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Tīeke conservation

Rats and forest regeneration | Aotea's bats

Weka and seabirds | Beyond Barrier

Aotea Great Barrier Environmental Trust

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Guest editorial: What's the plan for Rakitu

DR JOHN OGDEN

It seems to be the lot of the conservationist to go on and on repeating the same thing, backing it up with more and more evidence, and not being listened to. But it is particularly galling when the party not listening is also one you have supported with voluntary work for decades.

This is exactly the case with the issue of weka on Rakitu Island. The island is so well situated on the seabird super highway linking marine food resources and the remaining breeding colonies along the north-eastern coast of Aotearoa, that its restoration as a seabird ecosystem was a no-brainer. This, I was told, by Department of Conservation (DOC) staff, was the rationale for the rat eradication. Great, the GBI Environmental Trust knew the extensive published evidence – eradicating rats would allow re-colonisation by ground-nesting seabirds.

The Trust has championed Rakitu for years, through Environmental News, letters to Ministers of Conservation and senior DOC staff, and attending innumerable meetings with DOC, iwi, and local board representatives. Trustees have been advocates for, and staunch supporters of, DOC. Support for the eradication of rats on Rakitu was maintained in the face of opposition and vilification by some members of the community.

North Island weka (*Gallirallus australis greyi*) is one of five distinct 'subspecies' recognised by the Weka Recovery Group (WRG) within DOC. Weka was regarded as one species (*Gallirallus australis*) until genetic profiling showed that some morphologically different populations were also genetically distinct. The population of this subspecies has declined and is subject to wide numerical fluctuations. The reasons for this are not known, but in the 1950s it was considered prudent to establish some island populations as an insurance against mainland extinction. In 1951, 15 weka were transferred from the Gisborne area to Rakitu. Since then – even in the presence of abundant rats – they have increased exponentially. At the time of the drop, there were an estimated 450 weka on Rakitu (although no actual count of weka appears to have been made). The WRG required that about 50 were to be removed, *and subsequently returned*. More than 50 weka were 'easily captured'.

Removal was because it was thought that weka would be killed by eating rat bait, hence destroying the population of an endangered bird. The return was justified because no alternative location could be found for them, and Rakitu was considered by the WRG to be the best island on which to maintain a weka population.

The relative merits of weka versus seabirds, if discussed, must have been weighted by the convictions of the WRG. They were fully aware that the reason for the eradication campaign (as widely understood by the public) was restoration of Rakitu to a seabird nesting island, and that this result would not be achieved in the presence of weka. So, weka were returned to Rakitu, despite abundant literature, internal advice and external opinion, showing that they would prevent re-colonisation by seabirds.

Numerous accounts are available that document the impact of weka predation on seabirds (see article page 10 this issue). Fifty or even 450 weka may have relatively little effect on a colony of thousands of breeding birds. But that same number would have a devastating effect on a small colony (tens of birds) trying to re-establish on Rakitu after rat removal.

Cover: Tieke/(saddleback) nesting in an old WWII building on Cuvier Island (Photo: T. Lovegrove). Back cover: Coastal broadleaf forest, Aotea Great Barrier. Photo: C. Morton

A ‘compromise’ suggestion of ‘fencing off’ bits of Rakitu to keep the weka from the seabirds is more appropriate for a zoo than for a wildlife island, and will again make DOC the laughing-stock of Great Barrier. On the rugged coastal environment of Rakitu, fencing would probably be ineffective even in the short-term, visually unacceptable, and expensive,. Most importantly, it points to an unclear vision for island restoration.

With weka present, at best, some of the bigger species like grey-faced petrels may establish on cliff sites (which they do not prefer because burrows are hard to dig into rock!). Smaller species, such as storm petrels, prions, diving petrels, Cook’s petrel, fluttering and little sheawaters (all of which use the north-eastern super highway and nesting on nearby islands) do not stand a chance of returning to Rakitu in the face of predation by a population of several hundred breeding weka.

Part of the problem may be that many people, even within DOC, do not know what a ‘seabird island’ is like . Without firsthand knowledge it must be hard to have the vision. The nocturnal noise and bustle of thousands of ground nesting seabirds is an amazing experience, and speaks of an earlier Aotearoa.

Also, most people do not know how huge and diverse our former seabird populations were: There are more native seabirds than terrestrial species. Before human colonisation they were nesting everywhere on the mainland coast, even well up into the mountains – millions of birds digging in the soil, bringing huge amounts of phosphates and nitrates to land from the marine zone.

So far as I know, DOC has not published any rationale for the rat eradication. Despite verbal discussion locally, and three clear requests to the Minister of Conservation (2017, 2018, 2020), now, seven years since the eradication plan was funded, and three years since it commenced, there is still no management plan for Rakitu. There is still no published vision for a seabird island with iwi co-management and community involvement. Why?

Perhaps because the WRG are aware that leaving weka on Rakitu is a contentious issue on which they are likely to be in the minority; it is better not to have a plan. The strategy appears to be to keep public input to a minimum and run the island as a weka farm. If this is not the case – why has no management plan been published after so many years?

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Photo: E. Waterhouse

Rakitu, 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 Rakitu, despite its location on the north eastern New Zealand seabird super highway.

Tīeke/saddleback conservation – a short history

TIM LOVEGROVE, Auckland Council

*The tīeke or saddleback (*Philesturnus rufusater*) is one of New Zealand's ancient endemic species, which evolved in a land free of predatory mammals. The species has a fascinating conservation history as it was with the tīeke that the former Wildlife Service successfully pioneered island translocations to save threatened birds.*

Tīeke used to be common on Aotea Great Barrier, and could one day be reintroduced - feral cats and ship rats would need to be removed or reduced to very low numbers to allow them to survive.

Disappearing bird species

In 1868, Captain Frederick Hutton visited Aotea and described the birds. Hutton visited at a time before the full impact of European colonisation. He listed many species now extinct on the island, including shore plover/tuturuatu, falcon/kārearea, rifleman/titipounamu, whitehead/pōpokatea, robin/toutouwai, stitchbird/hihi, kōkako and tīeke.

Some of these species, including hihi and tīeke, disappeared soon after Hutton's visit, and like the mainland, both were probably extinct on Aotea by 1900.

