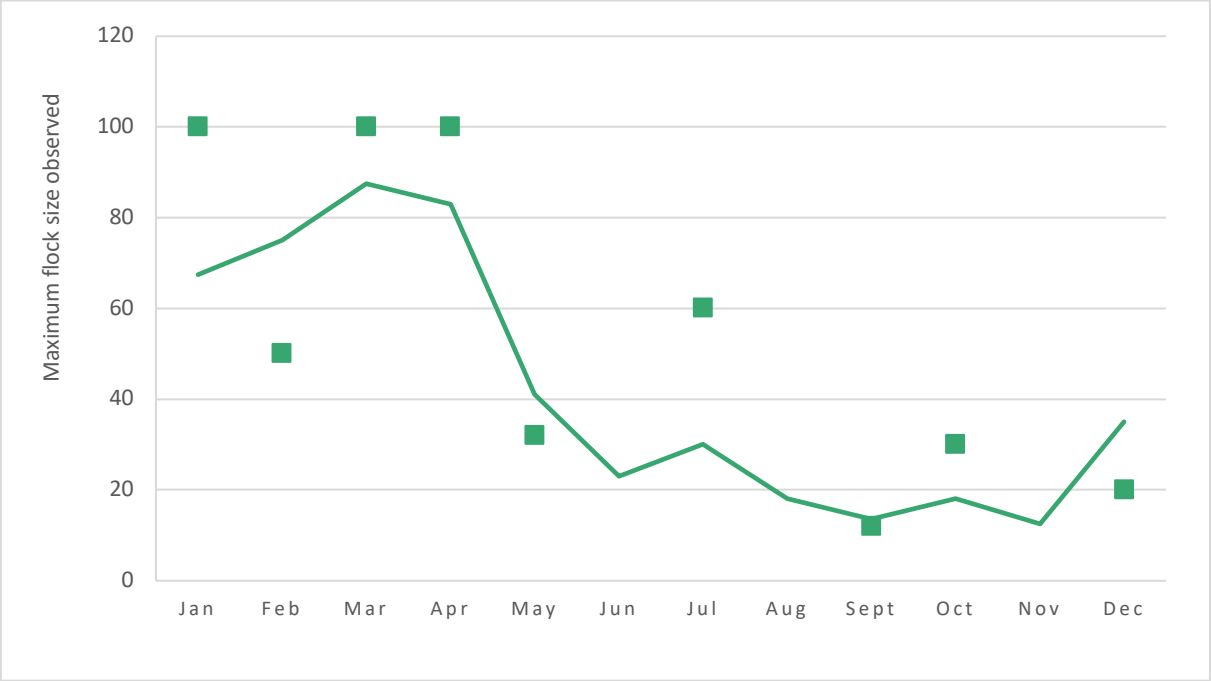


FIGURE 166

Starling maximum flock size observed 2002-2020 on eastern paddocks of Aotea. Green line is smoothed average.

Most of the larger flocks occur post-breeding (March or April) but flocks may occur throughout the year (**Figure 166**). As with mynas, starlings congregate in communal roosts after breeding. The largest roost recorded on Aotea, comprising hundreds of birds, was seen on the Shakespeare cliffs (south of Medlands) in the 1990s, but has not been assessed since. In both 2019 and 2020 Aotea Bird Counts (Simmonds 2020, Asena 2021), starling and myna were similar in abundance, but the more marked aggregation of starlings suggests that the total population is greater, possibly > 1000 birds.

11.2.14 Australian Magpie

Several races of magpies occur in Australia, and from the mid-1860s two forms, white-backed and black-backed were introduced to New Zealand from Tasmania and Victoria (Heather & Robertson, 1996; Thomson, 1922). Both forms freely interbreed. They were introduced from 1864 to control insect pests in crops. By 1949, magpies had reached Aotea although they were still regarded as infrequent at the time of Bell & Brathwaite's visits in 1957 and 1960 (Bell & Brathwaite, 1964). However, they were widespread by 2006-2007 (Ogden, 2009) with an overall frequency (all seasons and sites) of 14-28%, increasing to 50% in coastal urban areas and paddocks in summer. The Aotea Bird Count 2019 and 2020 surveys (Simmonds 2020, Asena 2021) also recorded magpies frequently: the transect frequency was c. 37% in 2019 and the density 0.41 individual/ha. Applied to the approximately 2390 ha. of paddocks and settled areas on Aotea, this gives a total population of more than 900 birds, which is certainly too high. Magpies are very conspicuous and noisy so the same birds could easily have been recorded more than once in the survey. From 2001-2008 the maximum numbers counted at any one time on Blackwell's paddocks (Kaitoke), Okiwi Basin and Mabey's Farm were 11, 12 and 10. Assuming similar numbers at Awana and at other sites on the west side of Aotea a maximum abundance of c. 100 seems more realistic. It appears that all suitable habitat has been occupied.

11.2.15 Paradise Shelduck/Pūtangitangi

The paradise shelduck (**Figure 167**) is an endemic species, and also a game bird. It was a late arrival on Aotea a pair introduced from Taranaki in 1970 and another pair from Whitford in 1972 (Bell, 1976). They increased slowly at first, but the population was probably boosted by a general increase throughout the North Island in the 1980s and 1990s (maps in (Robertson et al., 2007).Paradise shelducks were counted on paddocks in various eastern locations in different months from 1999 to 2021. In winter (July- September) they were monitored less frequently, but they were also less evident in these months, as pairs have dispersed to nesting territories and are inconspicuous.

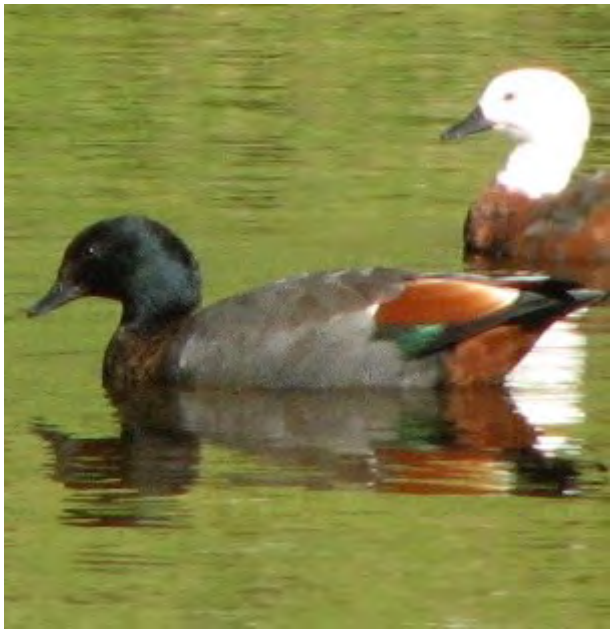


FIGURE 167

Paradise Shelduck. Male front, and female back. (photo by John Ogden)

Ducklings and juveniles are seen in October and November. Localised flocks of 40-50 moulting birds, including any surviving juveniles, occur from March to July, but these flocks appear to break up soon afterwards (**Figure 168**).

