

Conserving Fiordland's biodiversity 1987–2015

The challenges, the achievements, the knowledge

Te Tiaki i te Taiao ki Tu Rua o te moko

Ngā wero, ngā haumāuiui, ngā mātauranga



Department of
Conservation
Te Papa Atawhai

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Ngā wero, ngā haumāuiui, ngā mātauranga

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FRONT COVER:

Looking north from Tamatea/Dusky Sound along the Acheron Passage. *Photo: Rob Suisted.*

BACK COVER:

DOC Biodiversity Ranger Megan Willans checks for translocated rock wrens on the summit of Kā-Tū-Waewae-o Tū/Secretary Island, at the mouth of Doubtful Sound/Patea, January 2009. *Photo: Rod Morris.*

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A note from the compilers

The Department of Conservation Te Papa Atawhai (DOC) was formed in 1987 following the passing of the Conservation Act, which aimed to integrate some of the functions of the Department of Lands and Survey, Forest Service and Wildlife Service. In September 2013, DOC underwent major strategic and organisational changes, which transformed the way it operated, and the size and geographic boundaries of the areas that were previously known as ‘conservancies’. As part of these changes, the boundary of the area administered from Te Anau shifted to take in all of Fiordland National Park, to form an area that is now referred to as ‘Te Anau District’. This book covers the period from DOC’s establishment in 1987 to September 2015 and includes information about the area that was previously administered by Te Anau Area Office as part of the former Southland Conservancy.

The material presented in this book has been sourced from written correspondence, unpublished reports and scientific papers, and represents the collective effort of a great many individuals. It is the story of conservation efforts in the field of biodiversity in Fiordland and the Te Anau Basin from 1987 to 2015, told by the conservation managers, research scientists and community conservation advocates who worked there. We have included the names of people from outside Te Anau or external to DOC who have contributed to this work. However, in general, we have not included the names of DOC staff based in Te Anau who have led the majority of this work, as they should be considered ‘the authors’. That said, we would like to particularly thank the following individuals for their assistance in bringing this work together:

Chloe Corne, Dave Crouchley, Hannah Edmonds, Richard Ewans, Gerard Hill, Richard Kinsey, Sue Lake, Erina Loe, Andrew (Max) Smart and Megan Willans (Te Anau), and Graeme Elliott, Eric Edwards, Brian Rance, Moria Pryde, Colin O’Donnell and Jo Monks (Science and Policy Group, DOC) for providing text summaries for the various chapters; Martin Genet, Glen Greaves, Alistair Hay, Norm MacDonald, Pete McMurtrie, Em Oyston, Sanjay Thakur and Lindsay Wilson (Te Anau), Andrew Digby and Deidre Vercoe Scott (Invercargill), Peter Dilks, James Reardon, Carol West, Eduardo Villouta Stengl and Kerry Weston (Science and Policy Group, DOC), the late Ian Jamieson (University of Otago), Des Smith (Wildlands), Jen Brunton (MPI), Laura Harry (Fiordland Conservation Trust) and Viv Shaw (Pomona Island Charitable Trust) for providing additional input; Martin Sliva, Rod Morris, Rob Suisted, James Reardon, Graham Dainty, Barry Harcourt, Sabine Bernert, Chris Rance, Mark Sutton, Alan Mark, Richard Ewans, Jane Maxwell and DOC Te Anau staff for their photographic contributions and support; Dion Fabbro for creating the maps; and Fiona Moffat and Amanda Todd for valuable editorial advice. The foreword for this production was translated into Te Reo Māori by Melanie Nelson with input from Jane Davis and Tane Davis.

We also acknowledge the unfailing support and commitment of many individuals, groups and businesses who have contributed to the conservation management of Fiordland, the Eyre and Takitimu Mountains, and Mavora Lakes District. We cannot mention everyone by name and corporate/community partnership as this information is not readily available for all projects prior to 2006.

For ease of reading, we have omitted supporting references from this publication but have included references as footnotes where a report is directly referred to or a quote is provided. A full bibliography is available in digital format on the DOC website along with this book (www.doc.govt.nz/conserving-fiordland's-biodiversity). It was not possible to describe all of the scientific research that has been undertaken across the area in this publication as the studies are too numerous and the body of knowledge vast; however, an extensive list of these is included in the bibliography. We have also included a glossary of the scientific names of the plants and animals mentioned in this publication at the end of the report.

Kerri-Anne Edge Hill

Rebecca Reid

Foreword

When the legendary seafarer Tamatea, captain of the Takitimu waka, sailed around the Fiordland coast and discovered the fiords some 700 years ago, the natural environment would have looked very different from how it is today. Native wildlife would have filled the forests, coastal habitats and sea.

At that time, no introduced predatory or browsing pests were present. The arrival of people – both Māori and European – to Te Wai Pounamu/South Island was accompanied by the introduction of a range of foreign pests, which led to the extinction of many species and set the course of many others on a downward spiral. Fiordland's remoteness and sheer mountains proved no barrier – it took less than 20 years for stoats to invade Mauikatau/Resolution Island in 1900, following their liberation in Otago in the mid-1880s.

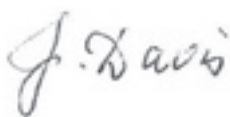
One by one, species disappeared from Fiordland. Some species, such as moa, native New Zealand thrush (piopio), bush wren (mātuhituhi) and tieke (South Island saddleback), went quite quickly, while others, such as little spotted kiwi, South Island kōkako, kākāpō and South Island brown teal (pāteke), held on until much later.

Today, several of the remaining species continue to decline in this region, and it is clear that without intervention, species such as takahē, kea, rock wren (tuke), kiwi, kākā, mohua (yellowhead), kakaruai (South Island robin), and bats (pekapeka) will disappear from the New Zealand mainland and perhaps into extinction.

This book outlines some of the work that has been carried out over the last three decades to try to halt this decline. Island pest eradication work, species reintroductions, marine protection and ecosystem restoration programmes have made a difference. Not everything tried has been successful, but the principle of taking a calculated risk and pushing boundaries has resulted in marked progress being made.

Much of this work has been a joint effort between Ngāi Tahu iwi through Te Rūnaka o Ōraka Aparima and the Department of Conservation. From the early days, this has been a productive Treaty Partnership, identifying projects that would make a real difference and then gaining support and funding for them. We hope that this summary will be well received and help to progress ecological restoration work throughout Aotearoa/New Zealand. We thank all those who have contributed to this publication both by writing excerpts and in carrying out the conservation work itself. The ancient whakataukī aptly describes our efforts:

I pā te ngaru ki uta, ka rerekē haere te whenua
Each wave breaking on the shore, alters the landscape slightly



Mrs Jane Davis
Kaumātua
Ngāi Tahu



Allan Munn
Conservation Services Director
Department of Conservation

March 2017

Kupu Whakataki

Nō tewā e 700 tau ki mua i haumiri ai te kaumoana rongonui a Tamatea, te kaiurungi o te waka Takitimu, i te ākau o Te Tūtae-o-Tūterakiwhānoa me tana whakatōmene i ngā tai matapiri, he tino rerekē te āhua o te taiao i tōna āhua o nāianei. I kapi ai ngā ngāhere, ngā nōhanga ākau, ngā moana i ngā manu, i ngā ika, i ngā aitanga pēpeke māori.

I taua wā, karekau ngā kararehe kino rāwaho i konei. I te taenga mai o te tangata Māori, o te tangata Pākehā anō hoki ki Te Wai Pounamu i kōkohutiamai ngā tini tūmomo kararehe rāwaho, nā tērā te korehāhātanga o ngā tini tūmomo māori, te tūmatanga hoki o te hekenga ihotanga o ngā tini tūmomo anō. Ehara te tawhiti, ngā maunga hūkere o Te Tūtae-o-Tūterakiwhānoa i te ārai – iti iho i te 20 tau te roa kia whakaeke ngā toriura i Mauikatau i te tau 1900, whai muri mai i te tukunga o ngā toriura ki Ōtākou i waenganui i te tekau tau 1880.

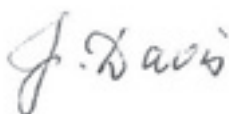
I ngaro takitahi ai ngā tūmomo māori i Te Tūtae-o-Tūterakiwhānoa. I tere ngaro atu ētahi tūmomo, pērā i te moa, i te piopio, i te mātuhihi, i te tūeke o Te Wai Pounamu, ā, ko ētahi atu pērā i te kiwi pukupuku, i te kōkako o Te Wai Pounamu, i te kakāpō, i te pāteke o Te Wai Pounamu, i ū tonu ai mō te wā roa.

I tēnei wā, ko ētahi o ngā tūmomo e toe ana kei te heke haere tonu ki te takiwā nei, ā, he pūrangiaho te kitea, ki te kore te mahi whakahaere, ko ngā tūmomo pērā i te takahē, i te kea, i te tuke, i te kiwi, i te kākā, i te mohua, i te kakaruwai o Te Wai Pounamu, i te pekapeka, ka ngaro katoa atu i te tuawhenua o Aotearoa, ka ngaro korehāhā atu pea.

Kei te whakatakoto tēnei pukapuka i ētahi o ngā mahi kua mahia i ngā tau 30 ki mua hei ngana ki te whakatū i taua hekenga. Kua whai hua ngā mahi whakakore kararehe kino ki ngā motu, te whakahoki i ngā tūmomo māori, te tiaki i ngā moana, ngā hōtaka whakarauora pūnaha hauropi. Kāore i angitū te katoa o ngā mahi i whakamātauria, heoi anō nā te whai i te mātāpono kote whakaae i te tūraru kua whakaarohia, ko te kōpani i ngā ripa tauārai, kua tino kauneeke whakamua.

Ko te nuinga o aua mahi he manawanui ngātahi i waenganui i te iwi o Ngāi Tahu mā Te Rūnaka o Ōraka Aparama me Te Papa Atawhai. Mai rā anō, he Rangapū Tiriti tōnu tēnei, e tohu ana i ngā kaupapa ka mātua whai hua, me te rapu tautoko, rapu pūtea hei whakatinana. Kei te tūmanako mātou ka rāhiritia tēnei whakarāpopototanga, ā, ka tautoko kia ahu whakamua ai ngā mahi whakarauora pūnaha hauropi puta noa i Aotearoa. Kei te mihi atu mātou ki ngā tāngata katoa kua tautoko i tēnei putanga nā te tuhi porohanga, nā te mahi hoki i ngā mahi atawhai taiao ake. E whakaahua tika ana te whakataukī tawhito nei i tō tātou manawanui:

I pā te ngaru ki uta, ka rerekē haere te whenua
Each wave breaking on the shore, alters the landscape slightly




Mrs Jane Davis
Kaumātua
Ngāi Tahu



Allan Munn
Conservation Services Director
Department of Conservation

Pou-tū-te-Rangi 2017



Fiordland, the southwest corner of Te Wāipounamu/South Island, contains some of the most dramatic natural landscapes seen anywhere in the world.

