OPTIONS FOR ECOLOGICAL RESTORATION ON RAKINO ISLAND

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CONSERVATION, TRANSLOCATIONS, RESTORATION, RESEARCH, MANAGEMENT

CONTENTS

SUMMARY

Aotearoa New Zealand has experienced significant extinctions and declines in native and endemic species as a result of introduced predators and habitat loss. However, we are also recognised as world leaders in recovering and restoring species and ecosystems. The growth of community based conservation is a particularly exciting development as it expands restoration opportunities and actively engages and involves a broad swathe of the community, with many groups (>400) across NZ actively restoring their local ecosystems. Rakino Island (150 ha) is unique among community conservation opportunities in that the entire island is not under active restoration by a designated group. This is because the island is privately owned by multiple owners with each managing their property as they see fit. However, Rakino offers an incredibly unique opportunity to create an ecologically intact, beautiful and valuable island community where people can live and play, especially given its strategic location in the Hauraki Gulf relative to other protected islands. This plan describes options for ecological restoration on Rakino Island. The first option is to simply maintain the island as it is, especially maintaining the pest free status of the island. Under this option ecological change will be slow and incremental. The second option is to actively restore habitat on the island, primarily through planting species representative of an inner Hauraki Gulf Island. Planting large, diverse and well-connected vegetation will increase habitat for existing wildlife and attract new species to the island. Large scale planting will also increase the beauty of the island, reduce fire risk, provide resilience to drought, stabilise slopes and add value to individual properties. The third option for ecological restoration on Rakino Island is to reintroduce missing species, including terrestrial birds, invertebrates, reptiles and seabirds typical to an inner Hauraki Gulf Island. These three options are iterative, i.e. large scale habitat restoration via planting is dependent on maintaining the pest free status of the island and wildlife reintroductions are dependent on habitat restoration via planting. Ultimately, the direction of ecological restoration on Rakino Island is up to the local community and individual property owners.

1.0 INTRODUCTION

Aotearoa New Zealand has experienced significant extinctions and declines in native and endemic species as a result of introduced predators and habitat loss. However, we are also recognised as world leaders in recovering and restoring species and ecosystems. The growth of community based conservation is a particularly exciting development as it expands restoration opportunities and actively engages and involves a broad swathe of the community, with many groups (>400) across NZ actively restoring their local ecosystems.

Rakino Island (150 ha) is unique among community conservation opportunities in that the entire island is not under active restoration by a designated group. This is because the island is privately owned by multiple owners with each managing their property as they see fit. However, Rakino offers an incredibly unique opportunity to create an ecologically intact, beautiful and valuable island community where people can live and play.

The purpose of this plan is to highlight opportunities for ecological restoration on Rakino Island. The plan does not state what should happen but rather what could happen, depending on the objectives and desires of the Rakino community. Ecological restoration on Rakino might be undertaken collectively as a community, by groups of owners, or by individual owners.

The plan begins by very briefly describing the biodiversity on Rakino and the human history. It then presents three options for restoration on Rakino; 1) maintain the island as it is; 2) actively create and manage habitat to support existing wildlife and attract new species; 3) reintroduce missing wildlife species, including both terrestrial and seabird species. The appendices list plants and birds currently known from Rakino, recommended plants for revegetating the island, and further detail on wildlife species that might be returned to the island either via translocation or by passive attraction.

As stated earlier, the purpose of this plan is simply to describe the options, how they might be obtained, the challenges associated with each and the ecological system that might be achieved if they are enacted. The decision as to how ecological restoration is initiated on the island is for the Rakino community alone. However, it should also be recognised that active ecological restoration will provide benefits beyond simply more plants and birds. It will increase the beauty of the island, reduce fire risk, provide resilience to drought, stabilise slopes and add value to individual properties.

2.0 RAKINO ISLAND BIODIVERSITY

The original fauna and flora that was present on Rakino is unknown. However, it is highly likely that it was covered in a coastal broadleaf forest with a few mixed conifer species, this vegetation association being common to most inner Hauraki Gulf Islands. The fauna would

have been dominated by extensive burrowing seabird colonies, including fluttering shearwaters (*Puffinus gavia*), common diving petrels (*Pelecanoides urinatrix*), white-faced storm petrels (*Pelagodroma marina*) and Pycroft's petrels (*Pterodroma pycrofti*). The seabird colonies would in turn have supported an abundance of invertebrates, including large flightless weta, weevils and beetles, along with a diverse reptile community, including tuatara (*Sphenodon punctatus*) and Duvaucel's gecko (*Hoplodactylus duvauceli*). There would also have been some forest birds present, likely including kākāriki (*Cyanoramphus* spp.), kākā (*Nester meridionalis*) and tīeke/North Island saddleback (*Philesturnus rufusater*).

Most of the original fauna and flora has been lost since human settlement and the island is now primarily covered in rank kikuyu (*Pennisetum clandestinum*) grassland. However, around 70 species of plants have been recorded on Rakino in recent times, including exotic species. Burrowing seabirds are no longer known to be present on the island, although they could be present in very low numbers on islets and headlands. Some seabirds still roost on the island, particularly in Home Bay, including white-fronted terns (*Sterna striata*) and variable oystercatchers (*Haematopus unicolor*). Blue penguins (*Eudyptula minor*) might possibly still use inaccessible coastal areas. The invertebrate fauna is completely unknown but copper (*Cyclodina aenea*), moko (*Oligosoma moco*) and shore skinks (*Oligosoma smithi*) have persisted in small numbers. The bird fauna is characterised by common native and exotic species, with the notable exception of the recent recolonisation by bellbirds (*Anthornis melanura*), banded rails (*Gallirallus philippensis*) and spotless crakes (*Porzana tabuensis*), likely a result of the eradication of Norway rats (*Rattus norvegicus*) in 2002. An additional important factor in the recolonisation of Rakino by native fauna and flora is its fortuitous location in the Hauraki Gulf, i.e. the island is surrounded by other islands undergoing various levels of ecological restoration that might in turn act as source populations for Rakino if suitable habitat is available (Figure 1). All introduced mammalian pests have been eradicated from Rakino but companion dogs, and a small number of companion cats, are present.

3.0 THE HUMAN HISTORY OF RAKINO ISLAND

Prior to European contact various iwi and hapū associated with the greater Hauraki Gulf would have used Rakino Island, although detailed information on Māori use is scarce. Following European contact the island was owned by Sir George Grey (1862), Albert Sanford (leased 1874-1963) and Dr Maxwell Rickard (1963-1965). Rakino was subdivided in 1965 into 25 ten acre blocks and 125 smaller parcels of land. There are currently 76 houses on the island, but most are used as holiday homes with few permanent residents. There are no services or shops on the island but there is a passenger and freight wharf in Sandy Bay.