Favoured flocking sites are in the Okiwi Basin, especially near the airfield, Awana flats and estuary, and the paddocks west of the road at Kaitoke. After moulting, groups of shelduck have been seen flying between these sites. The maximum 'simultaneous' shelduck count (several sites counted on the same or consecutive days) was 158 in March 2003. There may have been a weak downward trend since then. Assuming that additional shelducks are also present in places that were not sampled, the current total Aotea population could be in the range 150-200 birds.

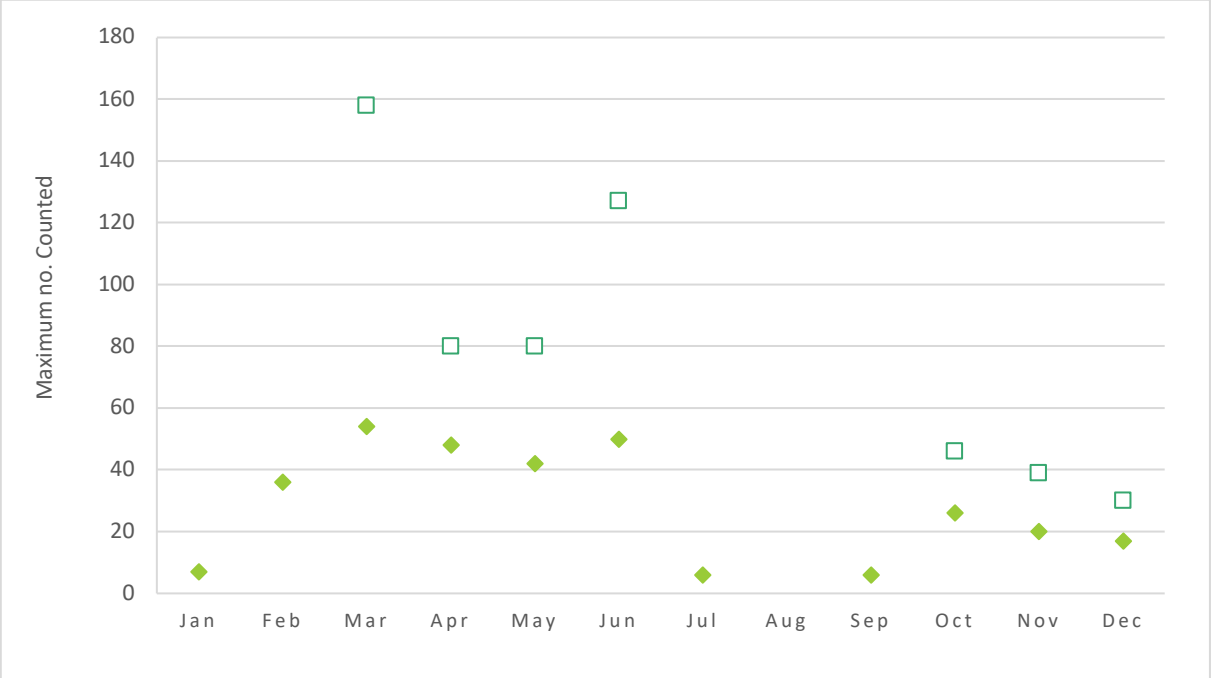


FIGURE 168

Paradise shelduck. Maximum counts in particular months 1999-2019. Closed symbols are maximum at any one location, Open symbols are the simultaneous sum of several sites. No counts in August in any year.

11.2.16 Brown Quail & Californian Quail

Brown quail (*Coturnix ypsilophora*) were introduced to the North Island from Australia in the 1860s. They were not recorded on Aotea by Hutton (1868), but were noted as present since 1949 by Bell and Brathwaite (1964). Ogle (1981) attempted to confirm the status of this species but found only one pair on the edge of Kaitoke swamp. Californian quail (*Callipepla californica*), introduced about the same time, had also disappeared on Aotea since the 1970's (Ogle, 1981). Being game birds, it is not unlikely that both species were exterminated by shooting, but as they nest on the ground, predation by rats

and cats could have been a factor. Unless they are present on Flat island/Rangiahua, where the extinct New Zealand quail (*Coturnix nonaezelandiae*) was last recorded sometime before 1867 (Hutton, 1868), both these quail species are now extinct on Aotea.

11.2.17 Common or Ring-necked Pheasant

The common pheasant (*Phasianus colchicus*) was introduced from England to New Zealand as a game bird from 1842. Hutton (1868) did not record pheasants but mentioned that the Chinese pheasant (*P. torquatus*) had been introduced but failed to establish. Chinese (ring-necked) pheasants were released in the Waitakere Ranges in the 1850s and soon became abundant. The two species are closely related, and are now regarded as subspecies, which freely interbreed (Thomson, 1922). The common ring-necked pheasant was first recorded on Aotea in 1949 and may have increased rapidly because it was numerous by the time of Bell and Brathwaite's visits in 1957 and 1960 (1964). Single birds, or up to three, were seen most years at Awana from 2001-2009. In 2006 and 2007 pheasant had a frequency in spring of 25% in the mānuka/kānuka scrub near Harataonga, and 8% in the eastern paddocks (Ogden, 2009). It was not recorded in these locations in the 2019/2020 ABC (Simmonds 2020, Asena 2021). Thus, although occasional sightings show it is widespread, it is no longer common, reports suggest a gradual decline since the 1960s perhaps due to increased predation on eggs/chicks by cats.

11.2.18 Cattle Egret

Several similar-looking white herons or egrets (*Egretta* spp.) occur in eastern Australia and some of these occur in New Zealand, including the white heron/kōtuku, which breeds at Ōkarito (on the West Coast of the South Island). Cattle egrets arrived in New Zealand in 1963 and they have been recorded as an autumn migrant from Australia since then, with the numbers seen here mirroring population trends there. They do not breed in New Zealand. On Aotea, a few cattle egrets occur occasionally at wet places or near cattle on the eastern paddocks. They were seen in April in 2002 (4), 2008 (2) and 2014 (4). Different reports of "white herons" (*Egretta alba*) on the island may or may not refer to this species.

11.2.19 Banded Rail/Moho Pererū

In contrast to spotless crake, the tiny rail of wetlands, the banded rail (**Figure 169** & **Figure 170**) is conspicuous on Aotea, even around dwellings where rats are present. Banded rail is much bigger than the spotless crake, being fourfold heavier. It is common at the estuarine ends of wetlands and in damp paddocks, where it is easily observed. However, Hutton (1868) noted an absence of rails, which suggests that (if present), they were much less common than now. They may have benefitted from forest clearance and partial drainage of wetlands during the 20th century. Aotea is now recognised as

a stronghold for the species, although no survey of numbers appears to have been made. The absence of mustelids may explain why they are common on Aotea.