Although tīeke were widespread on the mainland in the mid-nineteenth century, they were very rare by 1880. In the North Island, they had disappeared from many places even before stoats, ferrets and weasels were introduced in the 1880s.

The spread of ship rats coincided with the catastrophic declines of some of our most vulnerable birds such as bush wren, hihi, tīeke, huia and piopio.

Three important predatory mammals, cats, Norway rats and ship rats were already widespread. Cats and Norway rats established quite early in New Zealand, probably around the time of Cook's voyages and the sealing and whaling days of the late 1700s to early 1800s. Norway rats were aboard Cook's ships during his three voyages between 1769 and 1777.

Ship rats - arboreal killers

The ship rat did not arrive until much later, reaching New Zealand in the 1850s to 60s. This was around the time that the ship rat replaced the Norway rat as the common shipboard rat. It has been suggested that steamships with their warmer engine rooms suited ship rats better. And once established in New Zealand, they spread quickly. The spread of ship rats coincided with the catastrophic declines of some of our most vulnerable birds such as bush wren, hihi, tīeke, huia and piopio.

Photo: Tim Lovegrove

Tīeke preyed on by a rat while at its roost. This bird species is susceptible to rat predation when on the nest and at roosts.

Compared with the more terrestrial Norway rat, the ship rat is highly arboreal and almost all nests of forest birds are accessible to them. While Norway rats and feral cats would have made significant inroads into populations of some of these vulnerable birds before ship rats reached our shores, it was the ship rat that finished many of them off, aided later by mustelids, especially stoats.

First successful tīeke translocation

Taranga/Hen Island was the last place where North Island tīeke had survived after they became extinct on the mainland. Unsuccessful attempts had been made to establish populations on Kapiti and Hauturu in 1925 and Motumuka/Lady Alice Island in 1950. In January 1964, a party led by Don Merton successfully transferred 23 North Island tīeke from Taranga to nearby Whatupuke/Middle Chicken Island.

Taukihepa/Big South Cape Island - ship rat invasion

An example of how ship rats can quickly devastate vulnerable island faunas happened in the mid -1960s when they reached the hitherto rat-free Big South Cape Islands off Stewart Island. Herbert Guthrie-Smith had described the abundant birdlife on a visit in the early years of the 20th century and his classic of New Zealand natural history *Birdlife on Island and Shore* published in 1925, contains the exquisite first-ever photographs of the South Island tīeke and the now-extinct Stead's bush wren. Guthrie-Smith knew how vulnerable these precious island relics of pre-human New Zealand were to invasive rats, and at the time of his visit this was the last place where Stewart Island snipe and South Island tīeke survived. This Garden of Eden was plundered when stowaway ship rats invaded and swept across the islands in 1964-65.

Rescue attempt

Word reached the Wildlife Service in autumn 1964 that rats had invaded the Big South Cape Islands. Knowing the damage that rats could wreak on fragile birdlife, a party led by Brian Bell was sent to investigate. Rats were already in plague numbers at the northern end of 900 ha Taukihepa/Big South Cape Island, but the southern end was less affected. When the catching party returned in August, the rats had reached the southern end.

Photo: Don Merton/DOC

Stewart Island snipe, now extinct, was last known from Big South Cape Island before the arrival of ship rats.

While half of the party checked nearby rat-free islands for suitable release sites, the others built a rat-proof aviary and began catching as many tīeke, wrens and snipe as they could. It was late winter, days were short and cold and the weather in these southern latitudes stormy and very challenging, especially for making landings on exposed, rocky islands.

Tools from North Island tīeke translocations

New-found tools (see main article) used for translocations of North Island tīeke earlier that same year were quickly put to good use to rescue the Big South Cape tīeke, and 36 were captured with 21 and 15 respectively released on nearby Big Stage and Kaimohu Islands. This eleventh hour transfer averted almost certain extinction of the South Island tīeke. Sadly, due to difficulties of catching and captive feeding, along with weather delays, the transfer of wrens and snipe was much less successful. Just six wrens were caught and transferred to Kaimohu Island but attempts to transfer snipe failed. A few wrens survived on Kaimohu until 1972, but none was seen thereafter. Stead's bush wren and Stewart Island snipe are now extinct.

The Whatupuke transfer in 1964 was a milestone for inter-island translocations of threatened birds - this was the first time that synthetic mist nets and portable tape recorders were used. Johnny Kendrick, a Wildlife Service colleague in Don Merton's party, made tape recordings of tīeke calls and rigged up a switch and speaker system to play sound from each side of the net, allowing the birds to be lured back and forth until they were caught.

These new tools streamlined the capture process, making it much easier to catch larger numbers of birds quickly. Earlier attempts had suffered because too few birds were caught and released.

In terms of species loss, the rat invasion of the Big South Cape Islands (see box above) was New Zealand's most costly ecological disaster of the twentieth century. It was a microcosm of what probably happened on the mainland in the nineteenth century and alerted everyone to the danger invasive rats posed to vulnerable island ecosystems. From the mid-1960s, an active programme was undertaken to spread tīeke around as many suitable islands as possible, as an insurance against further rat invasions.

Coexisting with kiore

From the mid-1960s onwards, tīeke were released on a number of northern islands. A series of experimental transfers to Kapiti Island also occurred between 1981 and 1983. Apart from Kapiti, which also had Norway rats and possums, when choosing suitable release islands, the main criteria were sufficient areas (usually over 80 ha) of coastal forest and no predatory mammals, apart from Polynesian rats or kiore.

The relict tīeke population on Taranga had apparently coexisted with kiore for centuries, and at the time, apart from Kapiti, all of the recipient islands for tīeke releases had populations of kiore.

Photo: Tim Lovegrove

Mist-netting tīeke on Stanley Island/Kawhitihu in the Mercury group.

Tīeke translocations pick up pace

The early transfers included 29 birds from Taranga to Red Mercury/Whakau (1966), 29 and 25 respectively to Cuvier/Repanga and Fanal/Motukino (1968). The releases on Red Mercury and Cuvier were spectacularly successful but the release on Fanal in the Mokohinau Group failed for unknown reasons.