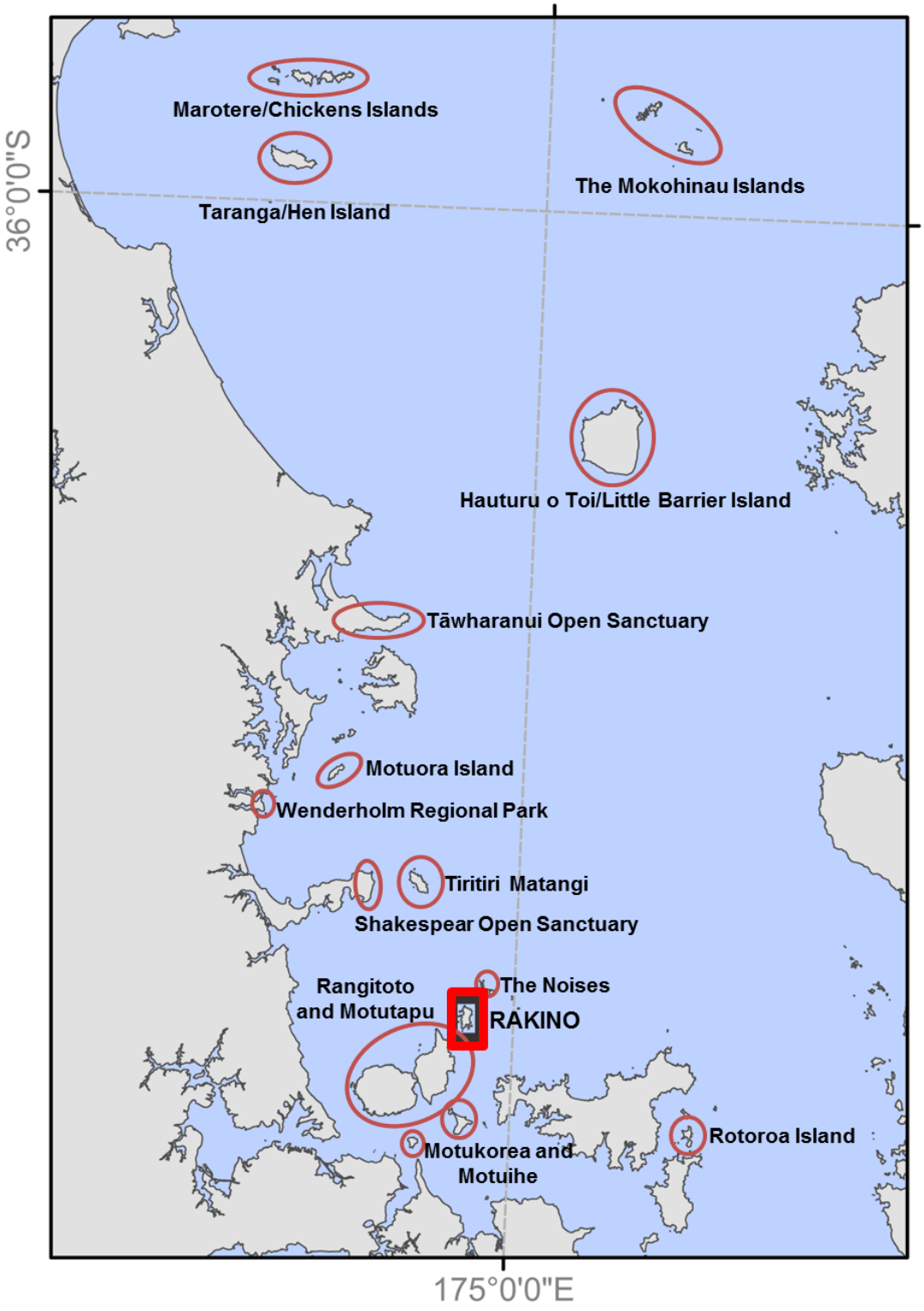

Figure 1. Rakino Island (the red box) relative to other protected islands and headlands in the Greater Hauraki Gulf (red ellipses). These islands are all potential sources for wildlife that might colonise or visit Rakino.

4.0 RESTORATION OPTIONS FOR RAKINO ISLAND

Given the existing biodiversity on Rakino, the location of the island relative to other Hauraki Gulf biodiversity hotspots (Figure 1), and interest within the Rakino community, there are three main options for ecological restoration on the island; 1) maintain the island in its present state; 2) enhance existing biodiversity on the island through active planned ecological restoration, primarily by creating habitat through planting; 3) reintroduce locally extinct wildlife. These options are iterative, i.e. active ecological restoration via planting will depend on maintaining the island in its present state and reintroducing locally extinct wildlife will be dependent on active ecological restoration via extensive planting.

4.1 *Maintain Rakino Island in its present state*

The simplest option for Rakino is to maintain the island in its present state. The most critical aspect of this option is to prevent reinvasion by rats (*Rattus* spp.) and avoid the introduction of any new pests. This is because the establishment or reestablishment of introduced pest species on Rakino could cause the local extinction of native species, reduce existing biodiversity and prevent the recolonisation of native species from other islands in the Hauraki Gulf. Keeping weeds and pests off Rakino also contributes to biosecurity within the greater Hauraki Gulf by reducing the risk of reinvasion on other islands, especially those immediately adjacent to Rakino. In addition to ecological impacts, introduced pests would also be significant household and garden pests, i.e. annoying and expensive for the Rakino community to deal with.

Therefore, all Rakino residents must be constantly aware of pests, especially when moving between the island and the mainland. Island residents must be especially vigilant for plague skinks (*Lampropholis delicata*), argentine ants (*Linepithema humile*), mice (*Mus musculus*), rats and new weed species. Collectively, these are the most likely invaders as they can stow away relatively easily on small boats and in materials transported to the island, especially building materials, landscape supplies, foodstuffs and live plants. The ongoing regular maintenance and checking of a robust pest detection network (traps, bait stations, tracking tunnels and chew cards) is essential as this is the first line of defence in dealing with any incursions, especially at the wharf and around houses.

There are no particular challenges associated with this option beyond maintaining current island protocols and current island life. Existing biodiversity might slowly increase as planted areas on the island mature and new areas are planted but ecological change will be relatively slow.

4.2 *Enhance existing biodiversity on Rakino Island*

The second option on Rakino Island is to enhance existing biodiversity through active ecological restoration, i.e. creating and managing habitat through planting. High quality habitat provides everything that plants and animals need for long term persistence. This includes all physical (e.g. climate, aspect, altitude, soil type) and biological (e.g. predators, competitors, vegetation associations, prey species, parasites, landscape connectivity) aspects of the areas where they live (Hall et al. 1997). In addition, larger habitats are usually better than smaller habitats. This is simply because large habitats support larger populations and larger populations are more likely to persist over long time scales, i.e. they are resistant to factors such as pest incursions, disease outbreaks, extreme weather events and loss of genetic diversity (Caughley & Gunn 1996).

The current habitat on Rakino Island is of sufficient quality to sustain existing wildlife and to permit the recolonisation of at least three species (bellbirds, spotless crakes and banded rails). An additional species, the red-crowned kākāriki (*Cyanoramphus novaezelandiae*), is visiting the island but only in very small numbers (2-3 birds), and it is unclear if they are actually resident and breeding on the island. These species, along with other residents and visitors such as tui (*Prosthemadera novaeseelandiae*) and kereru (*Hemiphaga novaeseelandiae*), can be supported by enhancing and increasing the amount of habitat on Rakino. There are several ways to achieve this (Table 1) with two concepts being particularly important. The first is to plant a diverse range of native species that flower, fruit and seed throughout the year so that the resources that animals need are always available on Rakino. There are many plants to choose from but ultimately the Rakino plant community should comprise native plants typical to a Hauraki Gulf island coastal broadleaf forest (see Appendix 8.3 for a list of potential species, including a description of flowering, fruiting and seeding times. The list of suggested species is not exhaustive and further options exist, particularly for additional small and threatened plants). These plants are most likely to thrive as they are adapted to local conditions, with plants sourced and propagated on Rakino, or from adjacent islands and headlands (Figure 1), even more likely to succeed. It is also important to recognise that habitat restoration does not necessarily mean planting a forest. Many species, especially invertebrates, lizards and ground dwelling birds will make use of low, but dense, ground cover vegetation, including muehlenbeckia (*Muehlenbeckia complexa*), rengarenga (*Arthropodium cirratum*) and flax (*Phormium tenax*) thickets. In addition, there are several small threatened plants that are extremely rare on the mainland but which might thrive on Rakino Island.

The second way to enhance habitat is to plant very large areas, with the ideal size simply being as large as is possible (tens of hectares). These areas should also be connected together as much as is practicable with vegetated corridors. Planting large areas, and then ensuring they are connected with other plantings, and the coastal fringe, creates an ecological network

that supports large populations of native plants and animals and facilitates movement around the island.

The easiest way to enact planting and increase habitat on the island would be to formulate a planting plan for the entire island. Rakino is unique in that most of the island is privately owned and individual landowners decide how their properties are managed according to their own objectives, tastes and desires. However, this is not incompatible with ecological restoration on Rakino Island as the same principles for habitat creation apply in formulating plans for individual properties (Table 1). Many landowners will want to maintain views and light, both of which are easily achieved by selecting the appropriate species, e.g. low growing shrubs and vines instead of larger trees on view lines (see appendix 8.3). It is also important to recognise that the choice of species is very large with a great diversity of colour, growth form, flowers, fruit and seed possible throughout the year.

Table 1. Guidelines for restoration planting on Rakino Island. See appendix 8.3 for a list of potential species, including a description of flowering, fruiting and seeding times and maximum height.

1. Plant a diverse range of native plants typical to a Hauraki Gulf Island coastal broad leaf forest (see Appendix 8.3)
2. Plant as large an area as is practicable at a spacing that allows for the formation of a canopy, regardless of the final height of the canopy (generally 1-2m spacing between plants, depending on the species, site and planting objectives)
3. Choose species that will provide food, shelter and nest sites for wildlife year round
4. Connect planted areas with vegetated corridors (even a single line of shrubs and trees is better than an open expanse of grass)
5. Where necessary plant species that maintain views and light
6. Where possible plant local Rakino sourced and propagated plants, or plants from adjacent islands and headlands.

There are no particular challenges associated with this approach as individual property owners can decide on the extent to which they want to engage with planting for ecological restoration. If an island wide plan cannot be agreed upon then an alternative might be for individual property owners to collaborate in forming planting plans, especially for adjacent properties. There might be economies of scale in taking this approach, i.e. bulk discounts when purchasing plants and shared labour resources for planting them. Even if planting only proceeds at the level of individual property owners a strategic approach, i.e. as diverse as is possible, as large as is possible and as connected to neighbouring properties as much as is possible, will contribute to the ecological restoration of Rakino Island (Table 1).