Looking north from Tamatea/Dusky Sound along the Acheron Passage with (L) Mauikatau/Resolution Island and (top R) Wet Jacket arm, with rātā in flower. *Photo: Rob Suisted.*



Map 1. Fiordland National Park overview.

Fiordland – rugged and diverse

The southwest corner of Te Wāipounamu/South Island contains some of the most dramatic natural landscapes seen anywhere in the world. At 1,260,740 ha, Fiordland National Park is the largest national park in New Zealand and one of the largest in the world (Map 1).

Fiordland National Park forms part of the Te Wāhipounamu (the place of greenstone) - South West New Zealand World Heritage Area (2.6 million ha) listed in 1990. This World Heritage Area encompasses much of the southwest of the South Island, including Aoraki/Mount Cook, Tai Poutini/Westland, Fiordland and Mount Aspiring National Parks.

The Takitimu Mountains (forming the Takitimu Conservation Area) east of Fiordland National Park and southeast of Lake Manapouri are the most prominent mountains in Southland. Regarded by Māori as the upturned hull of the *Takitimu* canoe, these mountains can be seen from most parts of the Southland plains. The Mavora Lakes Conservation Park and Livingston Mountains extend to the north and are both included in Te Wāhipounamu.

Rugged glaciated mountain peaks dominate the Fiordland skyline. Steep-sided valleys, waterfalls, glacier-fed rivers and lakes and sheer rock faces that fall dramatically away into the deep waters of the fiords

characterise this wild landscape. Fiordland contains hundreds of coastal and inland islands, ranging in size from small rock stacks to the impressive 20,860-ha Mauikatau/Resolution Island. Combined, the Fiordland islands have a land area of over 40,000 ha.

The region is renowned for its vast extent of natural flora and diverse and abundant wildlife. It is a stronghold for many of the less-common of New Zealand's endemic birds, bats and lizards. Indeed, new animal and plant species are still being discovered and previously unknown populations of threatened species identified. And there is just as much going on beneath the water. Wide recognition was given to the outstanding natural value of Fiordland's marine ecosystems in 2005 with the establishment of the Fiordland (Te Moana o Atawhenua) Marine Area (FMA), which extends from Awarua Point on the West Coast (just north of Big Bay) to Sandhill Point (western point of Te Waewae Bay), and 12 nautical miles out to sea.

When the Department of Conservation (DOC) was established in 1987, the Te Anau Area Office, within Southland Conservancy, became the centre for conservation management for Fiordland National Park, the northern Takitimu Mountains, Mavora Lakes and the Livingston Mountains. DOC's headquarters were (and



Looking over the cluster of islands near the entrance to Tamatea/Dusky Sound. Cook Channel and Long Island in the foreground, and Bowen Channel to Mauikatau/Resolution Island at right. Mamaku/Indian Island sits in front of Long Island and Pukenui/Anchor Island is out to the right with Taumoana/Five Fingers Peninsula beyond. *Photo: Rob Suisted.*

still are) located within the Te Anau township. There is also a field centre at Burwood Bush (near Te Anau), home of the takahē captive rearing programme. A team of seven permanent biodiversity staff was responsible for the protection and management of the district's public conservation land and the terrestrial and freshwater flora and fauna that inhabited the region.

The focus of biodiversity work in 1987 was wild animal control (deer in the Murchison Mountains and chamois in northeastern Fiordland), an early attempt at eradicating deer from Kā-Tū-Waewae-o Tū/Secretary Island in Doubtful Sound/Patea, island inventory monitoring, and species work with takahē and mohua (yellowheads). Searching was still underway for kākāpō in northern Fiordland after 'Richard Henry', the last known Fiordland kākāpō, was relocated from Gulliver Valley to an island in 1975.

But all of that was about to change! The eradication of Norway rats from Te Au Moana/Breaksea Island (170 ha) in 1987 attracted international attention as a world first in island pest eradication programmes. This project, hugely ambitious at the time, was the beginning of a

period of intense biodiversity research and management in Southland Conservancy that has been hugely influential for conservation in the rest of New Zealand and elsewhere.

In 2013, following a major restructuring of DOC, conservancies (including Southland) were disestablished. Boundaries shifted and most of what was Fiordland National Park became Te Anau District, with the inclusion of Waitutu Forest. This book summarises the work done under the auspices of Southland Conservancy. For consistency and simplicity, the geographic scope of the book retains the pre-2013 boundaries but covers the period from 1987 to 2015.

In 2016, DOC's Te Anau District had 51 permanent staff, including 15 biodiversity staff. However, conservation effort extends far beyond what this team manages and delivers, with significant contributions now made by community trusts, national (often corporate) and small business partners, schools and extremely motivated individuals.

Long may these cooperative conservation efforts continue to sustain Fiordland's precious places and species!



Dogs and hunters being dropped off on Kā-Tū-Waewae-o Tū/Secretary Island. Photo: DOC.

The general approach for island pest eradications is to develop successful techniques on small islands and then scale them up for progressively larger islands.



DOC Biodiversity Ranger Pete McMurtrie establishing track and trap lines on Kā-Tū-Waewae-o Tū/Secretary Island, 2005. Photo: Graham Dainty.



Map 2. Pest status of Fiordland Islands.

Island pest eradications

Integrated biodiversity management is often more cost effective on islands than on the mainland due to the lower numbers and types of pests present, and lower reinvasion rates. Therefore, pest-free islands are considered convenient and safe refuges for many of New Zealand's threatened species – and large pest-free islands are of particular importance as they have the potential to hold large, self-sustaining populations of these species (Map 2).

The value of pest-free islands

Rats, mice and brushtail possums have never been present on some of the islands in Fiordland. Kā-Tū-Waewae-o Tū/Secretary Island (8140 ha), at the entrance to Doubtful Sound/Patea, is one such place and is particularly noteworthy for its diversity of large invertebrates, which include the knobbed weevil – a giant alpine weevil (*Lyperobius* sp.), cave wētā (family Raphidophoridae), a tunnelweb spider (*Hexathele* or *Porrhothele* sp.) and a giant land snail (*Powelliphanta fiordlandica*), with the latter being first recorded on Kā-Tū-Waewae-o Tū/Secretary Island in 2007. The Fiordland skink (*Oligosoma acrinasum*) is also present. Kā-Tū-Waewae-o Tū/Secretary Island is the second largest island on the Fiordland coast and the third highest island in New Zealand (1196 m). It is one of only two islands in New Zealand of significant size that has never had rodents present – the other being Adams Island in the subantarctic Auckland Island group. In 2004, the enormous potential for pest eradication and restoration on both Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution Islands was recognised by the New Zealand Government, which allocated NZ\$7.1 million over 10 years to eradicate stoats and deer from them.



Kā-Tū-Waewae-o Tū/Secretary Island. Photo: Graham Dainty.

Given the number of islands in Fiordland, it is hardly surprising that this region has a long and particularly noteworthy association with island pest eradication and restoration projects. Shortly after DOC was formed, it successfully carried out the first ever eradication of rats from a large island, removing Norway rats from 170-ha Te Au Moana/Breaksea Island using ground-based baiting methods in 1988. This operation followed the success of a pilot campaign on the adjacent and much smaller Hāwea



Te Au Moana/Breaksea Island at the entrance to Te Puaitaha/Breaksea Sound. On islands such as Te Au Moana/Breaksea, Te Kākāhu-o-Tamatea/Chalky and Pukenui/Anchor, the removal of pest species has resulted in whole-ecosystem benefits, including increased forest health and the re-introduction of threatened bird species such as kākāpō and tīeke. Photo: Barry Harcourt.

Island (9 ha) in 1986, and gave DOC an international reputation for pioneering single-species (rodent) eradications on remote islands. Between 1987 and 2015, over 14 additional islands with a total area of more than 31,000 ha were targeted for pest eradication in Fiordland, along with many smaller 'stepping stone' islands that were included for monitoring and control purposes.

True eradication is defined as the complete removal of a pest species with zero chance of reinvasion. For some programmes, the eradication rule of zero reinvasion risk has not been met and so the programme objectives have had to be revised to fit with the currently available pest



A Norway rat taking bait from a station on Te Au Moana/Breaksea Island, during the successful rat eradication programme in 1988. Photo: Rod Morris.

Island approach to pest eradication

The general approach for island pest eradications is to develop successful techniques on small islands and then scale them up for progressively larger islands.

Rats and mice DOC has developed best-practice techniques for rat and mouse eradications which have since been used throughout the world. The mouse eradication operation on Te Puka-Hereka/Coal Island (1163 ha) in Fiordland in 2008 was, at the time, the largest ever attempted. It has since been surpassed by Australia's Macquarie Island (12,780 ha), which was declared pest-free in 2014.

Deer and stoats Techniques for deer and stoat eradication are still being developed. The first stoat eradication was conducted on Te Kākāhu-o-Tamatea/Chalky Island (514 ha) in 1999, and this programme was then successfully scaled up for Pukenui/Anchor Island (1130 ha) in 2001 and Te Puka-Hereka/Coal Island (1163 ha) in 2005. Red deer were successfully eliminated from Pukenui/Anchor Island between 2002 and 2007 by ground hunters using hunting dogs to detect the deer. The hunters initially worked independently but switched to team hunting after 2 years. Other techniques have also been trialled on Pukenui/Anchor Island, including remote monitoring of deer capture pens and self-attaching radio collars. These techniques have been further developed on Secretary Island with mixed success, along with additional technological advancements, including the use of high-definition remote trail cameras, superior 'hybrid' hand-held GPS/radio technology, and the identification of individual deer using DNA from fresh deer faecal pellets – a technique that has only been available since 2011. The current deer programme on Kā-Tū-Waewae-o Tū/Secretary Island largely uses a combination of helicopter and ground hunting (including teams) with dogs.



VHF radio tracking collar fitted to a deer in 2009. Photo: DOC.



Hunting indicator dogs with a deer on Kā-Tū-Waewae-o Tū/Secretary Island, 2014. Photo: DOC.

management methods. For islands where reinvasion is likely or ongoing it is more appropriate to use control to zero-density as the objective for the target pest. Control to zero-density is a state where a pest population has been reduced to such low numbers that it is no longer detectable. This objective recognises the fact that reinvasion is certain and so ongoing management to remove invaders is essential.

Operations in Fiordland have targeted stoats, red deer, Norway rats, mice and Australian brushtail possums. Where achievable, the desired outcome for each of these pest species has been eradication, and long-term control has also been established to reduce the likelihood of reinvasion. With the further development of control techniques over time, it has become increasingly possible to target larger islands with more complex terrain that are in closer proximity to the mainland – and thus have a greater risk of reinvasion.

Deer eradication programmes

Introduced red deer colonised islands in Fiordland in the last 50 years. Due to their good swimming abilities, they have reached all but the outermost islands of Te Au Moana/Breaksea and Te Kākāhu-o-Tamatea/Chalky Island as their numbers have increased.

