

Tiromoana Bush Restoration Project 2004-2022 Review



Prepared for Transwaste Canterbury Ltd. by:
Emeritus Professor David A. Norton
University of Canterbury and Biodiversity Solutions Ltd.
 david.norton@canterbury.ac.nz

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INTRODUCTION

In 2004 Transwaste Canterbury Ltd., a public-private joint venture company, commenced a comprehensive restoration programme in the Kate Valley Conservation Management Area (henceforth referred to as Tiromoana Bush; Figure 1) as part of the mitigation offered for the establishment of the Canterbury Regional Landfill at Kate Valley. The restoration project became a legal requirement of the resource consent for the operation of the landfill and aims to substantially increase native biodiversity values in Tiromoana Bush over the 35-years of the consent.

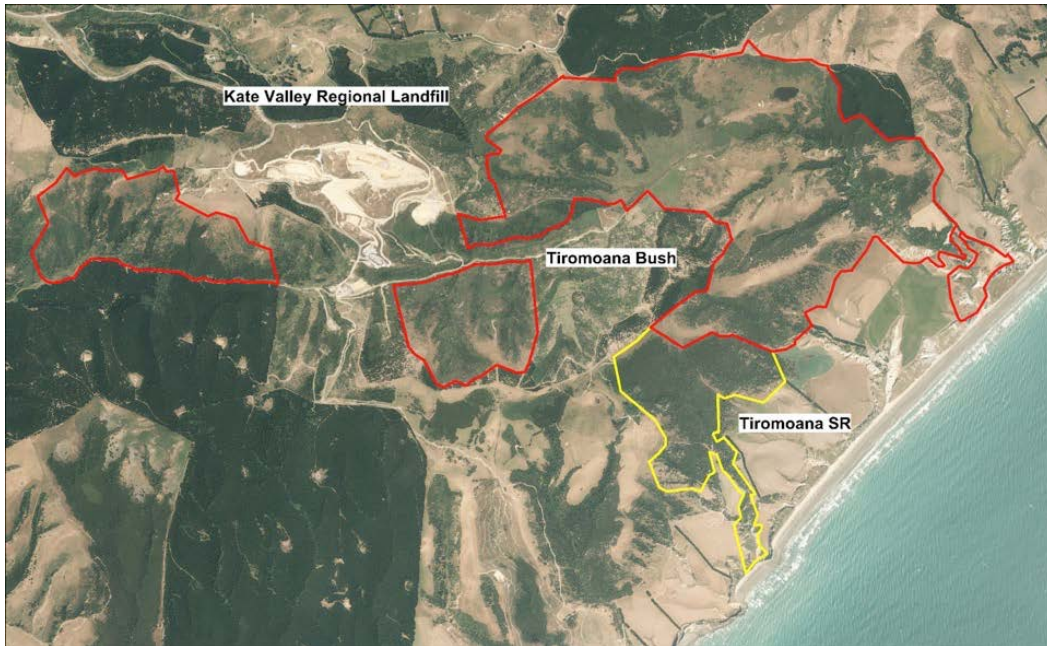


Figure 1. Location of Tiromoana Bush (red line) in relation to the Kate Valley (Canterbury) Regional Landfill and adjacent public conservation land (yellow line).

This report reviews progress with this restoration project over the 18 years through to May 2022 as a basis for planning management through until 2032 (when the project will have been running for 28 years). A summary of some of the earlier progress with the project is provided in Norton (2019). The current report provides a comprehensive review of the project against the 2017-2022 five-year management goals and then against the 35-year outcomes that underpin the overall vision for the project.

2017-2022 MANAGEMENT GOALS

To progress the project towards meeting the 35-year outcomes for Tiromoana Bush, 11 goals were developed for the 2017-2022 management period and progress against these goals is now reviewed.

Goal 1: Herbivorous mammal pests are controlled to levels that do not threaten the restoration plantings or natural regeneration in Tiromoana Bush.

Performance indicator: Key mammalian herbivores have not adversely affected restoration plantings or natural regeneration and any domestic livestock, deer or pigs found within the deer fence are promptly eliminated.