By 1971 there were enough birds on Whatupuke for a transfer of 21 to neighbouring Motumuka/Lady Alice Island and in 1972, 24 birds were transferred from the flourishing population on Cuvier to Stanley/Kawhitihu in the Mercury group.

Then, over a three-year period from 1981-83, in the largest translocation attempted to date and using four source islands, Cuvier, Taranga and Motumuka and Whatupuke in the Chicken Group, 244 birds were transferred to Kapiti. This was followed by transfers of 16 and 12 birds from Taranga to Motukawanui Island in the Cavalli Group in 1983 and 1984, and then 50 birds to Hauturu and 24 to Tiritiri Matangi in 1984 along with another transfer to Fanal of 29 birds in 1985.

Three more transfers of 138 birds sourced from Cuvier and the Chickens followed in 1986, 1987 and 1988 to Hauturu, along with three more experimental transfers of 122 birds from Stanley to Kapiti in 1986, 1987 and 1988. More recent transfers have included Mokoia, Motuhora, Rangitoto/Motutapu, Motuihe and Rotoroa islands, and to several predator-fenced mainland sanctuaries, including Tāwharanui and Shakepeare regional parks.

South Island tīeke transfers

During the same period, parallel transfers were undertaken of South Island tīeke from the productive populations on Big South and Kaimohu to nine islands, including seven Stewart Island outliers and two islands in the Marlborough Sounds.

The choice of release islands was more limited for the southern tīeke, as the population on Big South Cape had existed on islands free of all rats. The release on Inner Chetwode, where kiore occurred, failed, suggesting that Big South Cape tīeke could not coexist with this rat species. More recent transfers have been to several Fiordland and southern lake islands and Orokonui, a fenced mainland sanctuary.

Kapiti Island releases

In the experimental series of releases on Kapiti, the aim was to test whether tīeke could coexist with Norway rats as well as kiore. During the early to mid-nineteenth century observers at the time described tīeke as widespread, despite an assumed overlap with Norway rats, possibly since the arrival of Cook.

Kapiti at the time represented something of a biological relic of the early nineteenth century as it lacked ship rats. Although possums were present, mice, mustelids and feral cats were also absent.

An important point about Norway rats is that they are mainly terrestrial, unlike the highly arboreal ship rat. In the experimental releases to Kapiti it was thought that if plenty of tīeke were introduced, there might be selection for birds that habitually nested and roosted high, thus avoiding predation by Norway rats.

In 1981, shortly after the first release, I began a study of tīeke on Kapiti jointly funded by the Wildlife Service, and the Department of Lands and Survey, which administered the Kapiti Island Nature Reserve. My study proved to be especially instructive about the survival of tīeke in the presence of Norway rats. During the first 1981-82 summer, I found 24 survivors from the first release of 100 birds, and although one female was killed at a nest by a rat, that summer 22 young fledged. This gave strong grounds for optimism that tīeke might survive on Kapiti. However, despite the population being boosted by further releases of 94 birds in 1982 and 50 more in 1983, by November 1983 I found only 19 tīeke on Kapiti comprising 16 survivors from the 122 that were released and just 3 locally bred birds.

Tīeke are unusual because they not only nest in cavities, but they also seek sheltered night-time roosting places in tree holes, under epiphytes growing on rocky bluffs and under overhanging stream banks.

Rat predation on roosting birds

Even by the end of the first summer's field work in 1981-82 it was clear that mortality on Kapiti was much higher than the northern islands where kiore was the only rat. In April 1983, I found the first evidence of rat predation upon roosting birds. Although we knew that females would be vulnerable to rat predation at nest holes, until then we had no evidence that roosting birds would also be particularly vulnerable.

Tīeke are unusual because they not only nest in cavities, but they also seek sheltered night-time roosting places in tree holes, under epiphytes growing on rocky bluffs and under overhanging stream banks. On Kapiti, many of these roosts were on or near the ground. Thereafter, I tried to locate and monitor as many roosts as possible. I soon began to gather increasing evidence of rat kills at roosts, including sign that Norway rats were responsible. Roost predation explained the very high mortality on Kapiti - all birds were vulnerable every night of the year – it wasn't just a case of females being vulnerable at nest holes during the breeding season. By 1986, just four tīeke remained on Kapiti. It was no surprise that these four survivors all roosted high in tall trees where they were out of reach of Norway rats. During the previous year I attempted rat control over about 40 ha on Kapiti using poison baits, but the concept of removing rats completely from this rugged 2,000 ha island was just a pipe dream. At the time rats, had only been successfully removed from a few very small islands.

If we couldn't remove the rats, the observation of some birds roosting high got me thinking about how I could manipulate roosting behaviour by providing safe artificial roost sites. I had observed tīeke roosting and nesting inside the walls of the derelict WWII radar station buildings on Cuvier, so it seemed a roost box with features of these man-made roosts, which had a bottom entrance with a dark perch above, might be worth a try. In July 1984, with the help of volunteers, 100 roost boxes were erected on Tiritiri Matangi and Stanley Island - placed at about chest height on trees in secluded spots with some surrounding understorey.

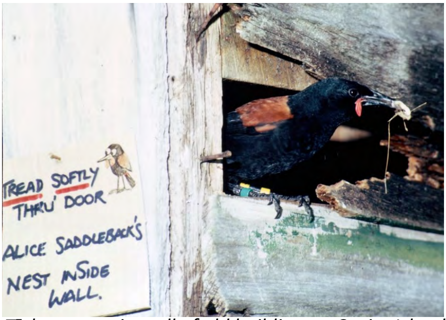

Photo: Tim Lovegrove

Tīeke at nest in wall of old building on Cuvier Island.

The roost boxes were an immediate success and enabled a series of experimental releases on Kapiti from 1986-88 into habitat with hundreds of boxes. In these releases, three batches of 40 birds each were transferred to Kapiti annually, with each batch comprising 20 known roost-box users and 20 natural roost users. Following release, most of the habitual roost-box users continued to use boxes and their survival was significantly higher than the natural-roost users.

Tīeke roosting behaviour

An important aspect of tīeke roosting behaviour, which enhanced the value of the roost box project, is that adults show their newly fledged young where to roost, and thus many box users trained their young how to roost in roost boxes. It was clear that this learned roosting behaviour had the potential to spread through the population. Rat predation at natural roosts would create strong selection in favour of birds roosting in boxes out of reach of Norway rats.