The large numbers of red deer on Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution Islands have caused significant changes in the composition and structure of the forest understorey (see *Flora and vegetation monitoring* – chapter 5). Deer preferentially feed on species such as broadleaf, māhoe, kāmahī, five-finger and hen and chickens fern; and in alpine areas, they have selectively grazed on large herbaceous plants, some species of which are now absent. Deer also deplete the forest litter layer, making it low in nitrogen



Richard Ewans with a red deer stag shot near Te Ra/Dagg Sound, Fiordland, 2012. Photo: Richard Ewans.



Red deer grazing on Kā-Tū-Waewae-o Tū/Secretary Island. This photo was snapped by one of DOC's trail cameras, set up on the island to aid in the deer eradication project. Photo: DOC remote camera.

and high in lignin, which has led to a dramatic decline in invertebrate populations that rely on the forest litter for shelter and food; and they browse on the host plants of some invertebrates (see *Invertebrates* – chapter 5).

The deer eradication programme on Pukenui/Anchor Island ran from 2002 to 2007, with eradication achieved in 2006. Surprisingly, given its proximity to the mainland, this island has remained deer-free since. Two very ambitious deer eradication programmes were also established on Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution Islands in 2006 and 2009, respectively. The DOC project team worked collaboratively with DOC's Islands Eradication Advisory Group (IEAG), expert hunters and staff from Landcare Research (Graham Nugent and Andrea Byrom) and its commercial DNA-based diagnostic lab EcoGene (Dianne Gleeson and Frank Molinia) to develop an operational plan for both islands. This collaborative approach ensured that the programme was supported by a range of expert knowledge.

The programme on Kā-Tū-Waewae-o Tū/Secretary Island met with initial success, with an estimated 80% of the deer population removed within the planned 2-year timeframe for population knockdown – and initial fears that deer would continually reinvade Kā-Tū-Waewae-o Tū/Secretary Island and compromise eradication efforts were not realised. DNA analysis of deer that were shot on the island and the adjacent mainland indicated that only a very small number of hinds originally arrived on the island and also suggested zero-immigration during the period November 2006 to June 2013. However, despite these achievements, a small population of deer still persisted on Kā-Tū-Waewae-o Tū/Secretary Island in June 2012. Therefore, the project team commissioned Graham Nugent and Cecilia Arienti-Latham of Landcare Research to construct simple eradication and harvest models for the deer population.

Using hunting data and information about the age and sex of each deer shot, Graham and Cecilia were able to assess patterns or trends in deer population size, reproductive rates and kill rates. This not only enabled them to estimate the likely cost of achieving eradication

on Kā-Tū-Waewae-o Tū/Secretary Island, but also informed the planning and implementation of other similar deer eradication programmes, most notably on Mauikatau/Resolution Island. They concluded that it would be possible to eradicate deer from Kā-Tū-Waewae-o Tū/Secretary Island using current methods, and so a decision needed to be made on whether to make a final push to achieve eradication within a single year, or to spread the final effort over 2 or 3 years.

In early 2013, a team of ground hunters and their indicating dogs grid searched all accessible parts of Kā-Tū-Waewae-o Tū/Secretary Island to assess the number and distribution of deer. They estimated the population at 14 individuals. It was clear that these remaining deer had become extremely wary and adept at avoiding hunters, dogs and helicopters. Extreme weather, acute topography and the regeneration of the island's understorey gave the remaining deer a significant advantage over hunters. However, no other eradication tools were currently available, and so the only option for eliminating these last deer was to hunt them more effectively.

The revised objective was to reduce the red deer population on the island to 'zero detectable density' within 12 months in acknowledgement of the slight but real risk of reinvasion. Helicopter-assisted team hunting with a combination of indicating and chasing dogs was used to quickly locate and eliminate deer. The DNA profiles of all animals shot and any fresh deer sign (faecal pellets) found was used to determine the familial relationships between deer. In September 2014 there was thought to be only one male deer remaining on the island. In August 2015 an exhaustive search of the island by 12 hunters over 9 days showed no recent sign of deer on the island. The project team are confident that their goal has been achieved and that no deer were present on the island during the time of the last search.

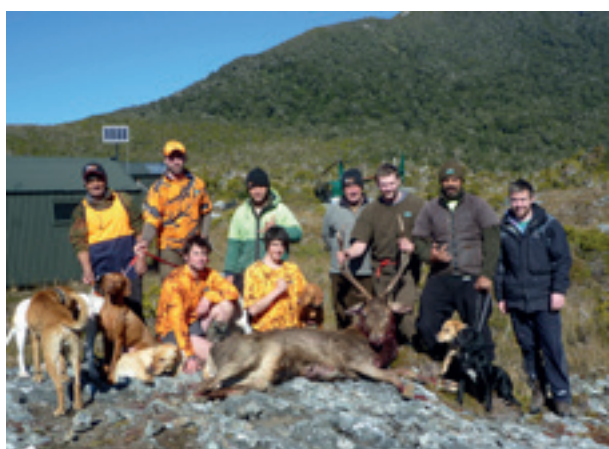
The decision to completely remove the deer population from Kā-Tū-Waewae-o Tū/Secretary Island has been subject to considerable scrutiny and rigour. For this kind of project to be successful, the team of highly skilled hunters, and the technical experts in the field of DNA-



DOC ground-hunting team with a hind on Kā-Tū-Waewae-o Tū/Secretary Island, June 2013. Photo: DOC.



A helicopter flies above Secretary Lake on Kā-Tū-Waewae-o Tū/Secretary Island as part of DOC operations, 2005. *Photo: Graham Dainty.*



DOC's Kā-Tū-Waewae-o Tū/Secretary Island hunting team with a stag, 2014. L to R: Puni Tiakiwai, John Clark, Pat Dawson, Robert Tiakiwai, Jordan Munn, Norm MacDonald, Ben Crouchley, Chino Apiata and Dan Harrison. *Photo: DOC.*

based diagnostics and population modelling must be engaged in the process from the outset. The project has now shifted to a monitoring phase using grid searching of the island every 3 years and a network of trail cameras. Any fresh deer sign reported will be immediately followed up using the previously mentioned team-hunting method.

On Mauikatau/Resolution Island, red deer were being removed using a traditional hunting approach that previously worked well for deer suppression in the Murchison Mountains in mainland Fiordland. However, although this programme has succeeded in reducing the deer population, some of the remaining deer are extremely wary of ground and helicopter hunting techniques. Further, the reduction in the number of deer has also led to regeneration of the forest understorey, which will likely hamper future efforts to eradicate the remaining animals using this approach.

In late 2013, two options were considered by DOC for the deer programme on Mauikatau/Resolution Island:

- Continue with the current hunting philosophy and alter the goal of the Mauikatau/Resolution eradication project to 'control to low densities'; or
- If eradication is still the favoured option, take steps to optimise the chances of successfully killing the last deer and remove any risks that are inherent in the current approach.

Critical to this evaluation was consideration of the significant up-front investment that would be required to achieve eradication, together with the cost of ongoing surveillance. However, in the medium term (20–50 years), this investment would be minor compared with the cost in perpetuity of a control programme where deer are suppressed to the desired level. Taking into account the moderately sized population of deer that is currently on Mauikatau/Resolution Island, an ongoing control programme would still require a significant investment in the short term. Furthermore, once deer have been reduced to very low levels, their population would need to be monitored and further control efforts pulsed every few years as required, which would probably equate to greater maintenance effort than the surveillance costs associated with maintaining a state of eradication (or control to zero-density if immigration were to become an issue for the island). Hunter effort may also need to increase over time as the understorey will rapidly increase in density once the pressure of browsing animals has been removed, which will reduce the efficacy of control techniques. Therefore, ongoing control is not necessarily a cheaper option than investing in and then maintaining a state of eradication once a medium-term financial horizon is determined.

The project team are now considering two further options in addition to those outlined in 2013, including high-level control in the alpine zone of the island and/or control to zero density on Taumoana/Five-fingers Peninsula (3500 ha) on the west of the island, with a buffer zone where deer are controlled on main Mauikatau/Resolution Island.



Mauikatau/Resolution Island. Photo: Richard Kinsey.

Stoat eradication programmes

Stoats were first introduced to mainland New Zealand in the late 1880s in response to feral rabbit plagues that were destroying pasturelands and posing a serious threat to the New Zealand economy. Stoats are very mobile and are capable swimmers. They were first observed by Richard Henry, curator on Mauikatau/Resolution Island, in 1900 and probably invaded other remote islands in Fiordland (including Kā-Tū-Waewae-o Tū/Secretary Island) at around the same time.

The first ever successful eradication of stoats from an island was conducted on Te Kākāhu-o-Tamatea/Chalky Island (514 ha) in 1999. In 2000, realising the potential to eradicate stoats from much larger islands in Fiordland, DOC Biodiversity staff in Te Anau and DOC scientist Graeme Elliott initiated a study measuring stoat immigration rates to islands in Fiordland. Stoats were trapped on 19 islands ranging in size from 1 ha to 67 ha and within varying distances from the mainland over a 4-year period in order to produce a predictive model of stoat reinvasion. Of 46 stoats captured, only one was caught on an island further than 304 m offshore. Based on these results, Graeme and the team concluded that large islands such as Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution would be suitable for stoat eradication attempts.

The project team worked with members of the IEAG, Elaine Murphy (DOC scientist), Darren Peters (DOC technical advisor), and staff from Landcare Research (Andrea Byrom, Dean Anderson and Richard Clayton) and EcoGene (Dianne Gleeson) to develop operational plans for both islands and to ensure that the programme was supported by robust scientific methodology. Work to establish the necessary infrastructure of tracks, traps and bivvies commenced on Kā-Tū-Waewae-o Tū/Secretary Island in 2004 and on Mauikatau/Resolution Island in 2007, with the initial knockdown of stoats in

The significance of Mauikatau/Resolution Island

Mauikatau/Resolution Island was gazetted as one of the world's first 'reserves' in 1891. Richard Henry considered islands to be beyond the reach of stoat invasion and so transferred 572 birds (mostly kiwi and kākāpō) to the island sanctuary. However, stoats are competent swimmers and had invaded many of the remote coastal islands of Fiordland only 6 years after their introduction to New Zealand. By 1900, Henry confirmed the worst when he observed a stoat on the island.



Richard Henry (1845-1929) outside his boatshed on Pigeon Island, Tamatea/Dusky Sound, c. 1900. Photo: DOC Collection.



Map 3. Distance swam by stoats to Kā-Tū-Waewae-o Tū/Secretary Island and Mauikatau/Resolution Island. The minimum stoat-swimming distance between Kā-Tū-Waewae-o Tū/Secretary Island and the mainland is 900m across Thompson Sound or 630m from the mainland to Bauza Island then 550m across to Shelter Islands and a further 215m to Kā-Tū-Waewae-o Tū/Secretary Island. For Mauikatau/Resolution Island the minimum distance to the mainland is 550m across Acheron Passage. Research work lead by Graeme Elliott predicted that stoats would be very unlikely to swim beyond 300m. This prediction, based on small islands in Fiordland, was not found to hold for these larger islands with long stretches of coastline adjacent to the mainland.

the winters of 2005 and 2008, respectively. Regular reviews were undertaken to assess progress against the programme objectives, to consider the current approach and methodology, and to determine whether the original eradication objective was still appropriate. At that time traps were checked and re-baited three times per year.