Progress against goal: The deer fence was completed in 2017 (Figure 2) which represents a major milestone for the project. Subsequently, four deer have been shot during pig culling operations and while recent sightings suggest that 2-3 deer may still be remain, a lack of widespread deer damage suggests that they are having a limited impact on the restoration plantings. Ongoing pig control will hopefully result in these remaining deer being eliminated and the deer fence is considered to be secure in terms of future deer invasion.



Figure 2. Deer fence being installed along the Tiromoana Bush boundary.

Sheep are occasionally observed within the deer fenced area, primarily accessing it through the farm fencing that separates the plantation forest on the Ella Peak side of Tiromoana Bush from the conservation management area – both areas are included within the deer fence. Sheep are not, however, a major issue as they appear mainly restricted to the walking track and no evidence of their having an impact on either the regenerating forest or restoration plantings has been noticed. When sheep are seen within Tiromoana Bush, the Mt Cass Organic Farms manager has been informed and asked to remove them, although more

recently it has been agreed that any sheep present within Tiromoana Bush can be shot during pig control operations. Cattle have not been seen inside the deer fence.

Pigs are, however, another matter, and have been consistently present within the deer fenced area throughout this management period despite two major culls: July 2018 (29 pigs killed) and June 2021 (39 pigs killed). The ongoing presence of pigs is likely due to several factors including the inability to exclude them with deer fencing, a failure to fully remove all animals during cull operations, their high intrinsic breeding rate, and high pig numbers in surrounding areas (especially within the pine forests management by Rayonier) thus putting pressure on the fence. Pigs are causing severe damage locally, both within forest remnants and grassland areas, and have also damaged restoration plantings (with all planting in 2021 postponed because of high pig impacts). Their impact requires ongoing targeted management.

Goal 2: A detailed assessment of predatory mammals is undertaken as a basis for assessing the need for future predator control.

Performance indicator: An assessment of mammalian predators has been undertaken.

Progress against goal: This assessment was completed in November 2018 using tracking tunnels and chew cards. The results showed the presence, in moderate to high numbers, of a suite of small mammals that are known to prey on native fauna (Maddigan 2018). Species identified were mice, rats, mustelids (weasels, stoats and ferrets) cats, hedgehogs and possums.



Figure 3. *Small mammal trap network comprising paired DOC200 and Timms traps.*

As a result of this monitoring, the decision was made to commence an active predator control programme in October 2019 focusing on these species. This control is based on a network of 200 paired DOC200 and Timms traps spread through the bush (Figure 3). The traps are serviced monthly, and all animals killed are recorded. Over the last 2 ½ years this has resulted in the killing of 226 mice, 394 ship rats, 282 weasels, 68 stoats, 17 ferrets, 96 cats, 312 hedgehogs and 183 possums. While mustelid, possum, hedgehog and cat kills have declined with time, indicating that we are starting to suppress these species, rodent numbers have been less impacted, perhaps because their predators (cats and mustelids) have been suppressed and also because of the abundance of grass seed in the area. Feral cats are increasingly being seen as the single biggest threat to native fauna nationally. Small mammal predator control will continue to be a major priority for management at Tiromoana Bush as reinvasion is constantly occurring from surrounding areas and numbers can increase rapidly if control stops

Goal 3: A systematic approach to plant pest control occurs and key plant pests are controlled to levels that do not threaten restoration or other values.

Performance indicator: A systematic approach to plant pest control has been undertaken that enables key plant pests to be controlled to a level that does not threaten the biodiversity values at Tiromoana Bush.

Progress against goal: Waiora Landscapes are contracted annually to undertake control of woody weeds. The focus has been primarily on willows in the Kate Stream catchment and wilding conifers, although any other woody weeds encountered (e.g. hawthorn and old man's beard) are also removed. Control is based on a division of the area into five weed control zones, with control rotating around these zones annually. While we should eventually be able to eliminate willows, wilding conifers are an ongoing issue as seed sources are present in the wider landscape and will require ongoing control until closed-canopy native forest dominates the site.

Goal 4: Restoration plantings focus on restoring kahikatea-dominated forest and associated wetland vegetation across the floor of Kate Valley, and angiosperm forest and associated shrubland and herbaceous vegetation in the coastal zone of lower Kate Stream.

Performance indicator: Restoration plantings have been established primarily on the floor of Kate Valley and in the coastal zone, and a review of the restoration plantings undertaken to-date has been completed.