Photo: Tim Lovegrove

Tīeke at ground level roost on Cuvier Island. Cavity-roosting and nesting behaviour means the species is extremely vulnerable to predation by introduced mammals.

I also provided nest boxes, which helped to reduce female losses at nests, although some continued to use vulnerable natural sites, where there were further losses to rats. I also found that the roost-learning process for young birds took time, and many young were preyed on at ground roosts before they had learned to use a roost box. Although the roost and nest box experiment greatly enhanced tīeke survival on Kapiti, modelling showed that there would still be a decline, but much more gradual than before, with the population eventually dying out after 50-75 years.

Removing rats from offshore islands

At about the same time as I was experimenting with the roost boxes on Kapiti, steady advances were being made in removing rats from larger islands. In 1986, the successful eradication of Norway rats from both Motuhora in the Bay of Plenty and Breaksea Island in Fiordland, both around 150 ha, was a breakthrough.

Tīeke spend a lot of time feeding on the ground, so they are especially vulnerable to stoats and cats.

Just 10 years later in September 1996, an aerial drop of anticoagulant poison baits successfully eradicated all rats from Kapiti, and during the 1996-97 summer, ten surviving pairs of tīeke bred in rat-free habitat for the first time. These birds formed the nucleus of the thriving tīēke population on Kapiti today.

Cats and stoats also threaten tīeke

Historically, rats haven't been the only threat for tīeke on islands. Cats exterminated tīeke on both Stephens and Cuvier after lighthouses were established in the late nineteenth century, and cats were almost certainly responsible for wiping out tīeke on Hauturu.

Tīeke were abundant when Hutton visited Hauturu in the late 1860s but very rare at the time of Reischek's visits in the 1880s. Tīeke are also extremely vulnerable to stoats and translocations to Maud, Motukawanui and Moturoa Islands all failed after stoats invaded by swimming from the nearby mainland.

Photo: Tim Lovegrove

Tīeke roost box on Kapiti Island. Adult birds show their newly fledged young where to roost. On Kapiti Island many box users trained their young how to roost in roost boxes.


Photo: Craig Hodsall

Tīeke in an aviary prior to inter-island transfer.

I recall Brian Bell telling me that when they were surveying Maud Island using tape recorded calls to find tīeke, a stoat appeared in response to the calls, alerting the team for the first time that stoats had reached Maud Island. Perhaps this stoat had learned to tune into tīeke calls to find an easy meal.

Both species of tīeke are now secure and flourishing populations on several islands are big enough to withstand regular harvesting to provide birds for further translocations.

Recently, the tīeke population at predator-fenced Orokonui Sanctuary was wiped out by stoats that had gained access over the predator fence, and the population at Tāwharanui was reduced by over 60% after stoats invaded the fenced peninsula. The Tāwharanui population was possibly spared because mice and rabbits provided a source of alternative prey for the stoats. Tīeke spend a lot of time feeding on the ground, so they are especially vulnerable to stoats and cats.

Pest-free islands and sanctuaries

These examples highlight the extreme vulnerability of tīeke to introduced predatory mammals, the importance of pest-free islands and sanctuaries to their survival and more recently, the role of brave and innovative conservation management to expand their range and greatly increase their numbers.

Both species of tīeke are now secure, and flourishing populations on several islands are big enough to withstand regular harvesting to provide birds for further translocations.

Predator Free 2050

The country has set itself an aspirational goal in Predator Free 2050. With present techniques, and to prove that this is achievable, we will probably have to undertake this as a series of incremental steps. An obvious early step is removing predatory mammals from 28,000 ha on Aotea, a goal that can be achieved with current methods.

Just imagine Aotea with tīeke, hihi, kokako, bellbird and other now-absent species joining kākā and tūī in the dawn chorus!

Tīeke on Tiritiri Matangi. Twenty-four birds were transferred to the island in 1984. The population on Tiri is now over 600 birds, with a total population of North Island tīeke of at least 7,000.

Weka and seabirds

DR JOHN OGDEN

Rakitū, located off the northern east coast of Aotea was recently declared predator free by the (former) Minister for the Environment, Hon. Eugenie Sage. The 330-hectare island joins more than 40 other pest free islands in the Hauraki Gulf Marine Park. Rakitū, like much of New Zealand, once had thriving breeding colonies of seabirds, before rats were introduced (see guest editorial, page 2 this issue).

The island is located on the northern New Zealand's seabird superhighway, and restoration could see numerous seabird species becoming re-established, just as they did on Burgess Island in the nearby Mokohinau group following rat eradication[1].

New Zealand – seabird capital of the world

New Zealand is known as the 'Seabird Capital of the World' - almost half of the world's 359 seabird species worldwide, 140 species occur within New Zealand's Exclusive Economic Zone (out to 200 nm from the coast).

Eighty-six of these species are endemic or native to New Zealand[2]. About a third of New Zealand's seabird species[3] are found in the Hauraki Gulf.

Weka prevent seabird re-colonisation

The return of North Island weka (*Gallirallus australis greyi*) to Rakitū is likely to prevent re-colonisation of the island by any of these seabirds. One of the clearest accounts of weka predation on shearwaters was provided by Harper in 2006[4].

"*The first observation of weka predation on shear-water chicks was on Taukihepa (Big South Cape Island) on 17 Jan 2004. On 3 occasions an adult weka with 2 chicks was seen grubbing around burrow entrances, then entering rapidly and pulling out 2-3-day-old chicks. The adult weka killed the chicks by striking the back of the head with its beak. The weka ate just the head and discarded the body. Another 4 shearwater chicks with the same distinctive injuries to the head were found in the area. After this initial observation, 37 chicks with head wounds suggesting attacks* by *weka were found at various locations around Taukihepa. Intact dead chicks ranged from 66 to 283g. Seven chicks were found with at least 1 eye missing and the brain cavity cleaned out; 16 others had only head injuries (normally to the back of the head), but with no skin punctures. The preferred method for killing petrel chicks was by repeated blows to the back of the head, which has been observed for weka elsewhere (St Clair & St Clair 1992). Ten other chicks had had the brain removed*