Stoats are now controlled to very low levels on both islands, but unfortunately the original goal of full and sustained eradication has not been achieved on either island due to continued immigration, and failure to intercept all resident and immigrant stoats prior to territory establishment and breeding. Fundamentally, stoat reinvasion of both islands is more frequent than either the stoat immigration model or previous experience predicted. DNA analysis of stoats captured on Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution Islands and in the adjacent areas of mainland since the commencement of the programmes indicates that a small number of stoats swim to these islands during most summers, with increased numbers following rodent plague years (i.e. 8 or more individuals in plague years). Consequently, the current operation is effectively maintaining stoats at very

low densities by trapping the offspring of 'hard-to-trap' stoats and most, but not all, invaders.

This moderate-cost management regime appears to be sufficient to sustain species of animals whose populations have some tolerance to low levels of stoat predation. For example, some fauna are responding positively to the low numbers of stoats on Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution islands, including populations



A stoat trap and tunnel in Kā-Tū-Waewae-o Tū/Secretary Island forest. Photo: Graham Dainty.

Can we eradicate stoats?

Despite the intensive control programmes, very small populations of stoats appear to have persisted on Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution Islands, based on trap capture data, stoat footprints and scats, and trail camera footage. A highly successful collaboration between DOC staff, Landcare Research, EcoGene and the University of Auckland has greatly informed the progress of these eradication campaigns. This partnership, supported by DOC's Islands Eradication Advisory Group (IEAG), has enabled the project management team to re-evaluate the programme's objectives and develop a fit-for-purpose operational plan for stoats on both islands for the next 3-5 years.

Dianne Gleeson (EcoGene) and Andrew Veale (PhD student, University of Auckland) analysed DNA from stoats captured on both Islands and adjacent areas of the mainland, Andrew estimated the age of trapped stoats by counting cementum (tooth enamel) layers on their teeth. It appears that these small, remnant populations are made up of new invaders, descendants of the original population that evaded capture for several years, and the offspring of both.

Predictive modelling led by Dean Anderson and Andrea Byrom (Landcare Research) has confirmed that the eradication of stoats from Mauikatau/Resolution Island is not achievable under the current management regime. The objectives of eradication or control to zero-density both require a substantial increase in effort to reduce immigration, and an ability to increase the capture rate of female stoats in particular. However, Mauikatau/Resolution Island stoats are highly productive and the residual population appears to have a strong female bias of 3:1, meaning that a reduction in trapping effort may result in higher stoat numbers and cessation of the stoat project would result in a return to pre-control stoat densities within 2-3 years. The Kā-Tū-Waewae-o Tū/Secretary Island stoat population has not yet been modelled in the same way as the Mauikatau/Resolution population, but the sex ratio of the original population was also female biased (2:1), so it is expected that the consequences of reducing or halting trapping effort would be similar.



Genevieve Taylor resets a trap after successfully bagging one more stoat on Kā-Tū-Waewae-o Tū/Secretary Island. Photo: Graham Dainty.



DOC Ranger Jane Tansell and Koha on Kā-Tū-Waewae-o Tū/Secretary Island during the first kōkako release in 2008. Koha's role was to sniff out any evidence of stoats in a bid to ensure the island was pest free. Photo: DOC.



DOC Biodiversity Ranger Pete McMurtrie weighs a stoat caught during the stoat 'knock down' on Kā-Tū-Waewae-o Tū/Secretary Island, 2005. Photo: Graham Dainty.

of Fiordland skinks, weka, bellbirds (korimako) and kākā on Kā-Tū-Waewae-o Tū/Secretary Island and rock wrens (tuke) on Mauikatau/Resolution Island. Several threatened species have also been successfully reintroduced to these islands – most notably rock wrens and mohua on Kā-Tū-Waewae-o Tū/Secretary Island, and mohua on Mauikatau/Resolution Island (see chapter 3). However, this level of control may not be sufficient to enable the successful reintroduction of tīeke or strong recovery and recruitment of kiwi species to these islands, and would not be adequate for translocated kākāpō or New Zealand snipe to persist. North Island kōkako were translocated to Kā-Tū-Waewae-o Tū/Secretary Island over 2 years from 2008 to 2009. Individual kōkako were known to survive and breed on the island, but have subsequently failed to establish (see chapter 3). The reason for this failure is unknown, but it is impossible to ignore the elevated number of stoats caught on the island subsequent to the birds' release.

In 2013 it was concluded that a status-quo approach to the management of stoats on these islands would not achieve eradication. Nor would it result in control to zero-density, as a small proportion of stoats will continue to remain untrapped. The revised (2015-19) programme objectives for both islands are:

- To achieve and maintain zero-density stoat populations on Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution Islands by 2019 (i.e. the removal of all known resident stoats on the island and the elimination of invaders before breeding occurs).

- To maintain and improve biosecurity measures to prevent incursions of rodents on Kā-Tū-Waewae-o Tū/Secretary Island and rats on Mauikatau/Resolution Island (which already has mice).

This revised objective for stoats will be achieved by intensifying stoat control in nearby sites on the mainland. This may include the trialling of aerially applied 1080 baits for rats (with the intention of controlling stoats via secondary poisoning from eating the poisoned rats) in winters following observed beech mast events in mainland areas adjacent to Mauikatau/Resolution Island (if rats are predicted to reach a predetermined target of 30% tracking by the month of December). Alternative methods for targeting resident stoats are also to be trialled on Kā-Tū-Waewae-o Tū/Secretary Island. These include a combination of four new trapping and baiting methods (using the current DOC 150™ series traps) that can be integrated into the programme without the need for further developments in technology. The island traps are now serviced four times per year, rather than three, to ensure that fresh bait is available at the most critical times.

The future of island pest eradication programmes in Fiordland

Restoration planning is currently in place for Kā-Tū-Waewae-o Tū/Secretary and Bauza Islands in Doubtful Sound/Patea, all islands within the Tamatea/Dusky Sound Project Area, Te Kākāhu-o-Tamatea/Chalky Island

in Chalky Inlet, and the community-led programmes on Pomona and Rona Islands on Lake Manapouri and Te Puka-Hereka/Coal Island in Preservation Inlet. The Tamatea/Dusky Sound project area encompasses all of the terrestrial and marine ecosystems within Tamatea/Dusky Sound, Te Puaitaha/Breaksea Sound, Wet Jacket Arm and Acheron Passage, including important mainland buffer zones that have intrinsic values, provide additional high-quality habitat, and will enhance the protection of established or proposed pest control areas. The aim of this plan is to provide a strategic assessment of where to direct conservation effort in Tamatea/Dusky Sound and to deliver a coordinated approach to all of the island work in Southern Fiordland. Individuals and corporate businesses (e.g. Te Puka Hereka Trust on Te Puka-Hereka/Coal Island and Fiordland Conservation Trust on Mamaku/Indian Island) have already made a significant commitment to conservation work in this region (supported by local and national funding; see chapter 3),

but this plan provides a localised strategic and organised way to respond to opportunities for external funding.

Managing the re-invasion of pests on near-shore and accessible islands in Fiordland (e.g. stoats to Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution Islands, rats to Pomona and Mamaku/Indian Islands and mice to Rona Island) remains a significant challenge for everyone. There is also an urgent requirement for new and effective 'field-ready' tools for eliminating hard-to-trap stoats in large areas with inaccessible terrain (see *Management of possums, stoats and rats* – chapter 4). To mitigate the risks associated with terrestrial incursions, there needs to be a greater coordinated effort across government agencies – e.g. around the provision of advice on the special conditions attached to Surface Water Resource Consents for coastal operators in Fiordland. An interagency approach is working extremely well in the marine environment and so may provide some tools to address this issue.

Catching trap-averse stoats

Some of the few remaining stoats on Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution Islands are now actively avoiding trap tunnels – a male stoat on Kā-Tū-Waewae-o Tū/Secretary Island that was a 1-year-old at the time of the original knockdown avoided capture for 4 years and fathered two litters before eventually being caught in 2008. The extremely difficult terrain on these islands also means that female stoats (which have smaller home ranges than males) may never encounter a trap. New tools, including stoat lures and self-resetting traps, are currently being developed to help tackle this problem, but in the meantime DOC staff are working to increase the possibility of stoats encountering traps by creating trap 'stab lines' that access the most inaccessible areas, which cannot be included in trap circuits. Run-through tunnels (open-ended with no bait) and natural scent lures placed inside standard tunnels have also been used. All methods have had some success, but appear still to be capturing only young (less than 1-year-old), inexperienced animals.



The TUN200, Zero Invasive Predator's (ZIP'S) prototype 'best practice' tool for stoats, is an example of new developments in technology targeting stoats. It houses two DOC 200™ traps in a 'tunnel' structure and is presently being trialed with a range of lures for both rats and stoats as well as automated reporting and lure dispensing to reduce the labour associated with servicing (see the auto-reporting 'node' on top of the box in the photo). *Photo: Rory Harnden.*

Managing the re-invasion of rodents on Rona and Pomona Islands, Lake Manapouri

Pomona (262 ha) and Rona (62 ha) are islands within Lake Manapouri. The Pomona Island Charitable Trust was successful in eradicating five pest species from Pomona Island – stoats, ship rats, deer, mice and possums – over 2 years from 2006 to 2007. Nearby Rona Island (62 ha) was targeted for mice by the Trust at the same time, and both islands were declared predator free in 2009. However, later in 2009 a single mouse was trapped in a rodent motel on each island and despite extensive trapping a mouse population had re-established on Pomona Island by 2010. Small numbers of mice were detected on Rona Island in 2012 and despite the Trust's best efforts, mouse tracks were recorded in 100% of rodent tracking tunnels deployed across the island in 2014.

Rona Island was being used as a predator-free crèche site for chicks of the critically endangered Haast tokoeka and the presence of mice caused the Kiwi Recovery Group to express concern at the island's ongoing suitability for this purpose. A report on mouse eradication versus control for the island was prepared by Viv Shaw and released by the Trust in 2015. The preference was to eradicate mice using ground-based methods; however, limited resources prevented a one-off eradication and the number of bait stations across the island was scaled back and the programme became one of on-going control. A 25 m × 50 m bait station grid (464 bait stations) was established alongside a network of 42 rodent tracking tunnels. At this time, mice were tracking at 23.8% (using DOC best practice with tracking cards in situ for one night). After two fills of the bait stations with the poison bait brodifacoum, mice were tracking at 0%. In March 2016, after tracking cards had been in the tracking tunnels continuously for 158 nights, mice were still tracking at 0%. It is conceivable that there are presently no mice on Rona Island, making the outcome of the 'control' programme quite remarkable. This was the first time in New Zealand that a ground-based control programme for mice was carried out on an island of Rona's size. Haast tokoeka were due to return in early May 2016.