Banded rails are diurnal and found in all settled areas, especially at Okiwi and Medlands. where they are tame and well-habituated to people. They naturally occupy open areas on the margins of wetlands and have adapted well to modified environments. Banded rails rarely occur in scrub or mature forest. In the 2006-2007 GBICT counts (Ogden, 2009) they were not recorded in montane bush or in mānuka-kānuka scrubland. The overall frequency in the 16 transects covering these and other habitats was 8.2%. In lowland sites close to houses and paddocks the mean frequency was 12.7%. In numerous counts at Windy Hill, which is mainly kānuka scrub and forest, banded rails have been very rarely encountered. At Glenfern Sanctuary the pre-predator-exclusion-fence counts (2005-2006) had a mean frequency of 5.2%, with none in bush counts. After predator exclusion (in 2010-2011) the frequency rose slightly to 5.8%, and although most were seen in pasture, banded rails were also encountered at low frequency along the bush edges.

Frequency data can indicate relative changes in status but cannot be translated into population estimates. However, it is unusual to travel the length of Aotea without seeing

FIGURE 169

Banded rail crossing the road
(photo by Lotte McIntyre)

FIGURE 170

Moho Pererū (Banded Rail) – Gallirallus philippensis
(illustrated by Erin Forsyth)

banded rails from the road. The 2019 AGBET counts (Simmonds, 2020) gave a density estimate of 0.35 banded rails/ha, which translates to a population of c. 900 if multiplied by the total area of exotic grassland, swamp, riparian and urban vegetation. But local populations appear quite aggregated, so the total population of these inquisitive and friendly birds might range from c. 300 to 1000 individuals.

11.3 Summary of the Status of Birds of Farmland and the Built Habitats

These areas are a diverse mixture of trees, paddocks, wetland or seasonally flooded areas, and human habitations, and consequently, it is not surprising that they have the most diverse bird fauna of the habitats considered here. It is possible to see over 30 species in a morning walk. Most of these will be relatively recent arrivals, many introduced to New Zealand intentionally during the nineteenth century. The populations of the smaller birds, finches in particular, have increased since their arrival on Aotea, and now appear to be stable or increasing. These species aggregate during the winter months when mixed flocks are notable. However, the most conspicuous birds in summer are pūkeko, kingfisher and spur-winged plover. In the damp eastern paddocks paradise shelduck forms noisy flocks after breeding. Endemic and native species are relatively infrequent, but the ubiquitous tūī, kākā, grey warbler, fantail, and silvereye are frequently present where there are bushes or trees.

Two species (the harrier and the pūkeko) are periodically culled by the Department of Conservation because it is thought they prey on pāteke. Mynas, magpies and spur-winged plovers are generally regarded as pests because of their aggressive behaviour towards other species. Both the skylark, although conspicuous when singing, and the pipit, may be declining. House sparrows, mynas and possibly starlings, appear to be increasing as the human population grows.

11.3.1 Population Status Estimates and Trends for Birds of Farmland & Built Habitats

Several of the introduced birds have large populations concentrated in these habitat areas, where they appear to be stable or increasing. Pipit, skylark and pheasant may be declining and as they are all ground nesting species, predation by rats and/or cats is a possible cause (**Table 17**).

TABLE 17

Species	Population Estimates for Aotea	Current Trends
Blackbird	5,000	Stable
Welcome Swallow	1,000 – 3,000	Stable
Song Thrush	< 2,000	Stable
Pūkeko	500 – 2,000	Increasing (managed)
Starling	c. 1,000	Stable/Increasing
House Sparrow	700 – 1,000	Increasing
Kingfisher/Kōtare	500 – 1,000	Variable (local migrant)
Banded Rail/Moho Pererū	300 – 1,000	Stable
Myna	500 – 800	Increasing
Goldfinch	750	Stable
Skylark	100 – 400	Declining? Stable?
Greenfinch	250	Stable
Paradise Shelduck	100 - 200	Stable
Common Pheasant	0 - 200	Declining?
Australian Magpie	c. 100	Stable
Pipit/Pīhoihoi	< 100	Declining
Spur-winged Plover	50 - 100	Stable (variable)
Redpoll	< 50	Stable
Australasian Harrier/Kāhu	< 20	Declining?
Cattle Egret	< 10	Vagrant

Table 17: *Population estimates and trends for the species of the paddocks, roadsides and settlements*

PART 6: VAGRANT SPECIES

FIGURE 171

Pitokuku Island and Sugarloaf (photo by Kate Waterhouse)

12 OCCASIONAL VISITORS

Vagrant species, that is, those turning up on Aotea from time to time, perhaps only once in twenty years, should not be disregarded. They indicate the wide connection between the birds of the island and its surrounding seas (**Figure 171** & **Table 18**). As the climate changes, so will oceanic circulation patterns, and the frequency of storm winds and other factors bringing new species into the vicinity of Aotea. Consequently we can regard vagrants as indicators and possible future colonisers of both Aotearoa and Aotea. At least 36 bird species can be considered vagrants to Aotea at present; that is, they occur infrequently and do not remain for long or breed. These are listed in the table below and can be divided, into four categories:

- Endemic species occurring on the mainland but occasionally visiting Aotea (EV)
- Native species occurring on the mainland but occasionally visiting Aotea (NV)
- Introduced species occurring on the mainland but occasionally visiting Aotea (IV)
- Species which are generally regarded as vagrants in New Zealand (true vagrants) (V).

With the exception of the New Zealand falcon (kārearea), which was formerly present on Aotea (Hutton, 1868) and still occurs on the Coromandel Peninsula, all endemic vagrants in **Table 18** are

seabirds, which occasionally range into the seas around Aotea, or which nest or forage elsewhere in the New Zealand region and have blown off-course (**Figure 172**). The native vagrants are predominantly pelagic species, mostly nesting much further south in the New Zealand archipelago and usually encountered only as beach-wrecks after storms. An example was the massive mortality of broad-billed prions around the coast in 2011, when approximately 250,000 were beach-wrecked (Miskelly, 2013).

The white heron/kōtuku is an exception. It is a freshwater species with a breeding colony of 150-200 birds in South Westland. They disperse widely around New Zealand after breeding and may appear in any suitable habitat (Heather & Robertson, 1996). There is, however, some uncertainty about sightings of large, white heron-like birds, especially if not seen closely, because they could be one of several similar species, particularly the cattle egret. Seabirds constitute most of the vagrant records (21 species). Some migratory waders (six species) also arrive as vagrants. Other migrants are regular visitors. Most of these have been seen in the Whangapoua Estuary or on the adjacent Okiwi Spit. A few vagrants arrive from Australia or the Pacific, e.g. needletail, roller and the lesser frigate bird.