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North Island weka were introduced to Rakitū in the 1950s and quickly reproduced to reach an estimated population of around 400-500 in 2018.

through the back of the head … "

Over a three-week period in 2004, 43 weka-predated chicks were recorded on Taukihepa, and more than 30 over a similar time the following year. The details leave no doubt as to the tenacity of the culprit:

*"A juvenile weka was seen killing a sooty shear-water chick on Mokonui on 16 Mar 2005. At 1515 h, I was watching a weka foraging in tupare (*Olearia colensoi*) forest when it suddenly entered a burrow. The weka's back was still visible as it grabbed a sooty shearwater chick by the mantle and, obviously struggling, dragged the chick to the burrow entrance. The weka repeated this procedure 6-8 times, because the chick shuffled back down the burrow. After the last attempt, the weka began to strike the chick's head with its beak, raising itself up to full stretch on its toes and then swiftly bringing the point of its beak down on the back of the chick's head. After every 3-4 strikes, the weka pulled at the chick again, working it towards the burrow entrance."*

*"The sequence of pulling and striking was repeated c. 6 times, then the weka grabbed the chick by the tail and pulled it further out of the burrow. The weka struck the chick c. 30 more blows on the back of its head, by which time it was not moving very much. The weka then pulled the chick under some punui (*Stilbocarpa lyalli*) about 10 m away, stopping regularly to strike the chick's head in the same characteristic manner as before. After another 2-3 min of this 'plunge-hitting', the weka rolled the chick over, climbed on to its back, and began pulling at the chick's head to feed. When it had finished feeding, the weka walked away, inspecting burrows as it left. The whole episode lasted c. 15 min."*

Once, on Rakitū, and the hills of Aotea Great Barrier, seabirds were digging in the soil, creating habitat for lizards, tuatara and invertebrates.

Harper concludes that:

"…when populations of shearwaters decline below a few thousand individuals, colonies can become very vulnerable to extinction as a result of depredation by a few individual predators (Brothers 1984; Lyver et al. 2000; Jones 2002).

Photo: Jack Warden

Interior of Rakitu, showing the mix of vegetation cover on the island.

Populations of smaller petrels with restricted numbers or nesting distribution are more vulnerable to extirpation or severe declines as a result of weka predation (Falla 1948; Blackburn 1965)".

As noted elsewhere in this issue (see guest editorial), the implications of these observations are clear. The seabird species most likely to recolonise Rakitū all weigh less than the sooty shearwater chicks predated on Big South Cape - storm petrel (*Fregetta maoriana*), prion (*Pachyptila* spp.), diving petrel (*Pelecanoides urinatrix*), Cook's petrel (*Pterodroma cookie*), fluttering shearwater (*Puffinus gavia*) and little shearwater (Puffinus *assimilis*), all nesting on islands close to Rakitū. Grey-faced petrel (*Pterodroma macroptera*) has colonised one site on Aotea Great Barrier[5], apparently since rats were eliminated on Cuvier. Even these large birds are smaller than sooty shearwaters, so they too must be vulnerable to weka predation.

Rakitu – restoring a seabird ecosystem

Seabirds once nested everywhere on the New Zealand mainland coast, even well up into the mountains – millions of birds. A few mainland colonies remain – Hutton's shearwater (*Puffinus huttoni*) in the alpine zone of the Kaikoura Range, Westland petrel (*Procellaria westlandica*) in the forests of the Paparoa Range, black petrel (*Procellaria parkinsoni*) and Cook's petrel on Hirakimata (Mount Hobson) and Hauturu (Little Barrier Island) in the Hauraki Gulf.

Once, on Rakitū, and the hills of Aotea Great Barrier, seabirds were digging in the soil, creating habitat for lizards, tuatara and invertebrates. These colonies were bringing vast amounts of phosphates and nitrates from the marine zone (in droppings, disgorged fish, feathers, broken eggs, even dead birds) – their additions compensating for leaching losses and maintaining forest growth rates[6]. This has all gone from the mainland but can still be experienced on some off-shore Islands.

Rakitū could readily become such a seabird ecosystem, if it was weka-free.

Acknowledgements

Thanks to June Brookes for useful discussion and background information on this article and my guest editorial.

Notes

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[2] Forest and Bird, 2014. New Zealand Seabirds: Important Bird Areas and Conservation. The Royal Forest and Bird Protection Society of New Zealand, Wellington, New Zealand.
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Photo: Nadine Gibbs, DOC

North Island weka are classified by the Department of Conservation as 'At Risk-Recovering' and aren't considered Threatened. Since 2000, the subspecies has been released near Russell in Whirinaki Forest. A few thousand are found in the Opotiki-Motu region.

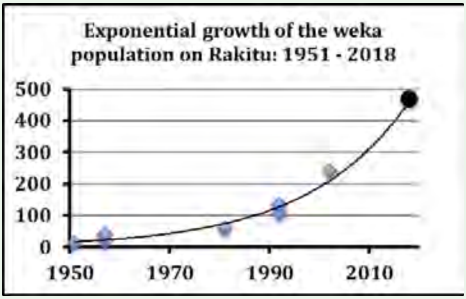
Weka, one species but four subspecies

The North Island weka introduced to Rakitu is one of four subspecies in New Zealand.

- **North Island weka** with strongholds on Russell Peninsula, Kawakawa Bay (Auckland) and the Opotiki-Motu region in the Bay of Plenty (At Risk-Recovering) .
- **Buff weka** (*G. a. hector*) is now found only on the Chatham Islands where it was introduced and is now plentiful, although is extinct in its natural distribution in the eastern South Island (At Risk-Relict).
- **Stewart Island weka** (*G. a. scott)* is largely confined to offshore islands around Stewart Island where it was introduced. On the main island, this subspecies has largely died out save for occasional reintroductions (Nationally Vulnerable).
- **Western weka** (*G. a. australis*) is relatively widely distributed on the West Coast, some populations being abundant, while others are sparse (Not Threatened).

Historically, weka was a significant resource for some iwi and also used by early European settlers, who gave it the name 'woodhen'.

If conditions are suitable, weka can breed prolifically, as seen on Rakitu since their introduction in the 1950s.