By creating more extensive native plantings on Rakino Island local plant and animal populations will increase and, as a result of larger population sizes, be more stable and secure, i.e. more likely to persist over the long term (decades to centuries). They will also become more conspicuous to island residents and visitors, thereby adding diversity and interest to the Rakino experience. Large diverse habitats also encourage the restoration of ecosystem processes such as natural revegetation via pollination and local dispersal, e.g. bellbirds are important pollinators and kereru are one of the few species that can eat and disperse large native fruits. Large diverse habitats are also more likely to encourage new species to visit and establish on the island, for example red-crowned kākāriki, kereru, pateke (*Anas chlorotis*) and tomtits (*Petroica macrocephala toitoi*) (Figure 1). In addition to the immediate ecological benefits large scale plantings are aesthetically pleasing, add value to individual properties, stabilise slopes and hills, provide more resilience to drought through the provision of shade, especially for watercourses, and reduce fire risk relative to large areas of rank kikuyu grassland.

An additional aspect of habitat management that the Rakino Island community could consider is the management of domestic dogs and cats on the island. Free ranging dogs (*Canis domesticus*) and cats (*Felis catus*) can have a considerable impact on native wildlife, especially ground dwelling species, roosting shorebirds, recolonising species and reintroduced species. Dogs are clearly valued companions for many people on the island so the best management is to simply keep dogs under control rather than let them wander at will, which is what most dog owners on Rakino currently do. The community might also give consideration to setting aside important bird areas by restricting dog access. For example, Home Bay is an important roost and feeding site for variable oystercatchers and white-fronted terns with a threatened New Zealand dotterel (*Charadrius obscurus*) also recently seen there (October 2017). Excluding dogs, or making these areas leash only, would improve them as habitat for roosting and feeding birds.

A small number of companion cats are currently on Rakino. While cats are valued pets to some people they are also very problematic for native and endemic birds, reptiles and invertebrates, especially when these species are at low numbers following recolonisation or reintroduction. Consideration could be given to not replacing the existing Rakino cats when they die. However, if the community decides that they are happy for individual property owners to have cats on the island there must be implicit recognition of the incompatibility of cats with many aspects of ecological restoration. This will be especially acute for ground nesting species, recolonising species and several species that might be considered for reintroduction (see below). If the Rakino community decides that cats can be on the island consideration should be given to requiring them to be contained on the cat owner's property, either as house cats or with large outdoor runs or "catios" (a Google search for "catio" will bring up many different designs).

4.3 *Reintroduce locally extinct wildlife to Rakino Island*

Assuming that Rakino can be maintained as a pest free island (see 4.1), that the amount of habitat can be increased in diversity and size (see 4.2), and that domestic pets can be managed in an appropriate manner (see 4.2), wildlife reintroductions might be possible on Rakino.

4.3.1 *Reintroductions in Aotearoa New Zealand*

Reintroduction has played an integral role in New Zealand conservation, particularly in the recovery of iconic species such as the Chatham Island black robin (*Petroica traversi*) (Butler & Merton 1992), kākāpō (*Strigops habroptilus*) (Powlesland et al. 2006) and saddleback (*Philesturnus* spp.) (Lovegrove 1996). Early reintroductions were focused on saving critically endangered species whereas increasingly reintroductions of species in lower threat categories, such as popokatea/whiteheads (*Mohoua albicilla*), are being carried out as a component of ecological restoration. Critically, reintroductions are increasingly conducted by local community based conservation groups rather than being the sole domain of conservation professionals (Parker 2008). This tremendous growth in community and private land owner initiated ecosystem restoration projects is providing many opportunities, and a great demand, for reintroductions of native and endemic species. This growth is positive as it increases conservation management, research and advocacy opportunities (Parker 2008). However, a decision to reintroduce any species requires extensive research, planning, and resources to maximise the likelihood of success.

All proposals to reintroduce native and endemic fauna and flora require assessment and approval by the Department of Conservation (DOC), and support from iwi/hapū, and other interested parties, at the source and release site. The initial process involves informal discussion with local DOC staff to gauge their support for a proposed translocation. Assuming no significant objections, a translocation outline can then be prepared. This is a short document that briefly describes the purpose, planning context, release site, history of the species at the release site, potential source populations, consultation, methodology and the translocation team. Consultation is an especially important step in gaining the support of iwi, hapū and other stakeholders at the source and release site.

If support in principle is given by DOC a full translocation proposal can be submitted. This elaborates and expands on the information given in the outline proposal. It requires a lot of detail (c. 20-30 pages) and can be labour intensive to complete. However, this process forces careful consideration of all elements of a successful translocation. This includes a description of the project team, the methodologies that will be used, and the overall reason and objectives for the translocation. A detailed description of the current management of the proposed release site, and an indication of the long term security of the site, is essential. This is because

translocated species will only persist if the reasons for their initial local extinction are identified and addressed.

Obviously the release site has to provide suitable habitat for the needs of the translocated species, along with sufficient area for a genetically viable population to establish. Assessment of supportive management (e.g. the provision of nest boxes or supplemental food), and the impact of the species on those already present at the release site, or on species that might be reintroduced at a later date, are additional important considerations.

A suitable source population or populations must be identified when planning a translocation. Clearly, a source population must be able to sustain a harvest of individuals for translocation with minimal impact on the source population itself. The genetic history of the source population should also be well documented, i.e. populations that have undergone bottlenecks over extended periods are not generally suitable as sole source populations. The logistics associated with accessing and capturing individuals at the source site, along with the potential for transmission of novel pathogens or disease, must also be carefully assessed.

4.3.2 *Reintroductions on Rakino Island*

The great advantage of Rakino Island is that several species typically thought of as reintroduction candidates can recolonise the island, e.g. red-crowned kākāriki and some seabirds. However, there are some species that cannot naturally recolonise the island. For these species, reintroduction is the only option. As described above, for reintroduction to succeed the needs of the reintroduced species must be met by the release site. Most reintroduced species are vulnerable to introduced predators. However, the key pest species, with the exception of cats, are absent on Rakino. The next important aspect of reintroduction success is large and diverse vegetated habitat. The vegetated habitat on Rakino is currently quite limited and fragmented. However, with large scale plantings it could be increased in a relatively short time (10-20 years; see section 4.2). Reintroduction options for Rakino include terrestrial species, such as bush birds and reptiles, and seabirds with a terrestrial breeding phase.

4.3.3 *Terrestrial reintroductions to Rakino Island*

Of the species listed below only one, the New Zealand falcon (*Falco novaeseelandiae*), is capable of naturally recolonising Rakino. All of the others will only establish on the island following reintroduction. Most will also require a greater area of habitat than is currently present on Rakino to establish large populations that are likely to persist over the long term (see section 4.2).

Whiteheads and North Island fernbirds (*Bowdleria punctata vealeae*) would likely be the first birds translocated to Rakino. Whiteheads have diverse diets and can reach very high densities

in relatively small patchy habitats (c. 50 ha of scrubby and/or forested habitat). North Island fernbirds can also reach high densities. They need very densely vegetated habitats but will use a wide variety of low vegetation associations, including thick rank grassland, muehlenbeckia thickets and bracken (*Pteridium esculentum*) stands. If forested habitat can be further increased (≥100 ha) tīeke/North Island saddlebacks (*Philesturnus rufusater*) and titipounamu/rifleman (*Acanthisitta chloris*) might then be considered.

The invertebrate and reptile translocation candidates suggested for Rakino are an interesting group for two reasons. First, some of them might still be on the island, albeit in very low numbers, e.g. the raukawa gecko (*Woodworthia maculatus*). Therefore, extensive site survey is required before planning any translocations of these species. Second, they are often overlooked as restoration candidates, even by the conservation community. This is because invertebrates and lizards are usually thought of as unattractive and secretive. However, on close inspection most species are very beautiful. Many are secretive but when they reach high densities they become much more apparent to the casual observer. As an example, raukawa geckos on Tiritiri Matangi escaped detection for several decades before rediscovery in 2004 (Baling et al. 2013). Some species are quick to dash to cover but are easily observed on warm days when they are out basking, especially when they reach high density.

Of the reptiles, the species listed under heading three in table two are all reasonably common and source populations are located within the greater Hauraki Gulf area, including salvage animals following destruction of habitat for development. Ornate skinks (*Cyclodina ornata*), raukawa geckos and Pacific geckos (*Dactylochnemis pacificus*) are all secretive and seldom observed at low population densities but, as described above, can become very abundant and obvious in protected habitats.

Table 2. Summary of terrestrial species assessed as potential candidates for translocation to Rakino Island. See Appendix 8.4 for a full description and the translocation requirements of each species (species not considered suitable for Rakino are not listed in Appendix 8.4).