FIGURE 172

Vagrant needletail (spine tailed swift) in westerly storm on Hirakimatā. This species moves across Australia ahead of storm fronts but on this occasion overshot a bit! (photo by Kathy Ombler)

Over geological time there have been constant influxes of Australian species to New Zealand, and this process has been the evolutionary source of many New Zealand birds, which have then diverged and formed new species as a result of geographic isolation (Fleming, 1962, 1979). To establish a new

population, sufficient numbers must arrive, and find a suitable environment. The 'first sightings' of vagrants are of value because, today, as the climate changes, new arrivals may find habitats more suited to them, and subsequently establish as new "native" species. In the past century, white-faced herons, Australian coots, spur-winged plovers and welcome swallows have all naturally colonised New Zealand.

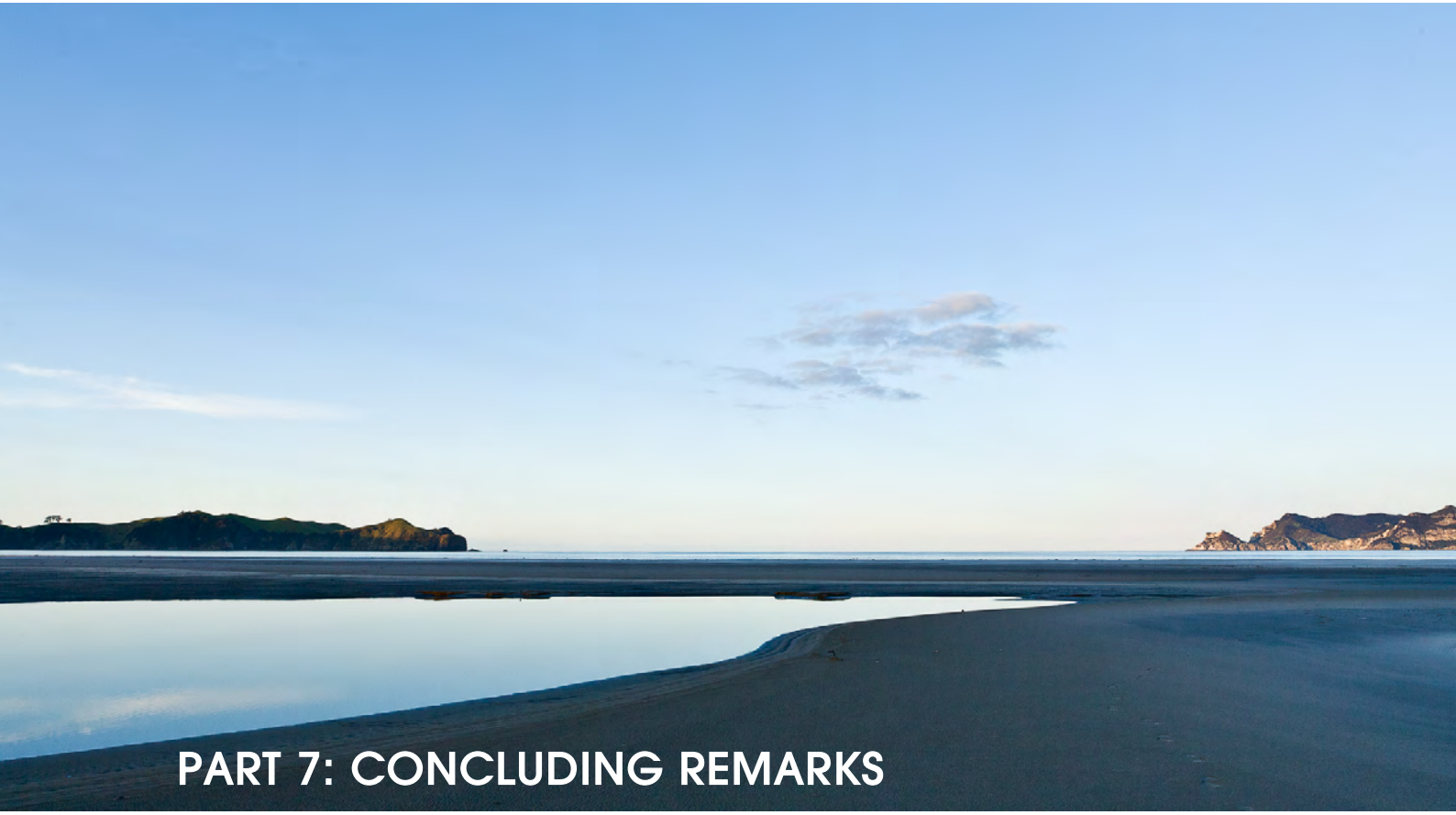
TABLE 18

Common Name: English	Māori Name	Category
Albatross, Royal	Toroa Whakaingo	EV
Albatross, Wandering	Toroa	EV
Petrel, Mottled	Kōrure	EV
Shag, Spotted	Pārekareka	EV
Shearwater, Hutton's	Tītī Kaikōra	EV
Falcon, New Zealand	Kārearea	EV
Swan, Black	Wāna	IV
Goose, Canada		IV
Dove, Barbary		IV
Cape Pigeon	Tītore	NV
Heron, White	Kōtuku	NV
Mollymawk, Black Browed	Toroa	NV
Mollymawk, Shy	Toroa	NV
Mollymawk, Yellow-nosed	Toroa	NV
Petrel, Black-winged	Tītī	NV
Petrel, Blue		NV
Petrel, Northern Giant	Pāngurunguru	NV

Common Name: English	Māori Name	Category
Petrel, Grey	Kuia	NV
Prion, Antarctic	Whiroia	NV
Prion, Broad-billed	Pararā	NV
Prion, Fairy	Tītī Wainui	NV
Prion, Narrow-billed	--	NV
Storm Petrel, Black Bellied	Takahikare	NV
Storm Petrel, Grey Backed	Reoreo	NV
Storm Petrel, New Zealand	Takahikare Raro	EV
Plover, Greater Sand		V
Plover, Lesser Sand		V
Egret, Cattle		V
Frigatebird, Lesser		V
Knot, Lesser	Huahou	V
Needletail, White-throated		V
Roller, Broad-billed		V
Sandpiper, Sharp-tailed		V
Tropic Bird, White-tailed		V
Turnstone		V
Whimbrel		V

Table 18: *Bird species vagrant on Aotea.*

EV= New Zealand endemic species. NV= New Zealand native species. IV= Introduced species vagrant to Aotea. V = Species vagrant to New Zealand.
Green highlights indicate species recorded only as single individuals once or twice only in the last 20 years.
The blue highlights are unconfirmed identifications.



PART 7: CONCLUDING REMARKS

FIGURE 173

Whangapoua Beach towards Waikaro Point and Rakitū Island (photo by Chris Morton)

13 LOSSES AND GAINS

13.1 Value Judgements

There is an asymmetry in the number of species lost, and gained on Aotea, and also, more significantly, in their 'value'. The lost and now endangered species are predominantly endemic birds, with an ancient lineage in Aotearoa, while the new arrivals are species that are abundant elsewhere in the world. The ancient endemics, that evolved in Aotearoa and are found nowhere else, clearly have a much higher cultural, scientific and conservation value than those that have evolved more recently, and which are widespread and not threatened with extinction. Jared Diamond aptly captured this loss of Aotearoa's unique species when he noted that *"… since New Zealand started off with the most important and interesting biota of any island, the extinctions on New Zealand have been the worst tragedy to befall the world's island biotas"* (Diamond, 1990).