ENVIRONMENTAL NEWS FROM NEW ZEALAND & AROUND THE WORLD

Pāteke do well in Abel Tasman National Park

Abel Tasman National Park is now seen as an important site for the survival of pāteke brown teal with 233 individuals released there since 2017. The birds breed after the first year of release and unbanded, wild bred ducks have been regularly sighted. Further releases are planned.

Monitoring by Project Janszoon has found very low mortality amongst the birds, although there has been some road kill, also an issue on Aotea for this at-risk species.

Orange-fronted parakeet/kākāriki karaka bumper breeding

Kākāriki karaka is in the same threat category as the kākāpō and is our rarest mainland forest bird. It has one remaining mainland habitat, restricted to the beech forest of upland valleys in Lake Sumner Forest Park and Arthur's Pass National Park.

Photo: Department of Conservation

Juvenile orange fronted parakeet (kākāriki karaka).

With only 100-300 of these birds left in the wild, the captive breeding programme is providing a much-needed boost to the populations. This year was a bumper breeding season and despite the challenges of Covid-19, 2020 saw the release of over 30 young kākāriki karaka into Canterbury.

The species is one of New Zealand's six species of parakeet/kakariki. It's thought the different species once occupied discrete niches on the mainland and may explain their current status. For example, after predators arrived, red-crowned parakeets, being ground-feeders, were the most vulnerable and disappeared from mainland forests first—and are now mainly found only on predator free islands, and on Aotea! Orange fronted parakeets, being birds of the high canopy, hung on longer, and still persist in beech forest of high valleys in Canterbury.

Ridge to reef—Tetiaroa Atoll

The tiny Tetiaroa Atoll in French Polynesia is on a pathway to eradicating rats. Restoration on the motu will revive the terrestrial ecosystem to "near-pristine" condition, creating a major sanctuary for seabirds, sea turtles, and other native fauna and flora.

Extensive field research is planned by the Tetiaroa Society and Island Conservation to understand the impacts of invasive species removal on the environment. Tetiaroa will serve as a living laboratory to research and understand flows to seabirds, native vegetation, invertebrates, soil, and marine ecology. The research also aims to test if natural seabird colonies increase the health and resilience of coral reefs through fertilising effects of guano; and will

"...complement traditional Polynesian knowledge and help raise awareness of the importance of restoring natural land-sea connections for biodiversity conservation and sustainable human development".

Photo: Tetiaroa Society

Introduced rats are a major problem on Pacific islands. The rats thrive on coconuts but also eat seabird and turtle eggs and hatchlings, as well as invertebrates, and plants.

Seeds, rats, fire and forest regeneration

GEORGE PERRY—UNIVERISTY OF AUCKLAND

*Invasive mammals are well known for the destruction they have wreaked on New Zealand's endemic fauna. However, mammals also affect plants and hence regeneration. Mammalian herbivores browse palatable species and have been implicated in the collapse of populations of tree species such as kohekohe (*Dysoxylum spectabile*) and northern rata (*Metrosideros robusta*). Rats and other invasive mammals, such as possums, directly and indirectly compromise seed dispersal by predating dispersers and consuming fruit and seeds.*

Photo: G Perry

Rat gnawed miro seeds in beech forest, Nelson Lakes National Park

Rats and seeds

Seed dispersal is a key stage in the plant life-cycle because it is the only chance that plants have to 'move'. This movement is important as it helps genetic mixing and allows plants to respond to climate change. Plants have developed a range of dispersal adaptations including those for dispersal by animals ('zoochory').

In New Zealand prior to human arrival in the mid-thirteenth century, seeds were dispersed by a range of animals including birds (some of which like the moa and huia are extinct), reptiles and potentially wētā. More than 50% of New Zealand's vertebrates are involved in seed dispersal and about 33% of NZ plant species dispersed by animals[1]. As populations of these dispersers have declined, so too have the seed dispersal services they provided, which may ultimately contribute to regeneration failure due to a lack of seed supply (termed 'dispersal limitation').

Another effect of rats, but one that has received less attention than their direct predation effect, is the consumption of seeds In southern beech forests, seed predation is well documented because it triggers trophic cascades. Beech trees seed irregularly with some years seeing almost no seed and occasional years seeing very heavy seedfall ('mast years').

During mast years, the abundance of food leads to irruptions of mouse populations, followed by irruptions of mustelids and eventually high levels of predation on native birds and other fauna. This dynamic underpins the Department of Conservation's 'battle for the birds'. Mast seeding is less prevalent in northern forests (although some tree species do mast). So what are the effects of rats on seeds in northern ecosystems?

Impact of rats in northern New Zealand ecosystems

A study spanning a number of northern offshore islands[2] showed that kiore (*Rattus exulans*) significantly reduced the recruitment of 11 of 17 coastal tree species including kohekoke, parapara (*Pisonia brunoniana*), karo (*Pittosporum crassifolium*), tawapou (*Planchonella costata*) and nikau (*Rhopalostylis sapida*).

This reduction in recruitment can occur through predation of seeds and/or seedlings. For example, kiore eat the seeds, underground organs and leaves of nikau. Prior to human arrival, northern offshore islands, including Aotea, would have been home to dense colonies of burrowing seabirds. Once rats reduce the densities of these seabirds it appears that a more diverse range of plant species are able to establish driving what has been described[2] as "massive compositional changes and major alteration of ecosystem processes".

These dynamics have also been described in island ecosystems in other parts of the Pacific (e.g. Hawaii) and for some plant species (e.g. the Hawaiian hau kuahiwi (*Hibiscadelphus giffardianus)* rat control is a component of the recovery plan (there to increase fruit retention on the plant) even if not enough on its own for the species persistence[3].

Making it happen: the project details

Using an enclosure trial, Campbell and Atkinson[2] estimated the ratio between the expected and observed germination of seedlings of 10 plant species (Figure 1) and clearly demonstrated that a suite of species are adversely affected. Another study,[4] left seeds of 11 fleshy-fruited species in piles (simulating what happens after dispersal) with some protected from mammalian predators and others not. Very few (about 10%) of seeds were removed (whether predators had access or not) but more seeds were removed when mammalian predators could access them.

Seeds and fire

Even if it can be a bottleneck, seed dispersal is just one component of the forest regeneration process. In contemporary New Zealand landscapes, fire, seed predation, herbivory and invasive plants interact to hinder regeneration.