Translocation requirements	Species
1. Suitable for translocation to Rakino if there is ≥50 ha of connected, diverse native vegetation (whiteheads), or dense ground cover vegetation, including rank grassland, (North Island fernbirds) and free-ranging cats are excluded from the island.	Popokatea/Whiteheads Matata/North Island fernbird
2. Suitable for translocation to Rakino if there is ≥100 ha of connected, diverse native vegetation and free-ranging cats are excluded from the island.	Tīeke/North Island saddlebacks Titipounamu/North Island rifleman[1]
3. Suitable for translocation to Rakino following extensive site survey to confirm current absence from the island. Site specific survey by species experts will then be required to confirm that sufficient habitat is present for establishment of a large population (100s of individuals - additional habitat might be required for these species). Free-ranging cats must be excluded from the island if reptiles are reintroduced to Rakino.	Native invertebrates (e.g. Wetapunga/giant weta, flax weevil and Darkling beetle) Pacific gecko Matua gecko Ornate skink[2]
4. Rare and threatened species that are possible long-term (≥20 years) translocation candidates following the establishment of at least 50-100 ha of connected, diverse, native vegetation, the exclusion of free-ranging cats, site assessment by species experts and support from the Department of Conservation Lizard Technical Advisory Group.	Northern Tuatara Duvaucel's gecko Hauraki skink[2]
5. Not suitable for translocation to Rakino due to the small size of the island and/or a lack of suitable habitat, the presence of dogs, and predatory impact on other species on the island.	Little spotted kiwi[3] North Island brown kiwi[3] Pateke[3] Takahe[3] Toutouwai/North Island robin[3] Hihi[3] North Island kokako[3] North Island weka[3] New Zealand falcon[3]

[1]*The outcome of the NI rifleman translocation to Tiritiri Matangi will be critical in deciding if translocation to Rakino is sensible*

[2]*The compatibility of these two species within a single site is unclear*

[3]*These species are not considered further in this plan*

4.3.4 *Seabird restoration on Rakino Island*

There are c. 400 species of seabirds and NZ has the highest global seabird diversity with 85 species breeding here (Heather & Roberton 2015). Seabirds are critical to marine and terrestrial ecosystems because they play a key role in nutrient cycling between these ecosystems. Terrestrially, seabirds act as importers of marine nutrients (Hawke & Holdaway 2005) and as habitat modifiers, particularly by digging burrows. This has resulted in higher invertebrate biomass and diversity on islands with seabirds relative to those without seabirds (Markwell & Daugherty 2003), and greater species richness in vegetation communities.

Unfortunately seabirds are one of the most threatened bird groups in the world, with nearly half of all species known or suspected to be declining (Croxall et al. 2012). Mammalian predators, habitat loss and excessive exploitation of seabirds for human harvest have caused the loss of most NZ seabird colonies present prior to human colonisation (Tennyson & Martinson 2006). Many species have survived on islands free of introduced predators but contemporary threats include incidental mortality of seabirds in commercial and recreational fisheries, direct competition with fisheries for food, pollution and climate change (Gremillet & Boulinier 2009; Croxall et al. 2012; Sigler 2014; Gremillet et al. 2015; McConnell et al. 2015). A significant additional challenge for the conservation management of seabirds is that many species have international lifestyles, i.e. they might breed in NZ but range widely across international waters when feeding. This exposes them to threats that NZ has no control over, particularly fisheries bycatch.

Seabirds are often neglected in NZ restoration projects. This is because seabirds are typically out of sight and out of mind but it is equally surprising because of their crucial role in island ecosystems such as Rakino. Seabird restoration also provides an invaluable advocacy opportunity. Therefore, helping Rakino residents and visitors become more aware of seabirds will encourage support for the conservation of seabirds, especially through observation of large rafts of petrels waiting on the water to come ashore to Rakino after dusk and hearing their calls overhead at night.

Seabirds can be established via natural recolonisation, passive attraction (attraction by playing calls and/or providing artificial burrows and putting out decoys (for gannets)) and/or direct translocation of pre-fledging chicks that are then fed an artificial diet in burrows until fledging (Miskelly et al. 2009). Depending on the target species it may take several decades for successful establishment of seabirds via these methods. This is because many species are slow maturing (5-11 years) and chick return rates are low (25-50%) (Department of Conservation 2014).

Of the seabirds that might have persisted in low numbers, or recolonised Rakino, grey-faced petrels (*Pterodroma macroptera*), diving petrels and fluttering petrels are the most likely species. This is because they are present and breeding within the Hauraki Gulf, they have

recolonised several sites (e.g. Tāwharanui and Shakespear Open Sanctuaries) and they would be relatively easy to overlook at low numbers on isolated headlands and slopes. Therefore, seabird surveys by a trained seabird dog and handler should be carried out on Rakino headlands, slopes and islets prior to any active restoration of seabirds on the island.

If no or very few seabirds are discovered on Rakino passive attraction might be attempted with a call-play-back system that broadcasts appropriate seabird calls out to sea at the correct time of year. Call-playback systems and artificial burrows are an affordable method to assist seabird restoration relative to seabird translocations. Seabirds within range of the broadcast calls during the prospecting phase of their breeding cycle might investigate what sounds like an active seabird colony. They are normally highly faithful to their breeding sites but some non-breeding birds may colonise new areas, including those where artificial calls are broadcast. If the calls are broadcast from areas that meet the nesting requirements of the target species (possibly enhanced with the provision of artificial burrows) some birds may eventually mate and breed there. Within the Hauraki Gulf seabird call-playback systems are being used at several sites, including Tāwharanui Open Sanctuary, Motuora Island, Rotoroa Island and Motuihe Island. Therefore, to avoid competition for birds between sites consultation with seabird experts, and other site managers, will be required prior to establishing a playback system on Rakino.

An alternative to passive attraction is to translocate seabirds to Rakino. Seabird translocation techniques have been successfully developed for ten New Zealand burrowing seabird species and these techniques are likely to have broad application for other species (Imber et al. 2003; Miskelly et al. 2009; Gummer et al. 2014). Translocation essentially involves an initial trip or trips to locate active burrows at the source location that can be accessed for harvest. On a subsequent trip, chicks of a suitable age are collected, transferred to artificial burrows at the release site and given intensive pre-fledgling care (Imber et al. 2003; Miskelly et al. 2009; Gummer et al. 2014). This is typically repeated over several breeding seasons. Therefore, seabird translocations represent a significant investment of personal and financial resources as suitable experienced personnel have to be employed to ensure successful translocation outcomes (Imber et al. 2003; Miskelly et al. 2009; Gummer et al. 2014). The seabirds listed in table three and Appendix 8.4 are possible candidates if passive attraction and/or seabird translocations are attempted on Rakino.

Table 3. Summary of seabird species assessed as potential candidates for translocation to Rakino. See Appendix 8.4 for a full description and the translocation requirements of each species.

Translocation requirements	Species
1. Currently suitable for passive attraction or translocation to Rakino, assuming protection from wandering dogs, the absence of free-ranging cats on Rakino, and coordination with other sites within the Hauraki Gulf	Grey-faced petrel Fluttering shearwater Common diving petrel Australasian gannet
2. Possible translocation to Rakino if the above species successfully establish and suitable/sufficient habitat is available	Little Shearwater White-faced storm petrel Pycroft's petrel

5.0 CONCLUSIONS

Rakino Island can simply be maintained in its existing state by ensuring that introduced pests do not reinvade the island. Ecological change will be relatively slow, but the island will retain some species that are rare or absent on the Auckland mainland, e.g. bellbirds, spotless crakes and banded rails. Alternatively, new habitat could be created and maintained on Rakino by active planting of species typical of a Hauraki Gulf island. This will enhance and increase existing wildlife and possibly attract new wildlife to the island. It will also make the island more beautiful, stabilise slopes, reduce fire risk, increase drought resilience and add value to properties. If more habitat is created on Rakino wildlife species that once existed on the island might be reintroduced, including terrestrial birds, invertebrates and reptiles, along with Hauraki Gulf seabirds. This would create a unique island community whereby people live alongside some of Aotearoa New Zealand's beautiful wildlife. The direction that ecological restoration might take on Rakino Island is now in the hands of the Rakino Island community.

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8.0 APPENDICES

8.1 *Rakino Island plant list*

The following Rakino Island plant species list is from Willmott (2002) and is likely incomplete.