Rat paw prints were found in a tracking tunnel on Pomona Island in 2010 and a rat was trapped shortly after. By 2011 a small number of rats had been trapped and DNA testing of these rats suggested that a breeding population had established. In late 2012 the Trust established an extensive bait station and trap network aimed at eradicating rats. This was extended in August 2013 and currently comprises 179 stations using Pindone baits and 172 trap sites on a 100 m × 100 m grid. Trapping peaked at 220 rats in spring 2013 and then dropped to no captures in spring 2015 and has subsequently continued at this level.



Pomona Island. Photo: Graham Dainty.



Viv Shaw with rat, Pomona Island. Photo: Chris Shaw.

Reducing rats to undetectable levels on Pomona Island has been beneficial for the robins and mohua translocated to the island. Mohua survived the rat re-invasion and appear to be doing well.

This work on Pomona and Rona islands has been possible because of the huge support received from the community, both financially and in terms of the volunteers involved. In July 2015 the Pomona Island Charitable Trust celebrated its tenth birthday. During that 10-year period more than 350 volunteers have put in almost 12,000 hours of work on the two islands.

DOC-led eradication programmes in Fiordland

Completed

- Norway rats (Hāwea Island, 8 ha, 1986; Te Au Moana/Breaksea Island, 170 ha, 1988).
- Stoats (Te Kākāhu-o-Tamatea/Chalky Island, 514 ha, 1999; Passage Islands, 189 ha, 1999; Pukenui/Anchor Island, 1130 ha, 2001; Bauza Island, 480 ha, 2002; Pigeon and Parrot Islands, 126 ha, 2005).
- Red deer (Pukenui/Anchor Island, 2002–07; Kā-Tū-Waewae-o Tū/Secretary Island, 8140 ha, 2006–2015).

Still underway

- Stoats (Kā-Tū-Waewae-o Tū/Secretary Island, 2005–; Mauikatau/Resolution Island, 20,860 ha, 2008).
- Red deer (Tau Moana/Resolution Island, 2009, on hold 2013).

NGO/community-led programmes

- Stoats (Te Puka-Hereka/Coal Island*, 1163 ha, 2005; Pomona Island†, 262 ha, 2006; Rona Island‡, 60 ha, 2006).
- Red deer (Pomona Island†, 2006–07; Coal Island, initiated in 2006).
- Mice (Rona Island‡, 2006; Pomona Island†, 2007; Te Puka-Hereka/Coal Island, 2008).
- Ship rats (Pomona Island†, 2007).
- Brushtail possums (Pomona Island†, 2007).
- Mice and rats (Mamaku/Indian Island‡, 168 ha, 2010).

Incursion/suspected incursion responses by DOC

- Single male rat trapped on Mauikatau/Resolution Island in 2006.
- Several rats trapped on Blanket Bay Island (50 m offshore from Kā-Tū-Waewae-o Tū/Secretary Island) in 2006.
- Possible mouse sighting at The Gut Hut, Kā-Tū-Waewae-o Tū/Secretary Island, in 2006.
- Possible mouse chew marks detected on a waxtag™ near Blanket Bay in 2009.
- Possible stoat sighting on Pukenui/Anchor Island in 2007.
- Response to vessel sinking off Mauikatau/Resolution Island in 2007.
- Response to vessel sinking off Kā-Tū-Waewae-o Tū/Secretary Island in 2012.
- Single rat trapped on Pukenui/Anchor Island in 2012.
- Response to vessel washing ashore on Te Au Moana/Breaksea Island 2016.

Post-eradication reinvasion

- Rats to Pomona Island in 2010. Bait station and trapping network established 2012–13. Rats maintained at zero-density from spring 2015 to Autumn 2016.
- Mice to Pomona and Rona Islands: A single mouse was trapped in a rodent motel on each of Pomona and Rona Islands in June/July 2009. Extensive trap networks targeting mice were established on both Islands. In March 2010, a further single mouse was trapped on Rona Island. A mouse population re-established on Pomona Island in 2010 and on Rona Island in 2012. Bait station grid established on Rona and mice currently tracking at 0%.
- Rats confirmed as re-established on Mamaku/Indian Island February 2016.

* South West New Zealand Endangered Species Charitable Trust est. 2004

† Pomona Island Charitable Trust est. 2005

‡ Fiordland Conservation Trust est. 2007

Preventing incursions

The ongoing success of island pest eradication programmes depends on no new plant or animal pests arriving on the islands. DOC's pest control activities have been carried out in accordance with the *Island Biosecurity Plan: Southland Conservancy* and weed management strategies developed for the large programmes on Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution Islands. In 2008, a new purpose-built island quarantine facility was opened to support the increased level of work on Fiordland islands and to ensure that the rigorous quarantine standards were being met. Rodent motels, bait stations and rodent monitoring devices have also been established at all common mainland anchorages adjacent to rodent-free islands in Fiordland.

These requirements also extend to operations on board the DOC vessel *MV Southern Winds* and other vessels visiting Fiordland. DOC has worked with local operators to develop their own biosecurity plans for vessels and shore parties. Regular reminders about the importance of island biosecurity are sent out to coastal operators in newsletters timed to coincide with peak boating activity in the region.



Inside DOC's quarantine facility, Te Anau. Photo: DOC.

Funding and partnerships

The majority of the Fiordland island eradication projects to date have been funded by the Government and led and managed by DOC, including the work on Kā-Tū-Waewae-o Tū/Secretary and Mauikatau/Resolution Islands (which received a \$7 million funding package in 2005). However, DOC's work has also been supported by financial sponsorship from many individuals and organisations; in particular, three community trusts have developed their own ambitious restoration projects in partnership with DOC and Te Rūnanga o Ōraka Aparima:



Te Puka-Hereka/Coal Island. Photo: DOC.

The South West New Zealand Endangered Species Charitable Trust (est. 2004) initiated a restoration programme for Te Puka-Hereka/Coal Island in Preservation Inlet in 2005. The Trust's focus is site-based on Te Puka-Hereka/Coal Island where they aim to fund and establish a world-class sanctuary for rare and endangered native species of flora and fauna. Their work is being jointly developed with a mix of private philanthropists and corporate and government participants.

The Pomona Island Charitable Trust (est. 2005) has been running a comprehensive community-led restoration programme

on Pomona and Rona islands in Lake Manapouri since 2006. Pomona Island is the largest inland island in New Zealand and the Pomona Island Charitable Trust aim to restore it to its presumed natural state prior to the introduction of pests.

The Fiordland Conservation Trust (FCT; established in 2007) was established as an independent locally-based philanthropic Trust to inspire the community to protect the special values in Fiordland and the wider Southland region. In 2010 FCT partnered with individual and group sponsors to enable the eradication of rodents (both mice and rats) from Mamaku/Indian Island. This project built on the stoat control put in place by DOC on Mamaku/Indian Island in 1999 to protect Pukenui/Anchor Island from stoat reinvasion.

Species translocation – defined as the deliberate movement and release of wildlife – is primarily carried out to ensure the persistence of the species.



Juvenile takahē Vancouver emerging from the tussock for her feed at Burwood Bush. Father Tuatahi is in the background. *Photo: Helen Dodson DOC.*

Translocation as a tool for conservation management

What is species translocation and why do we do it?

Species translocation is defined as the deliberate movement and release of wildlife. It is primarily carried out to ensure the persistence of a species. Individuals are often moved into an environment where they can be expected to survive in the absence of (or with a reduced level of) management – for example, onto islands or mainland sanctuaries that are predator-free. In some situations – particularly for critically endangered species such as kākāpō and takahē – the frequent translocation of birds across multiple sites is vital so that small

Translocation of whio

Translocation has been used successfully for whio (blue ducks) in Fiordland with the initiation of Whio Operation Nest Egg (WhiONE) and transfers of wild juveniles into protected catchments with very small numbers of whio.



A pair of whio with ducklings in Fiordland. *Photo: Rod Morris*

breeding populations can be collectively managed as a meta-population in order to minimise the loss of genetic diversity.

For some species, such as kiwi and whio (blue duck), translocation involves bringing eggs from the wild into captivity for hatching and rearing. As part of Operation Nest Egg (ONE), juvenile kiwi are reared in a safe ‘crèche’ site until they reach a certain size, at which time they are returned to their source or to a new location. In the case of whio (WhiONE), juveniles are released back into the source location or to another site to establish a new population.

Occasionally, the translocation of a surrogate species is used to assist the restoration of biotic communities that are likely to have been present before the arrival of introduced predators.

All of these approaches have been used for conservation management purposes in Fiordland.

Species translocations in Fiordland

Between 1987 and 2015 there were 26 translocations of threatened fauna to islands in Fiordland (including those in Lakes Te Anau and Manapouri) that resulted in the establishment and persistence of new breeding populations.

Although bird translocations have far outnumbered those of lizards, frogs and invertebrates in New Zealand, some of the earliest translocations in Fiordland were of the Fiordland skink and two large invertebrate species –



DOC Biodiversity Ranger Hannah Edmonds releases mohua (yellowheads) on Mauikatau/Resolution Island, July 2013. *Photo: Barry Harcourt.*

Bird, insect and lizard translocations to islands in Fiordland, 1987–2015

Population established and persisting

- **Kakaruai:** to Te Au Moana/Breaksea Island 1987; Pukenui/Anchor Island 2002, 2004; Pigeon Island 2007; Pomona/Rona Islands 2009; Te Kākāhu-o-Tamatea/Chalky Island 2010; Mamaku/Indian Island 2013.
- **Fiordland skink:** from Wairaki Island to Hāwea Island 1988.
- **Knobbed weevil:** from Outer Gilbert Island III to Te Au Moana/Breaksea Island 1991.
- **Flax weevil:** from Wairaki Island to Te Au Moana/Breaksea Island 1991.
- **Tieke:** to Te Au Moana/Breaksea Island 1992; Passage Islands 2001; Pukenui/Anchor Island 2002, 2004; Te Kākāhu-o-Tamatea/Chalky Island 2008.
- **Mohua:** to Te Au Moana/Breaksea Island 1995; Te Kākāhu-o-Tamatea/Chalky Island 2002; Pukenui/Anchor Island 2002; Pigeon Island 2007; Kā-Tū-Waewae-o Tū/Secretary Island 2008; Mauikatau/Resolution Island 2011, 2013; Pomona Island 2011.
- **Rock wren:** to Kā-Tū-Waewae-o Tū/Secretary Island 2008–2011.
- **Orange-fronted parakeet:** to Te Kākāhu-o-Tamatea/Chalky Island 2005, 2006, 2007.
- **Little spotted kiwi:** to Te Kākāhu-o-Tamatea/Chalky Island, 2008, 2009.
- **Haast tokoeka:** from Rona Island crèche site to Te Puka-Hereka/Coal Island (since 2009 - ongoing).
- **Haast tokoeka:** to Pomona Island, 2011.



Kakaruai (South Island robin). *Photo: Eamonn Ganley.*

Present in very low numbers

- **Kakaruai:** to Erin Island 2003; Doubtful Islands 2003; Kā-Tū-Waewae-o Tū/Secretary Island 2008.