13.2 The Legacy of Forest Lost

This report records only the losses and gains of bird species on Aotea since the first written European inventory was made by Hutton (1868). Leaving aside seabird data, which is ambiguous, Aotea has gained at least 18 new breeding species and lost 11 species since Hutton's list. The significant drivers

of both processes have been the reduction and fragmentation of the once ubiquitous old forest cover through logging, fire, and conversion to farmland, and the introduction of predatory mammals. Forest clearance greatly reduced the area of suitable habitat for some species, but also facilitated the ingress of other species introduced intentionally to New Zealand since the 1860s. New areas of open pasture also allowed some self-colonising species from Australia to become established. Some of these may have arrived previously but failed to establish then due to the near absence of suitable, open habitat.

Although some mature forest and extensive tracts of regenerating forest remain, mammalian predators are, at the time of writing, controlled over only a small part of the island. Bird populations, especially the endemic species, are threatened by ship rats, kiore, and feral cats in particular. Significant recovery of these populations and their ranges will only be possible when these predators are controlled to very low levels or completely removed from the island.

13.3 The Loss of Wetlands and the Need for Future Protection

The consequence of the dramatic reduction in the coastal wetlands of eastern Aotea by drainage for pasture, was the decline of several bird species to the 'at risk of extinction' category. Extensive wetlands remain in the Hirakimatā/Kaitoke catchment and at Whangapoua estuary and both are areas of major importance for some endangered birds in the Auckland Region. Whangapoua, linking marine and freshwater systems in a way that was once widespread in coastal New Zealand, should be given the highest priority for conservation of wetland endemics and both national and international migrants. Whangapoua estuary comprises an important feeding ground for these latter species and for nationally significant species such as the New Zealand dotterel, banded dotterel, pied stilt, wrybill and variable oystercatcher. The freshwater vegetated area of this Whangapoua wetland, and the more extensive freshwater area within Kaitoke wetland, have small populations of fernbirds, spotless crakes, pāteke and Australasian bitterns, all species of high conservation value.

13.4 Human Pressure on the Coastal Zone and it's Habitats

Throughout Aotearoa there is pressure on birds using the coastal zone (**Figure 173**), especially species nesting on Aotea's sandy beaches, such as New Zealand dotterel, variable oystercatcher and terns, including the Caspian tern/taranui. People and dogs are becoming more numerous on these beaches during the crucial breeding and fledging periods. The relative isolation of Okiwi spit has protected it to some extent, but visitor numbers are increasing every summer. Many estuaries which are feeding grounds for waders are being impacted by surrounding housing development and, in northern New Zealand, by mangrove spread resulting from increased sediment loads in rivers following catchment deforestation (Bell, 2021). The mangrove zone in the Whangapoua estuary has extended considerably

since the pre-European settlement era and perhaps most rapidly since forest clearances in European times (Ogden et al., 2006).

It is not generally known that Aotea is host to migratory waders, including the bar-tailed godwit, Pacific golden plover and wrybill, which are at risk through habitat loss or predation, and destruction of coastal staging posts while on their migrations. There is also pressure on oceanic species (*Procellariformes*) such as the black petrel/tākoketai arising from fishing and climatic changes, which directly impact or otherwise affect food availability. These effects, occurring both within New Zealand waters and further afield, are beyond the scope of this review. However, they further increase the value of Aotea's estuaries and coastal zone to conservation.

13.5 Future Trajectories of Change: Predators, Vegetation and Climate

The estimates of total population sizes of species presented here are estimates based on variable quality data. Nevertheless, trends over time can be established; in some cases, from knowing approximate arrival times, and in others, from regular monitoring over the last 20 years. Establishing the trends enables conservation management efforts to be focussed where needed. Three major factors can be predicted to influence the future abundance and composition of bird communities on Aotea. They are *mammalian predators, vegetation transition and climate warming*. These three main drivers interact in various ways, such that the only safe prediction is that populations, and the mix of species present, will change!

13.5.1 Predators

The first and most immediate of these factors is the extent and effectiveness of pest management, especially for ship rats and feral cats. Twenty years of bird monitoring and intense management of rodents at Windy Hill (**Figure 44**, **Figure 46**, **Figure 50**, **Figure 55**, **Figure 59**, **Figure 60**), and many rat eradications on islands elsewhere (Innes et al. (2010), see also, Towns and Broome (2003)), allow the impact of rats on bird populations to be clearly demonstrated (Atkinson, 1985). We also know that feral cats can have devastating impacts on bird populations (Fitzgerald & Veitch, 1985; Innes et al., 2010; King, 1984). Unless rodents and feral cats are eliminated from Aotea, those remaining endemic and native bird species with low populations may become extinct. Some species may be able to maintain small populations in restricted areas, and a few, such as tūī, which have been able to take advantage of new habitats, may increase towards former levels of abundance. Predator management (as at Windy Hill, Motu Kaikoura, Glenfern, Okiwi, Medlands and elsewhere) and restoration planting (as at Glenfern, Okiwi. Medlands and elsewhere) can help to slow or reverse declines—but cannot be *ad infinitum.* The current Predator Free 2050 initiative (see **pf2050.co.nz**) is positive for the future of

some bird species, but not all pests are covered under the Predator Free 2050 mandate, and feral cats are a crucial omission.

The eradication of rodents from Aotea is a laudable goal, but paradoxically it probably wouldn't universally improve the lot of all bird species (see Miskelly (2018)). This is because some species may decline as the competitive balance between bird species changes, new spatial overlaps occur, and food resources are altered (Walker et al., 2021). Our understanding of the differential impacts of three different rodents (ship rats, kiore and mice) on different bird species is still developing. To a large extent, conservation managers 'play God' when we seek to benefit some selected species over others. However, the evidence clearly demonstrates the overall detrimental effects of predatory mammals on previously isolated avifaunas (Atkinson, 1985; Innes et al., 2010). Control or removal of predatory mammals such as feral cats and rodents is a well-proven step in ecosystem restoration in Aotearoa.

13.5.2 Vegetation Transition

The second important current trajectory of change on Aotea is the legacy of human impacts on forests and how quickly they are recovering (**Figure 174** & **Figure 175**): specifically, the shift from relatively young successional forest dominated by small tree species with limited fruit and flower resources for endemic birds, to the structurally more complex and diverse broadleaf forest.

FIGURE 174

Transitional forest: old senescent kānuka, young conifers, broadleaf trees & tree ferns (photo by John Ogden)

This can be a relatively rapid process, with demonstrable changes in successional forest composition evident on Aotea over the last century.