Native/exotic	Species name	Maori name	Common name
Native	*Adiantum cunninghamii*	Puhinui	Common maidenhair fern
Native	*Apium prostratum*		Native celery, shore parsley
Exotic	*Araucaria heterophylia*		Norfolk pine
Native	*Arthropodium cirratum*	Rengarenga	Rock lily
Native	*Asplenium flaccidum*	Makawe	Hanging spleenwort
Native	*Asplenium haurakiense*	Raukatauri	Hanging spleenwort
Native	*Asplenium lamprophyllum*	Petako	Sickle spleenwort
Native	*Asplenium oblongifolium*	Huruhuru whenua	Shining spleenwort
Native	*Astelia banksii*	Wharawhara, horahora	Coastal astelia
Native	*Blechnum* spp. 1	Kiokio	
Native	*Brachyglottis repanda*	Rangiora	
Native	*Coprosma lucida*	Karamu	Shining coprosma
Native	*Coprosma arborea*	Mamangi	
Native	*Coprosma repens*	Taupata	Creeping coprosma
Native	*Coprosma robusta*	Karamu	Stout-leaved coprosma
Native	*Cordyline australis*	Ti kouka	Cabbage tree
Native	*Corynocarpus laevigatus*	Karaka	
Exotic	*Cupressus macrocarpa*		Macrocarpa, Monterey cypress
Exotic	*Cupressus sempervirens*		Pencil pine
Native	*Cyathea dealbata*	Ponga	Silver fern
Native	*Cyathodes juniperina*	Mingimingi	Prickly heath
Native	*Cyathea medullaris*	Mamaku	Black tree fern
Native	*Disphyma austale*		
Native	*Doodia media*	Pukupuku	Rasp fern
Native	*Dysoxylem spectibile*	Kohekohe	
Native	*Einadia triandra*		
Native	*Entelia arborescens*	Whau	
Native	*Griselinea littoralis*	Kapuka	Broadleaf
Native	*Hebe stricta*		Hebe
Native	*Isolepis nodosa*		Knobby clubrush
Native	*Juncus australis*		Native rush
Native	*Juncus gregiflorus*		Native rush
Native	*Leptospermum scoparium*	Manuka	Tea tree
Native	*Linum monogynum*		
Exotic	*Lycium ferocissimum*		
Native	*Macropiper excelsum*	Kawakawa	
Native	*Melicytus ramifloris*	Mahoe	Whiteywood
Native	*Melicope ternata*	Wharangi	
Native	*Metrosideros excelsa*	Pohutukawa	
Native	*Muehlenbeckia complexa*	Pohuehue	Wire vine
Native	*Myoporum laetum*	Ngaio	
Native	*Myrsine australis*	Mapou	
Exotic	*Olea europaea*		Common olive
Native	*Olearia paniculata*	Akiraho	
Native	*Paesia scaberula*	Matata	Ring fern

Exotic	*Pennisetum clandestinum*		Kikuyu grass
Native	*Peperomia urillaena*		
Native	*Phormium tenax*	Harakeke	NZ flax
Native	*Phymatosorus diversifolius*	kowaowao	Hound's tongue fern
Native	*Pimelea* spp.		
Exotic	*Pinus radiata*		Radiata pine
Native	*Pisonia brunoniana*	Parapara	
Native	*Pittosporum crassifolium*	Karo	
Native	*Podocarpus totara*	Totara	
Native	*Pouteria costata*	Tawapou	
Native	*Pseudopanax lessonii*	Houpara	
Native	*Ptendium esculatentum*	rahurahu	Bracken fern
Native	*Pteris tremula*	turawera	Shaking brake
Native	*Pyrrosia eleagnifolia*	Ngarara wehi	Leather-leaf fern
Exotic	*Rhamnus alaternus*		Evergreen buckthorn
Native	*Rhopaostylis sapida*	Nikau	
Native	*Sarcocornia quinqueflora*		Glasswort
Native	*Senecio lautus*		Shore groundsel
Native	*Solanum laciniatum*	Poroporo	
Exotic	*Solanum linnaeanum*		Apple of Sodom
Exotic	*Solanum mauritianum*		Woolly nightshade
Native	*Sophora microphylla*	kowhai	
Exotic	*Stenotaphrum secundatum*		Buffalo grass
Native	*Tetragonia trigyna*		Iceplant/NZ spinich
Exotic	*Ulex europaeus*		Gorse
Native	*Vitex lucens*	puriri	

8.2 *Rakino Island bird list*

The following list is almost certainly incomplete and does not include seabirds that commonly occur on the waters immediately surrounding Rakino.

Brown quail *Coturnix ypsilophora*
Paradise shelduck *Tadorna tadornoides*
Mallard *Anas platyrhynchos*
Blue penguin *Eudyptula minor*
Whitefaced-heron *Egretta novaehollandiae*
Australasian harrier *Circus approximans*
Banded rail *Gallirallus philippensis*
Spotless crake *Porzana tabuensis*
Pukeko *Porphyrio melanotus*
Variable oystercatcher *Haematopus unicolor*
Spur-winged plover *Vanellus miles*
New Zealand dotterel *Charadrius bicinctus*
Black-backed gull *Larus dominicanus*
Red-billed gull *Larus novaehollandiae*
White-fronted tern *Sterna striata*
Kereru *Hemiphaga novaeseelandiae*
Eastern rosella *Platycercus eximius*
Red-crowned kākāriki *Cyanoramphus novaezelandiae*
Shining cuckoo *Chrysococcyx lucidus*
Morepork *Ninox novaeseelandiae*
Kingfisher *Todiramphus sanctus*
Welcome swallow *Hirundo neoxena*
Silvereye *Zosterops lateralis*
Grey warbler *Gerygone igata*
Tui *Prosthemadera novaeseelandiae*
Bellbird *Anthornis melanura*
Fantail *Rhipidura fulginosa*
Starling *Sturnus vulgaris*
Myna *Acridotheres tristis*
Australian magpie *Gymnorhina tibicen*
Blackbird *Turdus merula*
Song thrush *Turdus philomelos*
Skylark *Alauda arvensis*
House sparrow *Passer domesticus*
Chaffinch *Fringilla coelebs*
Goldfinch *Carduelis carduelis*
Greenfinch Carduelis chloris
Yellowhammer *Emberiza citrinella*

8.3 *Planting options for Rakino Island*

The maximum height is in metres. The shaded cells indicate when resources are available to wildlife with the grey cells indicating flowering and the red cells fruiting and seeding. Where plants flower, fruit and seed at the same time they are indicated in red. Flowering, fruiting and seeding times are a guide only as there will be seasonal and annual variation associated with reproductive periods for all plant species.

On Rakino?	Maori name	Common name	Species	Max. height	J	F	M	A	M	J	J	A	S	O	N	D	Preferred site
Y	Karaka		*Corynocarpus laevigatus*	15													Coastal, hardy
?	Horoeka	Lancewood	*Pseudopanax crassifolius*	15													Hardy
Y	Karamu	Shining coprosma	*Coprosma lucida*	3													Tough and hardy
?		Small-leaved rata	*Metrosideros perforata*	vine													Vine
Y	Wharawhara, horahora	Coastal astelia	*Astelia banksii*	1													Understory, shady sites
Y	Mamangi		*Coprosma arborea*	12													Semi shade, free-draining, tolerant of dry when established
Y	Taupata	Creeping coprosma	*Coprosma repens*	8													Coastal
Y	Mingimingi	Prickly heath	*Leptecophylla juniperina*	2													Hardy but difficult to propagate
Y			*Disphyma australe*	<0.3													Coastal cliffs/rock stacks
Y	Manuka	Tea tree	*Leptospermum scoparium*	5													Hardy, pioneer species
Y	Kawakawa		*Macropiper excelsum*	5													Shady/understory/damp soil
Y	Karo		*Pittosporum crassifolium*	10													Coastal, hardy
Y	Poroporo		*Solanum laciniatum*	4													Coastal, hardy, pioneer
Y	Kowhai		*Sophora microphylla*	25													Hardy
Y	Puriri		*Vitex lucens*	20													Coastal, hardy
?	Matai		*Prumnopitys taxifolia*	25-30													