Translocation in progress

- **Kakaruai:** Te Puka-Hereka/Coal Island 2015.
- **Mohua:** Te Puka-Hereka/Coal Island 2015.
- **Little spotted kiwi:** to Pukenui/Anchor Island 2015, 2016.



Little spotted kiwi. *Photo: Tui De Roy.*

Population established but did not persist

- **Mohua:** to Centre Island 1992.
- **North Island kōkako:** to Kā-Tū-Waewae-o Tū/Secretary Island 2008, 2009.

Population did not establish

- **Kakaruai:** to Entry Island 1989.
- **Tieke:** to Bauza Island 2003, 2010; Erin Island 2004.
- **Fiordland tokoeka:** to Doubtful Islands, Lake Te Anau 2002–06 (at least two pairs remain on the islands, while some returned to the Murchison Mountains).
- **Rock wren:** to Pukenui/Anchor Island 2004, 2005.

Translocation as part of meta-population management

- **Takahē:** to Kā-Tū-Waewae-o Tū/Secretary Island 2009 – unsuccessful.
- **Kākāpō:** first translocations to Te Kākāhu-o-Tamatea/Chalky Island 2002, 2005; Pukenui/Anchor Island 2005. Currently, these sites are managed as part of the kākāpō meta-population.

Operation Nest Egg

- **Haast tokoeka:** to crèche sites – Centre Island Lake Te Anau 2004; Te Puka-Hereka/Coal Island and Rona Island (since 2008, ongoing).

Bird translocations to mainland sites in Fiordland, 1987–2015

Reinforcement translocation

- **Mohua:** from Te Kākāhu-o-Tamatea /Chalky Island to Eglinton Valley 2010 (both recipient populations had very few individuals); from Pukenui/Anchor Island to Eglinton Valley 2015.
- **Takahē:** egg transfers within the Murchison Mountains and to Burwood Bush for captive rearing; puppet-reared juveniles from Burwood Bush returned to Murchison Mountains 1988–2010; parent-reared juveniles from Burwood to Murchison Mountains 2015.
- **Whio:** egg transfers to Punanga Manu o Te Anau/Te Anau Bird Sanctuary for captive rearing; juveniles released into Clinton/Arthur Valleys and Murchison Mountains 2002–11. Three transfers of wild juveniles within northern Fiordland and Mt Aspiring National Park from 2005 to 2014.

Population established and persisting

- **Pāteke** (North Island brown teal): Arthur Valley 2009–13.

Population established but did not persist

- **Kakarua:** from Eglinton Valley to Cleddau Delta 2011, 2012 (birds dispersed from the delta but persist in Cleddau Valley).
- **Takahē:** juveniles to Stuart Mountains 1987–92.

Bird transfers from sites within Fiordland to other locations (excluding display sites), 1987–2015

- **Mohua:** from Te Au Moana/Breaksea Island to Whenua Hou/Codfish Island Nature Reserve 2003 (successful); Te Au Moana/Breaksea Island to South Branch of the Hurunui, Canterbury 2008; from Te Kākāhu-o-Tamatea/Chalky Island to Hawdon Valley 2015.
- **Tieke:** from Breaksea Island to Orokonui Ecosanctuary 2013, 2014.
- **Takahē:** from Fiordland/Te Anau Wildlife Park/Burwood Bush to Tiritiri Matangi Island 1991; Kapiti Island 1989; Mana Island 1987; Maud Island 1984; Maungatautari Ecological Island 2006; Motutapu Island 2011; Cape Sanctuary (Cape Kidnappers) 2012; Tawharanui Open Sanctuary 2014; Rotoroa Island 2015.
- **Haast tokoeka:** from Rona Island to Orokonui Ecosanctuary 2011.

the knobbled weevil and flax weevil – which took place shortly after the establishment of DOC in 1987. Since then, several pioneering translocation programmes have been carried out:

Tieke management on Fiordland Islands

‘Safe’ populations of tieke (South Island saddlebacks) have been established on four predator-free islands, contributing to the future security of this species and allowing birds to be translocated to other sites outside Fiordland. As a result of this work and other translocations throughout the South Island, the threat classification for South Island tieke has improved from ‘Nationally Endangered’ to ‘At Risk–Recovering’.

In the early 1960s, tieke were rescued from their last outpost on Taukihepa/Big South Cape Island, off Stewart Island/Rakiura, following invasion of the smaller island by ship rats. They were initially moved to other small islands off Stewart Island/Rakiura. They were then translocated from Big and Kundy Islands to Te Au Moana/Breaksea Island in 1992, and have since been translocated from Te Au Moana/Breaksea Island to Passage, Pukenui/Anchor and Te Kākāhu-o-Tamatea/



A female tieke (saddleback) from Taukihepa/Big South Cape Island (off the coast of Stewart Island/Rakiura). Photo: Rod Morris.

Chalky Islands, where they have established populations. In 2013, Colin Miskelly and Ralph Powlesland wrote a review of conservation bird translocations in New Zealand¹, in which tīeke is described as the most successful taxon in terms of the number of successful translocations (18 (75%), plus five in progress at the time of writing). They noted how remarkable this is given that tīeke would be extinct had they not been rescued through translocation in 1964. The work undertaken to secure tīeke in Fiordland has played a key role in this success.

Although tīeke are no longer present on the mainland in Fiordland, good numbers remain on islands such as Te Au Moana/Breaksea and South Passage, making translocations to other islands and secure mainland sites possible. Increasing pressure to harvest the Te Au Moana/Breaksea Island population for translocations to other sites prompted DOC staff in Te Anau to commission a quantitative survey for tīeke (using the Distance Sampling method) over an estimated 115 ha of Te Au Moana/Breaksea Island in 2013. From this, it was estimated that there were 6.41 birds/ha, which equated to a population of around 1015 birds on the island. An earlier survey estimated 0.42 birds/ha or 400 individuals and calculated the carrying capacity of the island to be less than 500. The recent survey results and subsequent population modelling undertaken by Andrew Grant (DOC) suggest that the current population is now double the earlier figure and still increasing.



Te Au Moana/Breaksea Island, at the entrance to Te Puaitaha/Breaksea Sound, Fiordland. Photo: Barry Harcourt.

While it is unknown whether the tīeke population will continue to increase, stabilise or decline, these findings provide a good indication that it can sustain a significant harvest regime. Andrew's model provides for various harvesting scenarios, but he concludes that the removal of 100 birds in one breeding cycle should not be an issue. However, he also stresses the importance of ensuring that future surveys are carried out on Te Au Moana/Breaksea Island to determine how the population is progressing and when it stabilises.

Orange-fronted parakeet Recovery Programme

This programme established a secure population on predator-free Te Kākāhu-o-Tamatea/Chalky Island.



Orange-fronted parakeet. Photo: Rod Morris.

Fewer than 300 orange-fronted parakeets survive on the New Zealand mainland, and the species is classified as 'Nationally Critical' under the New Zealand Threat Classification System. Three remnant populations can be found in alpine beech forest valleys in Canterbury: two in Arthur's Pass National Park and one in Lake Sumner Forest Park.

In 2002, a decision was made to establish a population of orange-fronted parakeets on a secure predator-free island. Te Kākāhu-o-Tamatea/Chalky Island was chosen as the highest priority site for a translocation, as it had recently been declared predator free and did not have a resident population of yellow-crowned parakeets that may have out-competed a small translocated population of orange-fronted parakeets. Therefore, in 2002 a captive breeding facility for orange-fronted parakeets was established at Punanga Manu o Te Anau/Te Anau Bird Sanctuary, to which eggs collected from the wild would be transferred for incubation and then fostered onto red-crowned parakeet parents. The intention was to release 20 orange-fronted parakeet juveniles onto Te Kākāhu-o-Tamatea/Chalky Island. In February 2003, the first egg transfer was carried out, resulting in four chicks being raised to fledging and subsequently being held at the Bird Sanctuary in an aviary awaiting transfer. The following

¹ Miskelly, C.M.; Powlesland, R.G. 2013. Conservation translocations of New Zealand birds, 1863–2012. *Notornis* 60: 3–28.

year, a further four orange-fronted parakeet eggs were found in the wild; however, these were reared at Peacock Spring/Isaacs Wildlife Trust in Christchurch, as there were no red-crowned parakeets nesting in Te Anau.

Concern that the wild population may not sustain ongoing egg harvesting, combined with the knowledge that parakeets can breed prolifically in captivity, led the Orange Fronted Parakeet Recovery Group to reconsider the captive breeding programme. Therefore, in 2005, a decision was made to establish ten breeding pairs in captivity at both Te Anau Wildlife Park (now Punanga Manu o Te Anau/Te Anau Bird Sanctuary) and Peacock Springs, and to translocate surplus birds (minimum of five) to Te Kākāhu-o-Tamatea/Chalky Island before mid-March 2006. In total, 45 orange-fronted parakeets (20 males and 25 females) were translocated from Peacock Springs to Te Kākāhu-o-Tamatea/Chalky Island in three transfers: December 2005, February 2006 and January 2007. While no juvenile birds were sourced from Te Anau, they were maintained in captivity at the Wildlife Park until 2006.



Te Kākāhu-o-Tamatea/Chalky Island at the entrance to Chalky Inlet. Photo: Richard Kinsey.

Since 2007, the key management objective for orange-fronted parakeets on Te Kākāhu-o-Tamatea/Chalky Island has been to carry out an annual census to determine the population status and trend. In 2013, the Recovery Group concluded that the translocation of orange-fronted parakeets to Te Kākāhu-o-Tamatea/Chalky Island had been successful, but that an increase in the number of yellow-crowned parakeets that self-introduced onto the island in 2007 was making it difficult to fully understand progress of the orange-fronted parakeet population. The current focus is still to create safe island populations and to ensure enough captive breeding capacity to allow for further translocations to mainland sites with catchment-wide predator control sufficient to sustain orange-fronted parakeet populations. These sites are currently outside of the Te Anau District.

Rock wren

The first ever successful translocation of rock wrens (tuke) occurred in 2008-11, when birds were transferred from the Murchison Mountains to Kā-Tū-Waewae-o Tū/Secretary Island.

Mohua Recovery Programme

Mohua (yellowheads) were translocated from the Blue Mountains in Otago to Te Au Moana/Breaksea Island in 1995, and have subsequently been successfully transferred to Te Kākāhu-o-Tamatea/Chalky, Pukenui/Anchor, Pigeon and Pomona Islands. Mohua on Kā-Tū-Waewae-o Tū/Secretary Island came from the Dart Valley in Otago, while the population on Mauikatau/Resolution Island was founded by birds from the Landsborough Valley on the West Coast and the Catlins in South Otago.



DOC Biodiversity Ranger Megan Willans releasing rock wrens (tuke) on Kā-Tū-Waewae-o Tū/Secretary Island, 2008. Photo: Sanjay Thakur.