However, this disturbed, successional forest is where most light-demanding, alien and invasive trees and shrubs become established. In most situations these will be gradually replaced by taller-growing indigenous species, as canopy height and density increases. Some exotic trees do provide food for birds. Pines (*Pinus* spp.), provide an important winter food resource for kākā, and others (*Banksia, Acacia, Eucalyptus*) provide pollen and nectar for species such as tūī. Some longer-lived 'environmental weeds' (e.g., *Hakea*) are fire-adapted, and regenerate vigorously after forest fires. The succession to mature forest is thus mediated by the probability of fire, which in turn is influenced by species composition, vegetation age, climate change, topographic aspect and location, and even by the presence of rodents (Perry et al., 2015). But, if fire can be prevented, the successional trajectory should continue, and its associated suite of birds, can be predicted (**Figure 177**). The larger fruit and nectar feeders kererū, kākā and tūī, will increase, while smaller insectivores such as fantail/pīwakawaka, grey warbler/riroriro and silvereye/tauhou may decrease.

FIGURE 175

Successional and mature forest (photo by Chris Morton)

The two drivers of change outlined above – predators and vegetation transition– are largely within the control of the local community and land managers. If it is the will of the community, predators can be controlled or eradicated, and forest succession can be speeded up by judicious planting and fire control. The third driver however, climate change, presents different challenges.

13.5.3 Climate Warming

Global climate change is uni-directional and predictable, although the reactions of the natural world, and the human economy, are not. Predictions are that spatial temperature regimes, such as latitudinal and altitudinal temperature gradients, will shift. Rainfall patterns will also change, and 'extreme events' (both droughts and floods), will become more common (Salinger, 2021). High temperatures and associated forest fires in vegetation seeded with exotic and fire-promoting species, could destroy significant areas of habitat, and reverse vegetation transition on Aotea.

Terrestrial species adapted to particular temperature ranges and rainfall gradients will move, but at different rates depending on their individual ecological requirements, physiology, behaviour and demographic abilities. The changes in forest composition will show a lag, due to the longevity of many tree species, and some birds which are dependent on old trees may also show a commensurate lag. A few species requiring cool, higher altitude forest may be lost as the climate warms, or alternatively if they can, some may move to more southerly locations (Walker et al., 2021). But the adaptability of birds, and their capacity for movement, must not be underestimated.

The effects of climate change will most likely be re-assortments, with unpredictable gains and losses. This is especially the case on islands such as Aotea, where species may not have alternative habitats, or may lack the physical or behavioural ability to move (Diamond, 1981). Small populations such as those on islands are particularly vulnerable to multiple risks (Macinnis-Ng et al., 2021).

Climate warming is likely to influence oceanic species and migratory waders first. Some of these, such as bar-tailed godwits and Pacific golden plover, are already showing signs of decline on Aotea or have altered migration patterns, taking them elsewhere. A warmer climate may also change local oceanic circulation patterns, influencing the arrival of new species and the expansion or contraction of species already present. Associated sea-level increases will reduce the areas of estuarine mudflats so crucial to many species (Bell, 2021).

Climate change and sea-level rise are largely beyond the direct control of Aotea's small local community. However, predictable outcomes of the warming climate can be prepared for and to some degree mitigated in the local context. The obvious example is forest fire-risk-reduction, through

education and rules around the lighting fires in the open. Extensive planting of the more fire-resistant indigenous tree species of the mature forest in the successional, kānuka forest, would hasten reduced flammability.

At present, few climate-change-driven trends are evident in New Zealand's avifauna. The gradual shift southwards in the North Island of warmth-loving mynas could be an example. While altitudinal shifts or movements to more southern locations by cooler climate-adapted species are foreseeable, which species will do this is not clear, especially in view of the other confounding drivers of change. The first signs of change are always hard to detect, especially without consistent monitoring in place – for example, does the sighting on Aotea of a frigatebird in 2018 and a tropicbird in 2022 indicate climate warming, or are these occurrences just chance events?

13.6 Future Birds of Aotea

FIGURE 176

Dotterel chick (photo by Emma Waterhouse)

It is certain that the future composition of the native avifauna of Aotea and its surrounding seas will change.

Current predator control and other conservation efforts, if maintained, seem capable of preventing the loss of any more forest species, and forest dwelling bird could increase. We have very little data on most wetland species (except pāteke) and without sustained widespread conservation efforts, downwards trends suggested in this report seem likely to continue. Introduced passerines and other species which benefit from past forest clearance and wetland drainage will react differently, with some species increasing and others probably declining. Several of these species are associated with human habitation and appear likely to increase if Aotea's population grows. Further new species may also arrive from the mainland, either naturally or as pets.

The pelagic birds nesting on Aotea, especially black petrels/tākoketai seem particularly at risk from climate change. Sea temperatures and weather cycles affects food supplies for adults on migration and chicks in burrows on Aotea (**Figure 176**). Both their food supplies and their remaining colonies are particularly vulnerable to climate events and predicted sea temperature change. This adds weight to efforts to protect them from predators while they are nesting on land.

In the coastal zone more pressure can be predicted on beach-nesting birds and migrant waders from increased human disturbance and sea-level rise. Again, different species will react differently to these influences, but without more public awareness of their plight, and action to protect them, more species could quietly disappear, just as wrybill and pied stilt appear to be doing already.