?		NZ Gloxinia	*Rhabdothamnus solandri*	2											Understory, shady sites
?		Supplejack	*Ripogonum scandens*												Vine, moist, shady site
?	Pate	Seven finger	*Schefflera digitata*	8											
?		orange rata vine	*Metrosideros fulgens*	vine											Vine
Y	Karamu	Stout-leaved coprosma	*Coprosma robusta*	6											Tough and hardy
Y	Akiraho		*Olearia paniculata*	6											Coastal
Y	Kohekohe		*Dysoxylem spectibile*	15											Coastal
?	Kanono		*Coprosma grandifolia*	6											Shaded, damp site
?		Five finger	*Pseudopanax arboreus*	8											Edges and understory
?	Miro		*Prumnopitys ferruginea*	25											
Y		Hebe	*Veronica stricta*	1-4											Hardy, pioneer species
?		Clematis	*Clematis paniculata*	vine											Creeper
?	Kotukutuku	Tree fuchsia	*Fuchsia excorticata*	12											Prefers moist sites
Y	Rangiora		*Brachyglottis repanda*	6											Tolerant of dry conditions, pioneer species
Y	Whau		*Entelea arborescens*	8											Coastal, fast growing, prefers sunny, free-draining sites
?	Toropapa		*Alseuosmia macrophylla*	2											Semi-shade, damp
?		Large leafed milk tree	*Streblus banksii*	12											Prefers fertile coastal sites but hardy
Y	Pohutukawa		*Metrosideros excelsa*	20											Coastal
Y	Mapou		*Myrsine*	6											Pioneer, hardy

			australis														
Y	Wharangi		*Melicope ternata*	6													Coastal
Y	Parapara		*Pisonia brunoniana*	8													Coastal
Y	Totara		*Podocarpus totara*	30													Hardy
?		Kaka beak	*Clianthus puniceus*	3													
?	Rewarewa		*Knightsia excelsa*	30													Secondary forest
?	Kumarahou		*Pomaderris kumeraho*	4													Coastal, disturbed sites
?	Pukatea		*Laurelia novae-zelandiae*	35													Damp sites
Y	Harakeke	NZ flax	*Phormium tenax*	3													Hardy
?	Mangeao		*Litsea calicaris*	18													Coastal
?	Hangehange		*Geniostoma ligustrifolium*	3													Understory, shady sites
?		White climbing rata	*Metrosideros diffusa*	vine													Vine
?	Tanekaha		*Phyllocladus trichomanoides*	25													Hardy
?		Bush lawyer	*Rubus cissoides*														Vine, moist, shady site
?	Kauri		*Agathis australis*	60													
?		NZ jasmine	*Parsonsia heterophylla*	vine													Vine
Y	Tawapou		*Planchonella costata*	18													Coastal
?	Tarairi		*Beilschmiedia tarairi*	22													Prefers a damp site, stream side, etc
Y	Kanuka	Tea tree	*Kunzea ericoides*	18													Hardy, pioneer species

Y	Mahoe	Whiteywood	*Melicytus ramifloris*	15												Hardy
Y		Iceplant/NZ spinach	*Tetragonia trigyna*	<0.5												Hardy but rare on the mainland
?	Tawaroa		*Beilschmiedia tawaroa*	35												
?	Kohuhu		*Pittosporum tenuifolium*	10												Secondary forest
?	Kahikatea		*Dacrycarpus dacrydioides*	50-65												Flooded, wet, damp sites
?		Coastal maire	*Nestegis apetala*	10												Coastal and very hardy
?		Small leafed milk tree	*Streblus heterophyllus*	12												
Y	Ngaio		*Myoporum laetum*	10												Hardy, coastal
Y	Kapuka	Broadleaf	*Griselinea littoralis*	20												Coastal
?	Titoki		*Alectryon exelsus*	10-20												Coastal, free draining
Y	Rengarenga	Rock lily	*Arthropodium cirratum*	1												Sun, shade, dry, exposed
?	Putaputaweta		*Carpodetus serratus*	10												Edges, secondary forest
?		White maire	*Nestegis lanceolata*	20												Coastal and very hardy
Y	Nikau		*Rhopaostylis sapida*	15												Coastal, hardy
Y	Pohuehue	Wire vine	*Muehlenbeckia complexa*	<0.5												Coastal
?	Rimu		*Dacrydium cupressinum*	35-60												
Y	Ti kouka	Cabbage tree	*Cordyline australis*	20												Tolerates a broad range of conditions
?		Pigeonwood	*Hedycarya arborea*	12												Quick growing

Y	Houpara		*Pseudopanax lessonii*	6											Coastal

8.4 *Wildlife reintroduction options for Rakino Island*

Species assessed for translocation to Rakino including current distribution, habitat requirements, source populations and notes on techniques and challenges.

Species	**Current distribution**	**Habitat requirements**	**Potential source populations**	**Notes**
Whitehead Popokatea *Mohoua albicilla*	Widespread and locally common south of the Waikato. All populations north of the Waikato are on predator free islands or protected mainland sites	Native & exotic forests & scrublands.	Tiritiri Matangi, Motuora, Tāwharanui.	Well established protocols for capture, translocation and post release management. Reach very high densities and form large noisy flocks. High translocation success to well protected sites with low connectivity. The only North Island host of the long tailed cuckoo.
North Island fernbird Matata *Bowdleria punctata vealeae*	Widespread but patchy distribution throughout northern and central New Zealand	Very dense tight vegetation with emergent species	Tiritiri Matangi, Limestone/Matakohe Island/salvage birds from the greater Auckland region	Well established protocols for capture, translocation and post release management.
NI Saddleback Tieke/Tiaki *Philesturnus rufusater*	17 island & five mainland populations.	Native inland and coastal forests & scrublands.	Tiritiri Matangi	Well established protocols for capture, translocation and post release management.
NI Rifleman Titipounamu *Acanthisitta chloris granti*	Widespread and locally common south of the Waikato. Hauturu O Toi/Little Barrier Island Tiritiri Matangi	Native forests & mature scrublands.	Hauturu O Toi/Little Barrier Island?	Established protocols for capture, translocation and post release management. Rifleman are very prone to stress related mortality and must be translocated on the day of capture, typically by helicopter. Capture rates on Hauturu O Toi are low and the suitability of Hauturu birds for translocation is unclear. Alternative source populations might be available (e.g. Hawkes Bay) but they will incur significant transportation costs during any translocation.

Species	**Current distribution**	**Habitat requirements**	**Potential source populations**	**Notes**
Invertebrate species	Primarily protected islands	Forest and edge dwelling species	Species dependent	Threatened invertebrates are typically ignored in mainland restoration projects. However, many species are in need of attention. Comprehensive surveys required to confirm absence before being reintroduced. Captive rearing could be used as a component of a reintroduction programme.
Pacific gecko *Dactylochnemis pacificus*	Widespread throughout the North Island on islands and the mainland	Forests, scrublands and coastal areas with dense cover	Salvage animals from development sites or the Mercury Islands	Well established protocols for capture, translocation and post release management. Would require comprehensive surveys to confirm absence before being reintroduced.
Raukawa gecko *Woodworthia maculatus*	Widespread but patchy throughout the North Island upper South Island	Forests, scrublands and coastal areas with tight cover	Salvage animals from development sites or the Mercury Islands	Possibly still present on Rakino Well established protocols for capture, translocation and post release management. Would require comprehensive surveys to confirm absence before being reintroduced.
Ornate skink *Cyclodina ornata*	Widespread throughout the North Island	Forests, shrublands and heavily vegetated coastal areas	Salvage animals from development sites	Well established protocols for capture, translocation and post release management. Would require comprehensive surveys to confirm absence before being reintroduced. It is unclear if ornate skinks can co-exist with Hauraki skinks
Tuatara *Sphenodon punctatus*	Islands in the Cook Straight and off the east coast of the North Island from the Bay of Plenty to Northland	Burrow dwelling but utilise a wide range of habitats including forests, scrublands, herbfields and grasslands	Tuatara Recovery group decision but likely northern islands.	Well established protocols for capture, translocation and post release management. Captive rearing could be used as a component of a reintroduction programme.
Duvaucel's gecko *Hoplodactylus duvaucelii*	Islands off the east coast of the Northern North Island and Cook Straight area	Forests, scublands, rock outcrops, cliffs, bluffs and coastal habitats	Marotere/Chicken Islands	Well established protocols for capture, translocation and post release management. Would require comprehensive surveys to confirm absence before being reintroduced.