A computer (simulation) model based on data from Aotea[5], showed that interactions between fire and seedling predation can completely halt succession. In New Zealand shrublands and forests, young vegetation (e.g. mānuka shrubland) is naturally more flammable than older vegetation.

A computer (simulation) model based on data from Aotea, showed that interactions between fire and seedling predation can completely halt succession.

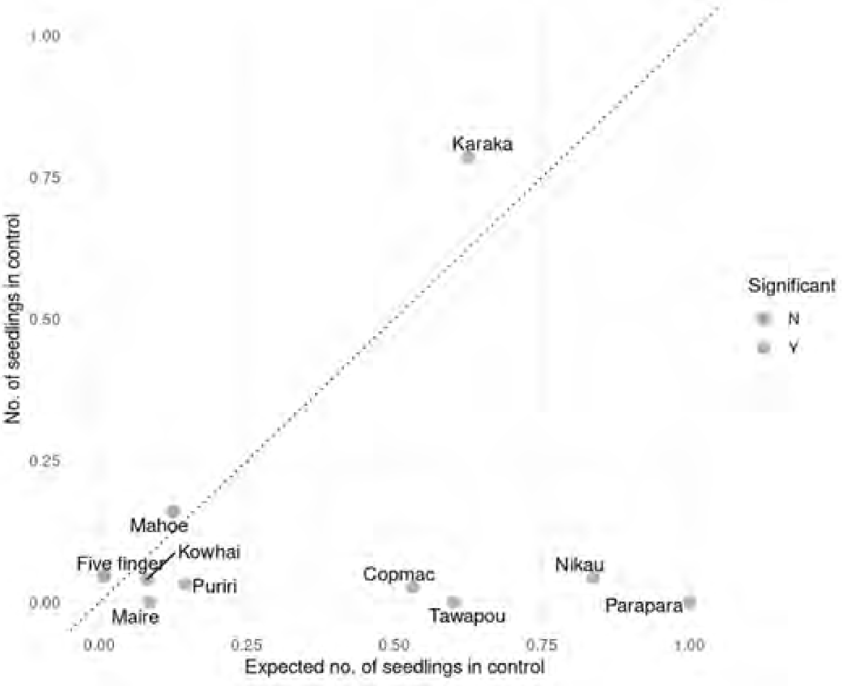


Figure 1: Based on an enclosure trial, Campbell & Atkinson[2] estimated the expected and observed proportion of seedlings that successfully germinated for 10 species potentially influenced by rat predation. Points above the dotted line indicate species that germinated more than expected in the presence of rats, and those below, less. The colour of the dots indicates whether the differences were statistically significant.

Thus, any process (e.g. seedling predation by rats, dispersal failure due to a lack of seed dispersers) that slows succession means the landscape spends longer in a vulnerable condition and is also susceptible to invasion by plant species favoured by fire (e.g. gorse). Each time a fire occurs, more forest burns and so the landscape falls into a 'trap'. There are some areas in this trap on Aotea, including the recent fire scar near the airport at Claris. So, as is usually the case in ecosystems, a number of processes interact through feedbacks to influence ecosystem composition and function (Figure 2).

Yellow flowering gorse is a common species on Aotea and is one species favoured by fire.

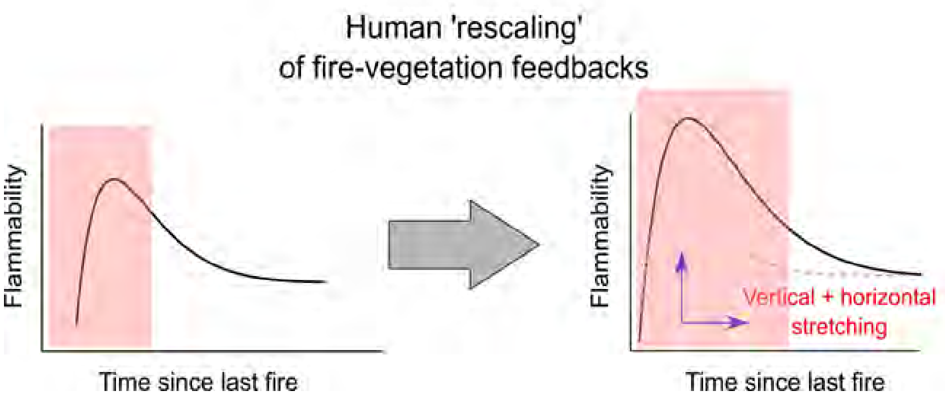


Figure 2: In New Zealand forests ,young vegetation is naturally more flammable than older vegetation and so there is a window (in red) in which fire risk is high. Over time, as the forest regenerates and composition changes, it becomes less flammable. Human activity has 'stretched' this curve so that regeneration is slower (e.g., through seed dispersal limits - 'vertical stretching') and so that the young vegetation is more flammable (e.g., through invasive weeds such as gorse – 'horizontal stretching').

As an aside

Finally, despite the deleterious effect that rats have had on New Zealand's ecosystems, they have had one scientific bonus. In 2008, Janet Wilmshurst and colleagues[5] used radiocarbon dating of kiore gnawed seeds (miro and hinau) to pin down the arrival of Maori in New Zealand! Their answer: c. 1280 AD.

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From the archives

The Claris fire scar—Ricki Taylor, University of Auckland (2017)

The 2013 fire at the Kaitoke dunes was an important event for the Barrier, burning through 116 hectares of regenerating scrub, putting much of Claris at risk, and requiring a large and expensive response by the fire service. But the fire also presented a valuable research opportunity.

My thesis, entitled 'Post-Fire Community Dynamics in a Disturbed Landscape, Great Barrier Island' aimed to take advantage of this opportunity, using it as a case study for the increasingly significant role fire is taking in New Zealand forests, especially where exotic fire-loving invasive plant species are present.

The initial aim of the research was to survey the post-fire vegetation at Claris to see if different plant communities had formed, and if so, to determine the main influences on the species that had become established.

The results show a range of distinct communities have regenerated across the fire scar area, from relatively uninvaded areas dominated by mānuka (*Leptospermum scoparium*) regrowth, to plant communities comprised almost exclusively of exotic invasive woody species, either pine species or brush wattle (*Paraserianthes lophantha*).