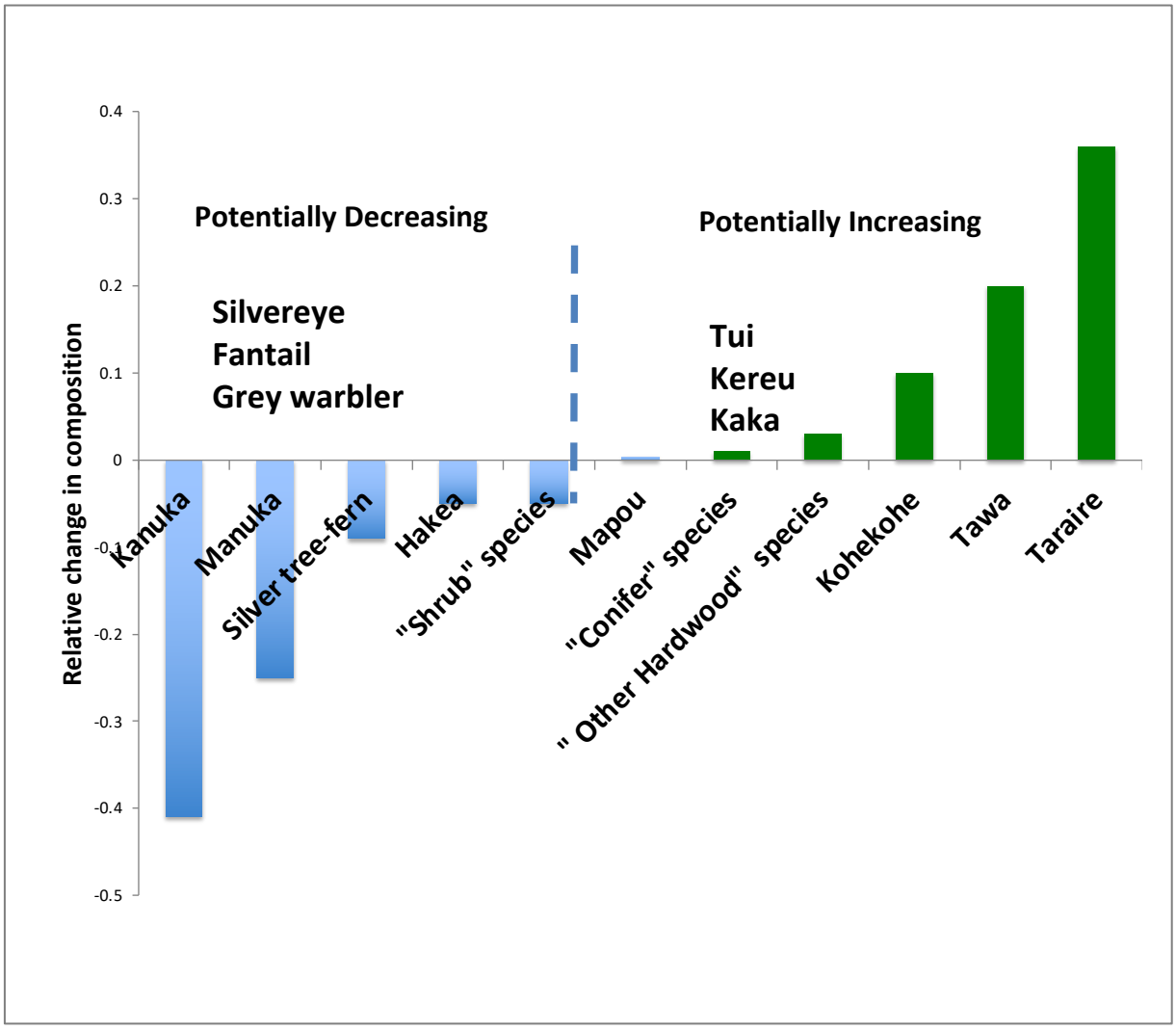


FIGURE 177

Relative changes in forest species composition (species decreasing on left, species increasing on right) at Glenfern and Windy Hill Sanctuaries (redrawn from Perry et al. (2010)).

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APPENDIX 1 - FULL LIST OF BIRD SPECIES OF AOTEA

FIGURE 178

Pāteke (photo by Chris Morton)

KEY TO STATUS

Bold green indicates bird listed by Hutton in 1868

E	Endemic – only found in New Zealand
N	Native – reached New Zealand naturally and established
I	Introduced – brought to New Zealand by man
Iº	Introduced to Aotea since Hutton's list (1868) but no longer present
B	Breeding or probably breeding on Aotea
M	Migrant to Aotea, either from within New Zealand or from overseas
V	Vagrant – occasional visitor or vagrant blown off course and not established
D	Domestic feral species
*	Indicates species lost as breeding bird on Aotea since Hutton's (1868) visit. Note that un-asterisked species in green are still present as breeding birds, migrants or vagrants
**	Indicates species lost but reintroduced and now breeding

SPECIES NAMES AND CATEGORIES

Species: English Name	Species: Māori Name	Scientific Name	Category
Albatross, royal	Toroa	*Diomedea epomophora*	EV
Albatross, wandering	Toroa	*Diomedea exulans*	NV
Bellbird*	Korimako	*Anthornis melanura*	E*
Bittern, Australasian	Matuku	*Botaurus poiciloptilus*	NB
Blackbird	Manu pango	*Turdus merula*	IB
Cape pigeon	Tītore	*Daption capense*	NV
Chaffinch	Pahirini	*Fringilla coelebs*	IB
Crake, marsh (?)	Koitareke	*Porzana pusilla*	N
Crake, spotless	Pūweto	*Porzana tabuensis*	NB
Cuckoo, long-tailed*	Koekoeā	*Eudynamys taitensis*	EM*
Cuckoo, shining	Pīpīwharauroa	*Chrysococcyx lucidus*	NBM
Domestic hen		*Gallus gallus*	ID
Dotterel, banded	Tūturiwhatu	*Charadrius bicinctus*	EB
Dotterel, large sand		*Charadrius leschenaultii*	V
Dotterel, Mongolian		*Charadrius mongolus*	V
Dotterel, New Zealand	Tūturiwhatu	*Charadrius obscurus*	EB
Dove, Barbary		*Streptopelia roseogrisea*	I
Dove, spotted		*Streptopelia chinensis*	I
Duck, grey*	Pārera	*Anas superciliosa*	N*?
Dunnock		*Prunella modularis*	IB
Egret, cattle		*Bubulcus ibis*	V
Falcon, New Zealand*	Kārearea	*Falco novaeseelandiae*	EV*

Species: English Name	Species: Māori Name	Scientific Name	Category
Fantail	Pīwakawaka	*Rhipidura fuliginosa*	NB
Fernbird	Mātātā	*Bowdleria punctata*	EB
Frigatebird, lesser		*Fregata ariel*	V
Gannet	Tākapu	*Morus serrator*	NB
Godwit bar-tailed	Kuaka	*Limosa lapponica*	NM
Goldfinch		*Carduelis carduelis*	IB
Goose, Canada		*Branta canadensis*	IV
Goose, domestic		*Anser anser*	IDB
Greenfinch		*Chloris chloris*	IB
Grey warbler	Riroriro	*Gerygone igata*	EB
Guineafowl, helmeted		*Numida meleagris*	ID
Gull, red-billed	Tarāpunga	*Larus novaehollandiae*	NB
Gull, southern black-backed	Karoro	*Larus dominicanus*	NB
Harrier, Australasian	Kāhu	*Circus approximans*	NB
Heron, reef	Matuku moana	*Egretta sacra*	NB
Heron, white	Kōtuku	*Ardea alba*	NV
Heron, white-faced	Matuku moana	*Egretta novaehollandiae*	NB
Kākā	Kākā	*Nestor meridionalis*	EB
Kingfisher	Kōtare	*Todiramphus sanctus*	NB
Knot	Huahou	*Calidris canutus*	NM
Kokako*	Kōkako	*Callaeas wilsoni*	E*
Magpie, white-backed	Makipai	*Gymnorhina tibicen*	IB
Mallard		*Anas platyrhynchos*	IB