Species	**Current distribution**	**Habitat requirements**	**Potential source populations**	**Notes**
Hauraki skink *Oligosoma townsi*	Restricted to a few islands off the Northland Coast	Occupies leaf litter in broadleaf forest and low scrub usually associated with boulders and rock scree.	Muriwhenua & Wareware/Chicken Islands?	Well established protocols for capture, translocation and post release management. Would require comprehensive surveys to confirm absence before being reintroduced. It is unclear if Hauraki skinks can co-exist with ornate skinks
Grey-faced petrel *Pterodroma macroptera*	Scattered colonies on headlands and islands from New Plymouth and East Cape northwards	Coastal forests, scrublands and rank grasslands	Bethells Beach	Established translocation protocols (Gummer et al. 2014)
Fluttering shearwater Pakaha *Puffinus gavia*	Abundant endemic. Breed on many Northern Islands	Breed in forest, scrub and open habitats	Poor Nights, Hen/Taranga, Northwest Chickens and Mercury Islands	Passively attracted to Tāwharanui Regional Park. Established translocation protocols (Bell et al. 2005; Gummer & Adams 2010).
Common diving petrel *Pelecanoides urinatrix*	Scattered colonies across the entire NZ region	Forests, scrublands and rank grasslands	Little Wooded Island	Natural recolonisation quite likely Established translocation protocols (Gummer et al. 2014)
Australasian gannet Takapu *Morus serrator*	Common native. Breed on islands, rock stacks and islets with large mainland colonies at Muriwai, Cape Kidnappers and Farewell Spit	Exposed headlands free of vegetation	Hauraki Gulf via passive attraction	Decoys, fake guano, fake nests and broadcast calls have been successfully used at several sites to attract gannets to new colonies. For attraction methods see Sawyer and Fogle (2013).
Little Shearwater *Puffinus assimilis*	Recovering native. Breed on islands on the north east coast of the North Island south to the Bay of Plenty	Breed in low scrub to forest vegetation	Poor Nights, Hen/Taranga, Coppermine, Lady Alice, Whatupuke, Muriwhenua, Mercury Islands	Translocation methods have not been developed for this species but will likely entail the methods employed for other burrowing seabirds (Bell et al. 2005; Miskelly et al. 2009; Gummer & Adams 2010; Gummer et al. 2014)

Species	**Current distribution**	**Habitat requirements**	**Potential source populations**	**Notes**
White-faced storm petrel Takahikare-moana *Pelagodroma marina*	Common native. Breed on many small islands in the NZ region	Breed in a broad range of habitats	Poor Nights, Mokohinau Islands	Translocation methods not yet developed, but feeding trials have been conducted for this species on the Mokohinau Islands (Young 2013) and translocation methodologies will likely be similar to those employed for other burrowing seabirds (Bell et al. 2005; Miskelly et al. 2009; Gummer & Adams 2010; Gummer et al. 2014).
Pycroft's petrel *Pterodroma pycrofti*	Recovering endemic but locally common. Breed on the Marotere/Chicken Group, Taranga/Hen and the Mercury Islands	Burrow amongst tree roots or under rocks, normally avoid dense clay	Red Mercury Island	Established translocation protocols (Gummer et al. 2014)

8.5 SPECIES ACCOUNTS FOR TRANSLOCATION CANDIDATES FOR RAKINO ISLAND

Whiteheads *Mohoua albicilla*
Popokatea
15 cm, 14-18g
Not threatened

Popokatea/whiteheads are a small flocking bush bird that can reach very high densities at protected sites (up to 14 birds per hectare on Tiritiri Matangi). They were once found throughout the North Island but disappeared from Northland, Auckland and Great Barrier Island following the introduction of mammalian pests (Heather & Roberton 2015). They have since been translocated to several sites in the Auckland and Northland area with great success on islands (e.g. Tiritiri Matangi, Motuora, Rangitoto, Motuihe, Rotoroa) and discreet mainland sites (Tawharanui Open Sanctuary, Shakespear Open Sanctuary) but lower success or failure at large contiguous sites (Waitakere Ranges, Hunua Ranges). Whiteheads use a wide variety of habitats including coastal forests, inland forests, exotic plantations, replanted areas and scrubby regenerating habitats. Whiteheads eat invertebrates, fruit, pollen and nectar. They can breed from September through to February, often in small family groups rather than as pairs, and typically raise 1-2 clutches of 2-4 eggs each.

North Island fernbirds *Bowdleria punctata vealeae*
Matata
15 cm, 14-18g
At Risk/Declining

Matata/North Island fernbirds are a small relatively secretive bird that can reach high densities in suitable habitats. They were once found throughout the North Island but have declined, likely as a result of habitat loss and predation by introduced mammalian predators. Their current distribution is widespread but patchy (Heather & Roberton 2015). North Island fernbirds use a wide variety of vegetation associations, all of which have a thick, dense understory, sometimes with emergent trees and shrubs, including saltmarsh and freshwater habitats, dense scrub, bracken thickets, muehlenbeckia tangles, blackberry thickets and long rank grasslands. North Island fernbirds primarily eat invertebrates, although they also occasionally take small fruits and lizards (Heather & Roberton 2015). They have been successfully translocated to two North Island sites (Tiritiri Matangi and Pauatahanui). North Island fernbirds are highly territorial, breed from September through to February and typically rear 2 clutches of 2-4 eggs each

North Island saddleback *Philesturnus rufusater*
Tieke, Tiaki
25 cm, 65-85g
Recovering

Tieke/NI saddlebacks are loud, conspicuous birds that are generally quite tolerant of people. They were once found throughout the North Island and adjacent islands but rapidly declined following the introduction of ship rats and mustelids and were extinct on the mainland by the 1880s (Heather & Roberton 2015). NI saddlebacks are especially vulnerable to mammalian

predators because they roost and nest in cavities so are vulnerable to predation year round (Lovegrove 1996). By the early 1900s they had been reduced to a single population of c. 500 birds on Taranga/Hen Island. The New Zealand Wildlife Service initiated a highly successful translocation programme in the mid-1960s and NI saddlebacks have become a conservation success story with 16 island and 5 mainland populations established via translocation to predator free islands or predator fenced mainland. Ideal habitat includes coastal and inland forests, particularly scrubby regenerating areas where they can forage for invertebrates, fruit, pollen and nectar. NI saddlebacks require abundant natural cavities for roosting and nesting, breed from August to March and typically rear 1-2 clutches of 2-3 eggs each.

Rifleman *Acanthisitta chloris*
Titipounamu
8 cm, 6-7g
Declining

The titipounamu/North Island rifleman, along with the grey warbler, is the smallest bird in New Zealand. They were once found throughout the North Island but aside from a small population in Warawara Forest in Northland (only discovered in 1996) they disappeared from Northland, Auckland, Coromandel and Great Barrier Island following the introduction of mammalian pests (Heather & Roberton 2015). Rifleman use a variety of native and exotic forests and mature scrub habitats but require abundant cavities for nesting. They have been translocated to several sites with reasonable success, including Tiritiri Matangi. They primarily eat invertebrates. They can breed from September through to February and typically lay 1-2 clutches of 2-5 eggs each. Pairs are highly territorial but they sometimes tolerate helpers in their territories. The make use of quite fragmented habitats in some parts of NZ but it is unclear whether Rakino is a suitable site for a NI rifleman translocation, especially during very dry summers.

Native invertebrates
Various threat categories ranging from threatened to non-threatened
Various sizes ranging from very small (<10mm) to large (250mm)

Knowledge on native invertebrates for translocation is patchy and sparse, typically because of limited information on the status of invertebrates at the restoration site and at potential source populations. Rakino likely had a range of large flightless invertebrates, including giant weta, darkling beetles, weevils, centipedes and land snails. Some of these species might still be present, although this is unlikely given extensive habitat clearance on Rakino and the former presence of Norway rats. There are also a range of other smaller invertebrates that were likely present, including invertebrate herbivores, detritivores and predators. Some might be capable of recolonising whereas others might require translocation. Ultimately, invertebrate surveys using a range of techniques will be required prior to any invertebrate translocations to Rakino.

Pacific gecko *Dactylochnemis pacificus*
Snout vent length 70-80 mm
Relict

Widespread in the North Island and reaching especially high densities on northern offshore islands (Jewell 2008). They are variable in colouration on their upper surfaces ranging

through shades of grey, green and brown and occasionally mustard blotches. Markings include bands, chevrons, blotches and stripes. They inhabit trees in forests and scrublands, especially under loose bark and in knotholes, rocky bluffs and outcrops, clay bans, scrubby vegetation, including flax, and in coastal driftwood, rocks and scrub well above the high tide mark. They are nocturnal and extremely secretive (Jewell 2008).

Raukawa gecko *Woodworthia maculatus*
Snout vent length 55-82 mm
Not threatened

Raukawa geckos have a widespread but patchy distribution from the top of the North Island to the top of the South Island, including many islands. They are highly variable in colouration on their upper surfaces ranging through shades of grey, green and brown and markings including bands, chevrons, blotches and stripes (Jewell 2008). They make use of a wide range of habitats, including dead and live trees in forests and scrublands, rocky outcrops and amongst driftwood and vegetated boulders on coastlines. They are mostly nocturnal but come out to bask during the day (Jewell 2008).

Ornate skink *Cyclodina ornata*
Snout vent length 65-83 mm
At risk

Ornate skinks are widespread in North Island forests and shrublands, including many offshore islands (Jewell 2008). They are variable in colouration ranging from grey brown, brown or reddish brown with flecking, blotches and a distinctive white or yellow tear drop marking below their eye. They inhabit leaf litter, under rocks and logs and dense forests, shrublands and vegetated coastlines. They are active night and day, but particularly dawn and dusk, and can be extremely secretive (Jewell 2008).