A mohua (yellowhead) before release, 2008. *Photo: DOC.*

Kākāpō

Translocations as part of the Kākāpō Recovery Programme saw the return of kākāpō to Fiordland (from Codfish Island/Whenua Hou Nature Reserve off Stewart Island/Rakiura) in 2002 (to Te Kākāhu-o-Tamatea/Chalky Island), with subsequent transfers to Pukenui/Anchor Island in 2005. In February 2011, a rimu-seeding (mast) event led to the first kākāpō nesting attempt in Fiordland in recent history (a single infertile egg). In the 2015/16 summer, 20 female kākāpō nested on Pukenui/Anchor Island. These nests produced 14 healthy chicks and contributed to the most successful breeding season for kākāpō on record, with a grand total of 36 chicks! Kākāpō on Pukenui/Anchor Island and Te Kākāhu-o-Tamatea/Chalky Island are now managed as part of the kākāpō ‘meta-population’, with ongoing translocations between breeding sites throughout the country to manage further loss of genetic diversity due to inbreeding. The work of the Kākāpō Team has



A juvenile kākāpō eating supplejack berries. *Photo: Tui De Roy.*

been supported by Kākāpō Recovery national partners: New Zealand Aluminium Smelters LTD (NZAS) for 25 years up until 2015 and Forest & Bird. In 2016, Meridian Energy became the new national partner of the Kākāpō Recovery Programme.

Little spotted kiwi

Richard Henry moved little-spotted kiwi from Fiordland to Kapiti Island, off the west coast of the lower North Island, between 1890 and 1910, prior to leaving his post on Mauikatau/Resolution Island following invasion of the island by stoats. In 2008, little spotted kiwi were returned to Fiordland (Te Kākāhu-o-Tamatea/Chalky Island) from Kapiti after a more than 100-year absence, which was cause for significant celebration. A second population was established in Fiordland in 2015, with a transfer of 20 birds translocated from Kapiti to Pukenui/Anchor Island in April. A further release of up to 25 birds was planned for 2016.



Stuart Bull of Ōraka Aparima Rūnaka takes part in the translocation of little spotted kiwi to Te Kākāhu-o-Tamatea/Chalky Island in 2009. *Photo: Kara Matheson.*

Takahē

For more than two decades, collection and artificial incubation of eggs from the takahē population in the Murchison Mountains and puppet-rearing of chicks at Burwood Bush Reserve near Te Anau was the mainstay of the Takahē Recovery Programme and key to retaining the only remaining wild takahē population in the Murchison Mountains. It is only because of the dedication of staff tasked with managing the captive-rearing and translocation programme, and the



Map 4. Location of takahē populations in New Zealand.

knowledge gained from this, that takahē are still with us today. However, puppet-rearing of chicks is no longer used as a management tool – instead, semi-captive pairs are now used to raise their own and other chicks. Also, the establishment of breeding adults on predator-free islands and within mainland sanctuaries has allowed for a secure and now expanding meta-population of takahē that is managed across ten locations throughout New Zealand (Map 4).

In 1987, efforts to establish a second wild population of takahē began in the Stuart Mountains, which adjoin the Murchison Mountains to the north and had been identified as the most suitable habitat for takahē outside the Murchison Mountains. Fifty-two takahē were released in the Stuart Mountains over 5 years and were monitored by University of Otago Master's student (and takahē ecologist for DOC) Jane Maxwell. Unfortunately, these birds did not establish at this site, which contained excellent, but fragmented habitat. This lack of success was attributed to the tendency for juvenile takahē to disperse widely, as well as too few birds being released each year over the 5-year programme. Stoat predation in the absence of predator control and lower rates of survival in captive (puppet-reared) birds are also likely to have contributed (see *Takahē* – chapter 5).

From 1988 to 2010, nest manipulation in the Murchison Mountains allowed managers to ensure that most located nests would contain at least one fertile egg. Although takahē generally lay two eggs per clutch, research by Jim Mills in the 1970s showed that single chicks appeared to have higher survival rates than chicks from multiple broods. Therefore, during the same period, single eggs were removed from nests that contained two fertile eggs, both eggs were removed from the nests of early nesters that were likely to re-lay, and young single chicks were

taken from twin-chick nests. This resulted in 267 fertile eggs and chicks being removed and transferred from the Murchison Mountains to Burwood Bush. The majority of takahē reared at Burwood Bush were returned to the Murchison Mountains as 1-year-old juveniles to bolster the existing population. In total, 259 birds were released back into the Murchison Mountains – these were predominantly Fiordland stock, but in later years a small number were also from island populations or Burwood Bush.

Research initiated in 2003 and led by University of Otago MSc student Catherine Gruber demonstrated that genetic diversity in island populations of takahē had been lost over a relatively short timeframe as a consequence of not carefully managing the pairing of specific birds following initial releases, leading to disproportionate breeding success for some birds. This is concerning because greater genetic diversity helps populations adapt to changing environments. Catherine subsequently reported a decline in the proportion of breeding takahē across the islands, despite a possible increase in the number of breeders occupying territories, which she attributed to inbreeding depression (when more recessive harmful traits manifest themselves in offspring because of breeding between related individuals).

In 2008, in response to Catherine's research, the Takahē Management Team began to address genetic problems from inbreeding in the island and mainland sanctuary populations by transferring individuals between sites. The birds managed at these locations (which includes Burwood Bush) represent what is now known as the 'meta-population' or 'national flock'. By 2012, a pedigree database had been established to support management of the meta-population. Information from the pedigree database is used to plan transfers of specific individuals between sites, thus ensuring that the

Takahē in Fiordland

The rediscovery of the takahē in New Zealand in 1948 prompted a major effort by government agencies to conserve the species, and this work has continued unabated for the last 65 years. The takahē is the only member of the flightless, ground-dwelling herbivore guild that was formerly present in New Zealand during the Holocene Epoch (which included moa and several rails) to have survived human settlement to the present day. The Murchison Mountains contains the only wild population of takahē. The area is valuable historically as the site of their rediscovery and is considered to be the tūrangawaewae ('place to stand') of takahē. In 2016 the takahē population reached a milestone of 300 birds and its ranking on the New Zealand Threat Classification System improved two places to Nationally Vulnerable.



Geoffrey 'Doc' Orbell (R) and Dr Robert Falla (Dominion Museum director) holding a takahē chick in 1948 during the rediscovery of the species in Takahē Valley, Murchison Mountains, Fiordland. Photo: DOC Collection.



Dr Geoffrey Orbell (1908–2007) revisits Takahē Valley in October 1998, 50 years after his famous rediscovery of takahē there in 1948. 'Doc' Orbell was 90 years old when this photo was taken. Photo: Rod Morris.

Commercial partnerships

Species translocations have traditionally attracted the greatest interest for project partnerships through leadership, funding and community involvement. The main relationships have been:

Fiordland Conservation Trust in partnership with:

- **Peregrine Wines** (mohua to Mauikatau/Resolution Island; tīeke to Te Kakahu-o-Tamatea/Chalky Island; tīeke to Bauza Island)
- **Chalky Digits** (kakaruai (South Island robins) to Te Kakahu-o-Tamatea/Chalky Island)
- **Fiordland Lobster Company** (little-spotted kiwi to Pukenui/Anchor Island)
- **Southern Discoveries** (Fiordland tokoeka to Sinbad Valley)
- **Lucy Bellerby, Ian & Jenny Willans, and the Quatre Vents Foundation** (kakaruai to Mamaku/Indian Island)
- **Ultimate Hikes and Otago Community Trust** (pāteke to Arthur Valley; 2010 release)
- **DOC** (kakaruai to Rangitoto/Kā-Tū-Waewae-o Tū/Secretary Island)



Greg Hay (L) and Lindsay McLachlan, owners of Peregrine Wines, help transfer a tīeke to Te Kākāhu/Chalky Island, 2008. Photo: Barry Harcourt.

Pomona Island Charitable Trust in partnership with:

- **Meridian Energy** (mohua to Pomona Island)
- **Anonymous** (kakaruai to Pomona Island)
- **DOC** (Haast tokoeka to Rona Island)

South South West New Zealand Endangered Species Charitable Trust in partnership with:

- **Mohua Charitable Trust** (mohua to Te Puka Hereka/Coal Island)
- **DOC** (kakaruai to Te Puka-Hereka/Coal Island)

Additional partnerships supporting DOC:

- **Air New Zealand** (prior to 2012: kakaruai to Te Kākāhu-o-Tamatea/Chalky Island; since 2012 national partner: free flights for species being translocated on Air New Zealand's regular passenger flights, and funding for species translocations to sites on DOC's Great Walks)
- **BDG Synthesis** (rock wrens to Kā-Tū-Waewae-o Tū/Secretary Island)
- **Banrock Wines/Wetland Care NZ/Ducks Unlimited** (2009 & 2011, pāteke to Arthur Valley)
- **Fiordland Lobster Company** (mohua and kakaruai to Pigeon Island; North Island kōkako to Kā-Tū-Waewae-o Tū/Secretary Island;
- **Fiordland Wapiti Foundation** (whio)
- **Genesis Energy** (national partner for whio)
- **Flight Centre** (sponsorship for takahē recovery prior to 2005)
- **Mitre 10 Takahē Rescue** (national partner for takahē 2005-16)
- **Fulton Hogan** (national partner for takahē from 2016)
- **Mitre 10** ('Official Supplier to Takahē Recovery' supporter from 2016)
- **Les Hutchings Foundation** (little spotted kiwi to Te Kākāhu-o-Tamatea/Chalky Island)
- **Mohua Charitable Trust** (mohua to the Eglinton Valley and Mauikatau/Resolution Island)
- **Real Journeys** (little spotted kiwi to Te Kākāhu-o-Tamatea/Chalky Island; whio recovery in Fiordland)
- **South West Helicopters, Fiordland Helicopters and Southern Lakes Helicopters** (helicopter time and support with translocations)



A takahē ready for transfer in a specially designed Mitre 10 box. Photo: DOC.

DOC greatly appreciates the efforts of these businesses, groups and individuals.



Takahē chicks being feed by hand puppet, Burwood, 1999.
Photo: Rod Morris.

genetics of the population are well managed (i.e. there is minimal inbreeding and certain birds' genes are not over-represented in the population). The takahē metapopulation currently provides the species with security from the risk of extinction. However, the populations rely on an ongoing management commitment to counter inbreeding and genetic drift through annual bird transfers so that viable fertility rates are maintained. Burwood Bush is central to this aspect of the programme and currently produces around 25 chicks per annum – with this figure forecast to increase to 30 by 2016, with an average of 1.5 chicks produced for every breeding pair.

In 2008, a pilot study investigating the suitability of Kā-Tū-Waewae-o-Tū/Secretary Island for takahē was also initiated and nine takahē were released there over 3 years from 2008 to 2010. A couple of nesting attempts were recorded but chicks were never observed. Suitable habitat for takahē on Kā-Tū-Waewae-o Tū/Secretary Island was limited to regenerating slips and scattered areas on the tops. Therefore, it was determined that the costs and logistics of managing takahē on the island were not merited at this stage in the species' recovery and so the trial was discontinued.