Mānuka and a range of sedge species emerging among standing remains of mānuka that burned in 2013. This is one of the least-invaded communities at the Kaitoke dunes.

The other major invasive species present included hakea (both *Hakea sericea* and *H. gibbosa*) and berry heath (*Erica baccans*), with gorse (*Ulex europaeus*), and Banksia species seen in lower numbers. Common to all of these invasive plant and tree species are fire-tolerant traits that gave them a competitive advantage following the fire.

A dense stand of brush wattle emerging beneath mature Pinus spp. within the Claris fire scar. In 2013, 116 hectares of regenerating scrub was burnt.

A secondary aim of the research was to determine the major influences on the establishment and composition of post-fire communities. The most influential factor was topographic position and the associated closeness of the surface to the groundwater table. For example, the mānuka-dominated community only occurred in low-lying areas inundated with water during winter. Alongside soil moisture soil nutrient levels were also influential, with high moisture and fertility associated with the most resilient areas where no invasive plants were found. Soil conditions of low moisture and fertility were consistent across the rest of the site, with the distribution of plant communities controlled mainly by the presence (or absence) of an invasive species prior to the fire.

Another aim was to assess change in community composition from before the fire, to two, and four years afterwards. This work revealed changes in the make-up of plant communities with important implications for the risk of future fire at the site.

Bats on Barrier?

EMMA WATERHOUSE

*Are bats on Aotea? Well yes, but very little is known about them. One of New Zealand's two species is definitely on the island, the long-tailed bat (*Chalinolobus tuberculatus*). The other, the lesser short-tailed bat (*Mystacina tuberculate*) has never been recorded on the motu, but was likely here before the arrival of humans.*

The long-tailed bat, or pekapeka, was recently reclassified as nationally critical. They inhabit the forest edge, feeding above the canopy, pasture margins, along streams at night, and sometimes in caves. Look out for them flying around at dusk.

There are sporadic records of its presence on Aotea, including from Miners Cove (Te Paparahi), although the first island wide survey wasn't carried out until 2004.

Island wide bat survey

According to Halema Jameson and associated records, the Department of Conservation carried out island wide bat surveys in 2004 and 2005. The survey targeted the long-tailed bat by walking one kilometre-long transects along the island's roads (including Kaiarara Forest Road) at night. Bat passes were recorded on a hand-held bat detector.

The data shows that long-tailed bats were recorded or seen in Okiwi, Fitzroy, Awana and Kaitoke transects, with the most records from Fitzroy followed by Okiwi.

Photo: C Morton

Long tailed bats (pekapeka) change roost trees each night and need plenty of large hollow trees to roost in such as those found in the Okiwi Reserve.

Automatic bat recorders were also placed in Te Paparahi in the Wreck Bay catchment to look for short-tailed bats, but none were detected.

Lesser short-tailed bats on Aotea?

At one time, lesser short-tailed bats are likely to have been common throughout Aotea. They are an important pollinator of the native wood rose (*Dactylanthus taylorii)*, New Zealand's only fully parasitic plant. Both the wood rose and the lesser short-tailed bat are now at risk of extinction.

Photo: J Osborne (Wikimedia Commons)

Short-tailed bats can roost communally with over a hundred individuals. Roost trees need to be large with significant hollows. This species has not been recorded on Aotea and, if present, is likely to be in areas of remaining old growth forest.

Short tailed bats are more likely to be found in larger old growth forest as they roost in large numbers and often use large old hollow trees. No comprehensive survey for short tailed bats on the island appears to have been completed - but if they do hold on in Aotea's forests, a good place to look might be Te Paparahi.

Thanks to Halema Jamison and Department of Conservation for providing information on the Aotea bat survey and past sightings.

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New Zealand’s bat species

New Zealand has two living species of bats, the lesser short-tailed bat and the long tailed bat*;* and one species which is thought to be extinct (greater short-tailed bat (*Mystacina robusta*)). Pekepeke (bats) have been around in New Zealand for a long time - for long-tailed bats over a million years ago when their ancestors came across from Australia. Short-tails were already ancient residents.

Bats are New Zealand’s only species of land mammal, using echolocation to find food and for navigation. These tiny animals emit rapid pulses of high-frequency sound, detecting sound as it bounces back from nearby objects. We are unlikely to hear bats, as most of their sounds are above the level of human hearing.

The natural habitat of bats is mature forest with many large hollow trees which are used as roosting sites, either alone or in colonies of up to 100. Bats are thought to live for up to 30 years and are known to hibernate, entering periods of torpor for up to 10 days, interspersed with periods of activity.

Lesser short-tailed bats

This ancient species endemic to New Zealand is found in a few scattered sites around the country. Three subspecies are recognised:

- Northern lesser short-tailed bat (At risk - recovering) - Northland and Hauturu Little Barrier
- Central lesser short-tailed bat (Nationally vulnerable) - Northland, central North Island
- Southern lesser short-tailed bat (At risk - declining) - Whenua Hou/Codfish and Fiordland.

Photo: Department of Conservation

Lesser short-tailed bat are the only species of bat in the world to forage on the ground, and the only species of small bat to carry out lek mating.

Weighing in at between 12 and 15 grams, these bats have adapted to hunting on the ground for insects, fruit, and pollen.

They are thought to be ‘lek’ breeders, with male bats congregating to compete for females by ‘singing’. As ground feeders, they are vulnerable to rats, cats and stoats.

Long-tailed bat

This species is nationally critical and is found in areas of the North and South Island, Stewart Island, Hauturu Little Barrier, Aotea Great Barrier and Kapiti Island. Smaller than the short tailed bat, this species weighs in up to 11 grams.

Photo: Department of Conservation

Long-tailed bats weight just 9-11 grams.

Long-tailed bats catch prey in the air, feeding on small moths, midges, mosquitoes and beetles.

The species forms complex social groups, frequently switching between roosting alone and roosting with a colony, often staying only one night at one location.

Long-tailed bats are more commonly seen than short-tailed bats as they fly at dusk along forest edges. They can fly at 60 km/hour and have a home range of up to 100 km^2. Have you seen any?

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