Northern tuatara *Sphenodon punctatus*

Snout vent length 20-28 cm
Relict

The tuatara is an iconic NZ species that once occurred throughout the North and South Islands. However, they declined following the arrival of humans and mammalian pests and are now restricted to islands free of introduced predators from Cook Straight through to Northland. They are generally very cryptic but can be spotted while sun basking outside burrows during daylight hours and while out foraging at night. Tuatara occupy a range of habitats, including forest, shrublands, herbfields and grasslands. Adults eat invertebrates, reptiles and occasionally seabird eggs and chicks. Females produce a single clutch every four years, the eggs take 11-16 months to hatch and the offspring take c. 13 years to reach sexual maturity. Adult lifespans probably exceed 100 years (Jewell 2008). There have been several successful tuatara translocations to islands and fenced mainland sites free of introduced mammals.

Duvaucel's gecko *Hoplodactylus duvaucelii*
Snout vent length up to 161 mm

Duvaucel's geckos were once distributed throughout NZ as far south as North Otago but become all but extinct on the mainland following the introduction of mammalian pests and are now only found on islands in the Northern North Island and Cook Straight areas. They are nocturnal but can be observed sun basking during the day. They occupy a wide range of habitats, including forests, scrublands, rocky outcrops, cliffs, bluffs and coastal habitats. Duvaucel's geckos eat invertebrates, fruit, pollen and nectar. They produce young every second year and take c. 7 years to reach sexual maturity. Duvaucel's geckos can live for up to 50 years (Jewell 2008). Single individuals have turned up on Maungatautari in 2010 (Morgan-Richards et al. 2015), and Little Windy Hill on Great Barrier despite sharing long histories with mammalian pests.

Hauraki skink *Oligosoma townsi*
Snout vent length up to 95 mm
Recovering

The large, nocturnal Hauraki skink has only been recently been separated from the marbled skink (*Oligosoma oliveri*) through the revision of this species complex. Both species only occur in relict populations on islands, and because mainland subfossils of these two species cannot be differentiated, it is unclear if one or both species were present on the mainland. The Hauraki skink is known from the Mokohinau Islands, the Chickens (including three translocated populations), Hauturu O Toi/Little Barrier and a small population in scree slopes on Great Barrier Island. Little is known about this species other than it lives in leaf litter on the forest floor and is rarely observed basking in the sun (Jewell 2008) and eating invertebrates. Similar to *O. oliveri* it may associate with seabird burrows as well as rocks and scree.

Grey-faced petrel *Pterodroma macroptera*

Oi, titi, kuia, great-winged petrel, northern muttonbird
41 cm, 550g
Not threatened

Grey-faced petrels have an extensive breeding range throughout the northern North Island, the South Atlantic Ocean and the Southern Indian Ocean. Breeding colonies are typically on headlands, clifftops and slopes (Heather & Roberton 2015). Adults return to burrows in March, lay late June to late July and fledge chicks early December through to late January (Heather & Roberton 2015). Their diet is primarily squid with some fish and crustaceans and they typically feed in the Tasman Sea, Coral Sea and the South Pacific. Small protected mainland colonies are persisting but those at unprotected sites are likely in decline. They have been translocated to several sites but the long-term success of the translocations is currently unclear.

Fluttering shearwater *Puffinus gavial*
Pakaha, pakahā, Forster's shearwater
33 cm, 300g
Relict

Fluttering shearwaters have an extensive breeding range throughout northern New Zealand and in the Marlborough Sounds (Heather & Roberton 2015). There are no colonies outside of New Zealand. Colonies are in forest or scrub habitat and burrows can be densely concentrated. Adults return to burrows in August, lay September to mid-October and fledge late January to February (Heather & Roberton 2015). During the breeding season birds feed on small fish and krill on inshore areas close to breeding colonies. Outside of the breeding season birds migrate to the Australian coast between South Australia and Queensland. Introduced mammalian predators have reduced or eradicated fluttering shearwaters from mainland and offshore island sites. The species has benefited from the eradication of mammalian predators on many islands and the species is now recolonising Hauturu O Toi/Little Barrier, Cuvier and Moutohora Islands (Gaskin & Rayner 2013). Chicks have been successfully translocated to Maud and Mana Islands and playback systems have been effective at attracting birds at Tāwharanui, Young Nick's Head and Matiu-Somes Island.

Common diving petrel *Pelacanoides urinatrix urinatrix*
Kuaka
20 cm, 130 g
Not threatened

The small, robust northern diving petrel breeds from the Three Kings Islands south to the Marlborough Sounds (Gaskin & Rayner 2013). Two other sub-species exist in New Zealand, the southern diving petrel, *P. u. chathamensis* on the Chatham Islands, Stewart, Solander and Snares Islands and the sub-antarctic *P. u. exsul* on the Antipodes, Auckland and Campbell Islands (Heather & Roberton 2015). None of the subspecies are threatened, but they have been extirpated from many sites due to predation from mammalian predators. Burrows, rock crevices and dense vegetation are used for nesting on steep coastal slopes (Marchant & Higgins 1993). Breeding adults return to the low density colonies as early as March but breeding begins in August in northern New Zealand, and later elsewhere (Heather & Roberton 2015). Incubation lasts some 53 days and chicks fledge between 45-59 days, in November or December (Heather & Roberton 2015). Diving petrels are abundant and commonly seen throughout the New Zealand region. Large groups are frequently seen at sea. A pursuit predator, diving petrels feed on pelagic crustaceans (Marchant & Higgins 1993). Diving petrels have been translocated on a number of occasions with encouraging results (Miskelly et al. 2009).

Australasian gannet *Morus serrator*
tākapu, takapu, tākupu, takupu, Pacific gannet
89 cm, 2.3 kg
Not Threatened

Australasian gannets are commonly seen around the New Zealand coast. They breed in dense island and mainland colonies throughout New Zealand. The largest colonies are in the North Island (Heather & Roberton 2015). The single egg is laid between July and mid-October and chicks fledge from early February. The diet varies between colonies, but generally consists of

fish and squid. Bird feed mostly over continental shelf and inland waters (Heather & Roberton 2015). Numbers of gannet are reportedly increasing. The species is vulnerable to disturbance by humans but fortunately this has been reduced at some important mainland colonies (Gaskin & Rayner 2013).

Little shearwater *Puffinus assimilis haurakiensis*
Allied shearwater
28 cm, 240 g
Recovering

Little shearwaters breed in the south Pacific, Atlantic and Indian Oceans (Shrihai 2007). Of the four sub species of little shearwater in New Zealand, two are from the north. *P. kermadecensis* is restricted to the Kermadec Islands and P. *Haurakiensis* to the greater Hauraki Gulf region (Heather & Roberton 2015). There are large little shearwater colonies on the Poor Knights and Chicken Island groups. Little shearwaters are winter to spring breeders, laying from July to mid-August in northern New Zealand and chicks fledging from November to December (Gaskin & Rayner 2013). Their diet is mostly krill, small fish, squid and octopus (Heather & Roberton 2015).

White-faced storm petrel *Pelagodroma marina maoriana*
Takahikare-moana, Takahikare , frigate petrel, Jesus Christ bird
20 cm, 45 g
Relict

White-faced storm petrels are one of the smallest seabirds. Their characteristic feeding behaviour of having their wings out-stretched and their legs on the water's surface has earned them the common name 'Jesus Christ bird' (Heather & Roberton 2015). They are circumpolar in distribution ranging from the sub-Antarctic to sub-tropics in distribution. There are five subspecies, two of which occur in New Zealand. *P. m. maoriana* breeds in northern New Zealand and *P.m. dulciae* in the Chatham and Auckland Islands (Heather & Roberton 2015). The species breeds on at least six islands in the wider Hauraki Gulf region (Gaskin & Rayner 2013). Birds breed in dense colonies in burrows. The single egg is laid from late October to early December and chicks fledge from mid-February to mid-March (Heather & Roberton 2015). After breeding birds migrate to warmer waters in the eastern Pacific.

Pycroft's petrel *Pterodroma pycrofti*
18 cm, 160 g
Recovering

Pycroft's petrels are very similar in appearance to Cook's petrels. They breed on the Hen and Chickens, Poor Nights, Ririwha and Mercury Island groups (Gaskin & Rayner 2013). They previously bred on Norfolk and Lord Howe Islands (Heather & Roberton 2015). Roughly 75% of the population is on Red Mercury, where the population has increased since rats were eradicated. Pycroft's petrels are a forest breeder with small burrows in localised colonies. They breed during the summer, with birds returning in October, laying in mid-November to mid-December and chicks fledging mid-March to mid-April (Heather & Roberton 2015). During breeding Pycroft petrels feed in temperate and sub-tropical waters north of New Zealand and in the winter in the central and North Pacific. Diet during the breeding season is

squid, crustaceans and small fish. Populations have recovered strongly after kiore/Pacific rats *Rattus exulans* were eradicated.