The collection and transfer of eggs within and from the Murchison Mountains ceased in 2011, as did the artificial incubation of eggs and puppet-rearing of chicks at Burwood Bush, and the release of captive-reared juveniles into the Murchison Mountains. An initial assessment

of takahē recruitment comparing wild and captive-reared (both puppet- and adult-reared) birds indicated no significant difference in survival rates once juveniles were released back into the Murchison Mountains. However, a subsequent analysis of breeding success indicated that captive-reared birds from Burwood Bush released into the Murchison Mountains had substantially (up to 65%) lower reproductive success than wild-reared takahē. The continued release of captive-reared juveniles into the Murchison Mountains has also been correlated with reduced hatching success in the population over time, meaning that the presence of captive-reared birds in the population was potentially undermining its ability to bounce back from adverse events, such as the significant adult mortality event in 2007 (see chapter 5). Current best-practice for captive management of takahē is for chicks to be raised (individually or in pairs) by adult takahē in large natural pens, and that subadult (1-year-old) takahē helpers are used. Late 2015 saw the largest release of takahē into the Murchison Mountains with the release of 29 young adult birds from Burwood Bush.

Others

Numerous translocations from one mainland site to another have also taken place to establish new populations or to bolster existing ones, with varying degrees of success. In addition, two North Island species have been translocated to sites in Fiordland – the North Island kōkako² to Kā-Tū-Waewae-o Tū/Secretary Island and pāteke (North Island brown teal) to the Arthur Valley – to support species recovery and as surrogates for similar South Island species that are considered functionally extinct. Probably the most significant of these is the *Takahe Recovery Programme*, which is perhaps New Zealand's best-known species recovery programme. It is managed from Te Anau utilising translocation and captive rearing and is addressed in more detail later in the report.



DOC Biodiversity Ranger Dave Crouchley holding a kōkako during the first release of the birds on Kā-Tū-Waewae-o Tū/Secretary Island, 2008.
Photo: DOC.

² While declared extinct by the Department of Conservation in 2008, the classification of South Island kōkako was revised in 2013 and the species' conservation status was changed to Data Deficient.



Katrina Hale (L) and Sabrina Taylor (R) banding tīeke on the Titi Islands, off Stewart Island/Rakiura. *Photo: Ian Jamieson.*



DOC Biodiversity Ranger Andrew (Max) Smart releases pāteke in the Arthur Valley, Milford Track, February 2013. *Photo: Graham Dainty.*

Translocations and the role of genetics

Whenever a translocation is being planned, the security of the overall population must come first – particularly when critically endangered species are involved. A small total population size may dictate that only a small number of animals can be transferred from one site to another, which will result in loss of genetic diversity within the new (founder) population and/or the population from which the individuals have been harvested (donor population).

Kākāpō, takahē and tīeke have among the lowest genetic diversity of any threatened bird species worldwide. Until recently, it was a commonly-held view that threatened bird species in New Zealand were less susceptible to the effects of inbreeding depression than species elsewhere. However, some researchers argued that although inbred populations can reach the same population size as outbred populations, they may take longer to reach their optimal population size (carrying capacity), be more susceptible to new impacts (such as introduced diseases or parasites) and be slower to recover from any subsequent population catastrophes. Thanks to the research interests and work of the late Professor Ian Jamieson and the Threatened Bird Research Group at the University of Otago, we now have a much better understanding of the influence of inbreeding on threatened bird species managed both

in Fiordland and nationally. This research group uses fieldwork, molecular genetics and population modelling techniques to explore how the loss of genetic diversity affects the survival and long-term adaptability of rare bird species. Over the past 10 years, Ian and his team of research associates and post-graduate students have provided conservation managers with advice and tools to adequately plan translocations with respect to managing inbreeding (e.g. for takahē and kākāpō) and establishing new populations of species (e.g. tīeke and mohua).

Failed translocations – what have we learnt?

Typically, the success of a translocation is measured by whether or not a population establishes. However, numerous transfers are conducted as pilot studies, with the aim of developing techniques for future translocations, or finding out how individual birds settle, pair up and utilise habitat at a new site. The first pilot translocation of mohua involved only six birds released on Centre Island, Lake Te Anau, in October 1992. This release resulted in a small population persisting on Centre Island for several years. More importantly, it enabled staff to develop techniques that were later applied to a number of successful mohua translocations to other sites.

The first ever translocation of rock wrens was attempted between December 2004 and February 2005, when 28 rock wrens were transferred from the Murchison Mountains to Pukenui/Anchor Island. Individual birds were observed on Pukenui/Anchor Island up to 2007, but the population did not persist. However, the information obtained and expertise developed through this initial project provided guidance for a subsequent successful translocation of 41 rock wrens from the Murchison Mountains to Kā-Tū-Waewae-o Tū/Secretary Island in 2008–11. This resulted in a breeding population establishing on Kā-Tū-Waewae-o Tū/Secretary Island, with 66 birds observed in a survey in 2013, 63 of which were unbanded offspring of the founding population.



Kakaruai (South Island robins) being translocated to Pukenui/Anchor Island in 2004. DOC staff (L to R) Nick Torr, Hannah Edmonds and Gerard Hill. Helicopter pilot Mark Deaker behind. *Photo: DOC.*

North Island kōkako translocations

The North Island kōkako is ranked as Nationally Endangered and is subject to intensive conservation management to reverse its decline. The establishment of a large breeding population of North Island kōkako would contribute significantly to the species recovery goal of reaching a population of c. 1000 pairs by 2020. In 2008, it was proposed that a North Island kōkako population be established on Kā-Tū-Waewae-o Tū/Secretary Island, despite it being well beyond the natural range of this species. The island was thought to have the potential to hold a large viable population due to its size, rat- and possum-free status, and very low numbers of stoats. The North Island kōkako is closely related to the 'functionally extinct' South Island species and is thought to occupy a similar ecological niche. Therefore, their introduction to Kā-Tū-Waewae-o Tū/Secretary Island would restore a component of the ecosystem that has disappeared. Moreover, the translocation would afford an opportunity for research into improving kōkako translocation techniques and its success would provide an additional insurance population.

The Fiordland Lobster Company agreed to fund a significant proportion of the cost of the translocation (\$80,000), despite the sizable risks associated with translocating kōkako to a remote South Island site for the first time. From 2008 to 2009, 27 kōkako were translocated from three North Island sites to Kā-Tū-Waewae-o Tū/Secretary Island: 10 from Mapara Wildlife Reserve, 7 from Kaharoa Forest and 10 from Rotoehu Forest. Six of the Mapara birds were fitted with radio-transmitters for post-release monitoring. Five survived their first 5 months on the island, while one succumbed to a New Zealand falcon (kārearea) attack. At least four of these birds also survived to 8 months post-release and surveys undertaken in 2011 confirmed that one pair had successfully bred, with an unbanded juvenile being observed.

In 2013, an island-wide survey failed to locate a single kōkako, indicating that the founder population had not established – although it is possible that a few single birds remain on the island, as a contract hunter heard a kōkako call at the time of the survey and another as recently as August 2015. Despite this unfortunate result, there have been some positive outcomes for kōkako conservation and the Secretary Island Restoration Project. In particular, greater synergies have been developed for kōkako conservation within DOC (working across regions), and with iwi and sponsors through their support of the translocations. However, a number of key challenges will need to be addressed if a second attempt is to be made to establish kōkako on Kā-Tū-Waewae-o Tū/Secretary Island or, indeed, anywhere in the South Island. These include:

- Re-evaluating the appropriateness of translocating North Island kōkako to the South Island.
- If translocations are appropriate, identifying suitable sites for future releases in Fiordland.
- Catching sufficient birds to establish a robust founder population.
- Building relationships between partners (iwi and DOC) to enable future translocations to occur.
- Maintaining expectations and relationships with sponsors.



Kōkako from Kaharoa Conservation Area in the North Island arrive on Kā-Tū-Waewae-o Tū/Secretary Island, Fiordland, in their specially designed translocation boxes, September 2009. *Photo: Kirsty Macnichol (The Fiordland Advocate).*



Carmel Richardson, Kaharoa Kōkako Trust ecologist, with kōkako in hand, and DOC Biodiversity Ranger Kerri-Anne Edge, during the second kōkako release onto Kā-Tū-Waewae-o Tū/Secretary Island in September 2009. *Photo: Kirsty Macnichol (The Fiordland Advocate).*

In 2015 a rock wren monitoring programme for Kā-Tū-Waewae-o Tū/Secretary Island was formally established as one of the key outcome monitoring programmes for measuring the benefits of stoat removal on the island.

There have been three unsuccessful attempts to reintroduce tīeke to islands in Fiordland. The first of these was a translocation of 28 tīeke to Bauza Island

in 2004, which likely failed as a result of predation by stoats – presumably reinvading from Kā-Tū-Waewae-o Tū/Secretary Island. A second release of 36 birds to Bauza Island in 2010 also did not establish for a range of reasons, possibly including the presence of large numbers of weka, which are known to take tīeke eggs. The third programme involved 38 tīeke being

translocated to Erin Island in Lake Te Anau over 2 years (2003–04). This programme was carried out by DOC in partnership with Sabrina Taylor (PhD student) and the late Ian Jamieson (University of Otago). It had two primary research objectives: to assess the value of inshore islands for translocation of threatened species, and to determine the short- and long-term

effects of inbreeding in small island populations (see *Translocations and the role of genetics* above). This translocation was also unsuccessful, probably due to the small number of birds released, dispersal of the birds to the adjacent Murchison Mountains and predation by stoats reinvading from the mainland.

Managing the risk of disease

During translocations, animals can become ill due to either stress or diseases which may be spread to new sites by the animals, humans or equipment. Therefore, it is important that measures to mitigate the disease risk are addressed during the translocation planning process.

In 2004, three kākāpō died from the bacterial infection erysipelas, following their transfer from Whenua Hou/Codfish Island Nature Reserve (off Rakiura/Stewart Island) to Te Kākāhu-o-Tamatea/Chalky Island. These highly valuable 2-year-old females were part of a translocation involving 18 kākāpō – and were the first of the hundred or so previously translocated kākāpō to succumb to erysipelas. Initially it wasn't known what had caused the deaths, but subsequent testing showed that most adult kākāpō had been previously exposed to the bacteria. Therefore, it was not a new disease within the population; rather, young and potentially quite stressed birds had simply succumbed to the disease. DOC staff from Te Anau travelled to Te Kākāhu-o-Tamatea/Chalky Island to support the Kākāpō Management Team and constructed temporary holding pens so that each bird could receive either antibiotics or several doses of vaccine, which needed to be administered over several days. This outbreak of erysipelas highlighted the need for constant vigilance with regard to disease management and translocations, as well as day-to-day management.



Taking blood from a kākāpō.
Photo: Tui De Roy.



Takahē juveniles at Burwood Bush in their 'natural pens', 2014. Photo: Sabine Bernert.



Compared with other parts of New Zealand, some of the remote areas of Fiordland have been characterised by a quite recent weed and pest invasion history.

A hunter searching at dusk for deer in the Fiordland Wapiti Area, high above Lake Alice in the Edith River, George Sound.
Photo: Rob Suisted.