Species: English Name	Species: Māori Name	Scientific Name	Category
Mollymawk, black-browed	Toroa	*Diomedeioa (Thalassarche) melanophrys*	NV
Mollymawk, shy	Toroa	*Diomedia (Thalassarche) cauta steadi*	NV
Mollymawk, yellow-nosed	Toroa	*Thalassarche carteri*	NV
Morepork	Ruru	*Ninox novaeseelandiae*	NB
Myna, common		*Acridotheres tristis*	IB
Needletail, white-throated		*Hirundapus caudacutus*	V
Oystercatcher, South Island pied	Tōrea	*Haematopus finschi*	NM
Oystercatcher, variable	Tōrea pango	*Haematopus unicolor*	EB
Parakeet, red-crowned	Kākāriki	*Cyanoramphus novaezelandiae*	EB
Parakeet, yellow-crowned*	Kākāriki	*Cyanoramphus auriceps*	E*
Penguin, little	Kororā	*Eudyptula minor*	NB
Petrel, black	Tākoketai	*Procellaria parkinsoni*	EB
Petrel, black-winged	Tītī	*Pterodroma nigripennis*	NV
Petrel, blue		*Halobaena caerulea*	NV
Petrel, Cook's	Tītī	*Pterodroma cookii*	EB
Petrel, northern diving	Kuaka	*Pelecanoides urinatrix*	NB
Petrel, northern giant	Pāngurunguru	*Macronectes halli*	NV
Petrel, grey	Kuia	*Procellaria cinerea*	NV
Petrel, grey-faced	Ōi	*Pterodroma gouldi*	EB
Petrel, mottled	Kōrure	*Pterodroma inexpectata*	EV
Petrel, white-headed		*Pterodroma lessonii*	NV
Pheasant, ring-necked		*Phasianus colchicus*	IB

Species: English Name	Species: Māori Name	Scientific Name	Category
Pigeon, New Zealand	Kererū	*Hemiphaga novaeseelandiae*	EB
Pigeon, rock		*Columba livia*	IB
Pipit, New Zealand	Pīhoihoi	*Anthus novaeseelandiae*	NB
Plover, Pacific golden	Kuriri	*Pluvialis fulva*	NM
Plover, shore*	Tuturuatu	*Thinornis novaeseelandiae*	E*
Plover, spur-winged		*Vanellus miles*	NB
Prion, Antarctic	Whiroia	*Pachyptila desolata*	NV
Prion, broad-billed	Pararā	*Pachyptila vittata*	NV
Prion, fairy	Tītī wainui	*Pachyptila turtur*	NV
Prion, narrow-billed		*Pachyptila belcheri*	NV
Pūkeko	Pūkeko	*Porphyrio melanotus*	NB
Quail, brown		*Coturnix ypsilophora*	Iº
Quail, California		*Callipepla californica*	Iº
Quail, New Zealand*		*Coturnix novaezelandiae*	E*
Rail, banded	Moho pererū	*Gallirallus philippensis*	NB
Redpoll, lesser		*Acanthis flammea*	IB
Rifleman	Titipounamu	*Acanthisitta chloris*	E *
Robin, North Island**	Toutouwai	*Petroica longipes*	EB **
Roller, broad-billed		*Eurystomus orientalis*	V
Saddleback, North Island*	Tīeke	*Philesturnus rufusater*	E*
Sandpiper, sharp-tailed		*Calidris acuminata*	V
Shag, black	Kawau	*Phalacrocorax carbo*	?NB
Shag, little	Kawaupaka	*Phalacrocorax melanoleucos*	?NB

Species: English Name	Species: Māori Name	Scientific Name	Category
Shag, little black	Kawau tūī	*Phalacrocorax sulcirostris*	?NB
Shag, pied	Kāruhiruhi	*Phalacrocorax varius*	NB
Shag, spotted	Pārekareka	*Stictocarbo punctatus*	EV
Shearwater, Buller's	Rako	*Ardenna bulleri*	E
Shearwater, flesh-footed	Toanui	*Ardenna carneipes*	N
Shearwater, fluttering	Pakahā	*Puffinus gavia*	EB
Shearwater, Hutton's	Tītī kaikōura	*Puffinus hutttoni*	EV
Shearwater, little	Pakahā	*Puffinus assimilis*	N
Shearwater, short-tailed	Koakoa	*Ardenna tenuirostris*	M
Shearwater, sooty	Tītī	*Ardenna grisea*	N
Shelduck, paradise	Pūtangitangi	*Tadorna variegata*	EB
Silvereye	Tauhou	*Zosterops lateralis*	NB
Skua, Arctic		*Stercorarius parasiticus*	M
Skylark	Kaireka	*Alauda arvensis*	IB
Sparrow, house	Tiu	*Passer domesticus*	IB
Spoonbill, royal	Kōtuku ngutupapa	*Platalea regia*	N
Starling		*Sturnus vulgaris*	IB
Stilt, pied	Poaka	*Himantopus leucocephalus*	NB
Stitchbird*	Hihi	*Notiomystis cincta*	E*
Stint, red-necked		*Calidris ruficollis*	M
Storm petrel, black- bellied	Takahikare	*Fregetta tropica*	NV
Storm petrel, grey- backed	Reoreo	*Garrodia nereis*	NV
Storm petrel, New Zealand	Takahikare raro	*Fregetta maoriana*	E

Species: English Name	Species: Māori Name	Scientific Name	Category
Storm petrel, white- faced	Takahikare-moana	*Pelagodroma marina*	N
Swallow, welcome	Warou	*Hirundo neoxena*	NB
Swan, black	Karianau	*Cygnus atratus*	IV
Teal, brown	Pāteke	*Anas chlorotis*	EB
Tern, Caspian	Taranui	*Hydroprogne caspia*	NB
Tern, white-fronted	Tara	*Sterna striata*	NB
Thrush, song		*Turdus philomelos*	IB
Tomtit, North Island	Miromiro	*Petroica macrocephala*	EB
Tropicbird, white tailed		*Phaethon lepturus*	V
Tui	Tūī	*Prosthemadera novaeseelandiae*	EB
Turkey		*Meleagris gallopavo*	IDB
Turnstone		*Arenaria interpres*	V
Weka	Weka	*Gallirallus australis greyi*	EB
Whimbrel		*Numenius phaeopus*	V
Whitehead*	Pōpokotea	*Mohoua albicilla*	E*
Wrybill	Ngutu parore	*Anarhynchus frontalis*	EV
Yellowhammer		*Emberiza citrinella*	IB

Note: There are 130 species on the full list, and:

- **53 species on Hutton's list**
- 62 species are breeding
    - 18 are endemics
    - 27 are natives
    - 17 are introduced
- 68 are non-breeding
- 11 are extinct
- 36 are visitors/vagrants

ABOUT AOTEA GREAT BARRIER ENVIRONMENTAL TRUST

The trust's mission is to work with our community to protect native species through the eradication of rats and feral cats, to re-introduce species lost to the island, and to work towards an ecology-based economy for Aotea | Great Barrier Island. We focus on research, projects that protect biodiversity, communication of conservation and related information, and advocacy that informs decision-making. These activities help the community to act towards protection of the biodiversity of the island for future generations. Find out more by visiting our website: **www.gbiet.org**

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