Progress against goal: Except for 2021, when no plantings were undertaken because of high pig numbers, restoration plantings have continued to be undertaken annually, primarily on the floor of Kate Valley (Figure 4) and in the coastal zone of lower Kate Stream. Some infill panting at other sites has also been undertaken.



Figure 4. Kahikatea forest restoration plantings, Kate Valley.

To assess the overall success of restoration plantings to date, University of Canterbury masters student Alistair Kernahan assessed all of the restoration monitoring plots that have been established since 2006, as well as kahikatea planted in 2006 and the three areas where black beech has been planted (see Goal 5). Monitoring sites include plantings established in 2006 (1 plot), 2008 (3 plots), 2011 (3 plots) and 2012 (2 plots). While there is variation from site to site reflecting differences in species composition and site attributes, the overall conclusion is that restoration plantings have done well with good survival of most species (Kernahan 2021).

The three monitoring plots in the 2008 planting (13 years growth) are perhaps the best indication of what is being achieved through restoration. The plots are spread between two different planting areas and are variable in terms of species composition and aspect. Despite this they show strong similarities, especially in height growth. Plant survival was generally good, 83% in two plots and 66% in the third, as was canopy cover (85, 83 and 53%). The 53% canopy cover was due to that plot having a high proportion of tī kōuka (cabbage trees) which do not form large spreading canopies as other species do (e.g. kōhūhū/black matipo, ngaio and tarata/lemonwood). However, for the dominant species across all three plots, tree height exceeded 5 m and was greater than 8 m in some cases. One of the plots also had a reasonable amount of natural regeneration occurring under the planted canopy. These three plots were also estimated as having sequestered 222 tonnes CO₂/ha after 13 years.

Ten kahikatea were planted along the shores of Kate Pond (Figure 5) at the outset of our restoration efforts. These trees were tagged and have been monitored since. By 2021 (15 years later) all were still alive, with their heights ranging from 3 m to just over 6 m tall, and with an average diameter at breast height of 8 cm.



Figure 5. Vigorously growing 11-year old kahikatea, Kate Pond.

Goal 5: Consolidate restoration of black beech.

Performance indicator: Black beech has been planted adjacent to Remnant “B” and, where appropriate, the three new black beech stands have been enriched through further plantings.

Progress against goal: Mainly because of a lack of seed, no new black beech plantings have been established. However, the progress of the existing three stands were assessed as part of the 2021 restoration assessment by Alistair Kernahan. The three black beech stands comprised 16, 21 and 93 live black beech, plus five dead plants. This suggests high survival (96%), although some black beech may have died soon after planting and are no longer visible. All stands are of a similar age (11-12 years old in 2021). The plants have grown well with average plant heights now 6–7.5 m, with the tallest nearly 10m, and an average diameter at breast height of 10 cm (Figure 6).



Figure 6. Vigorously growing black beech.

Goal 6: Commence a programme of enriching the existing seral kānuka low forest stands.

Performance indicator: A programme of enrichment through canopy gap creation has commenced, including strategic tōtara planting.

Progress against goal: This work was not commenced during this period, although the two scientific papers, based on research at Tiromoana Bush, providing the rationale for this approach have now been published in scientific journals (Tulod et al. 2019, Tulod & Norton 2020).

Goal 7: Undertake due diligence work necessary for a possible introduction of a native animal species that is currently absent from Tiromoana Bush.

Performance indicator: Due diligence has been undertaken to assess the potential of introducing a native animal species that is currently extinct from Tiromoana Bush, including the development of a reintroduction plan if it is deemed that this is appropriate.

Progress against goal: While no formal work was undertaken on this, a number of informal discussions were held and it was established that reintroduction of mudfish into Kate Pond would not be possible because of the presence of eels. Given we only started predator control at the end of 2019, it has probably been too soon to start progressing this issue.

Goal 8: Establish additional biodiversity monitoring.

Performance indicator: At least five vegetation monitoring plots have been established in areas of gorse/broom shrubland to monitor the development of these areas towards native forest. Baseline surveys of the snail Wainuia, weta and reptiles have been undertaken.

Progress against goal: These activities were not undertaken during this management period. However, our regular monitoring of permanent vegetation plots (forest and restoration plantings), photo-points and birds (2017-2019) has continued and reports on the monitoring of forest plots (Tulod & Norton in submission), restoration plantings (Kernahan 2020), bird monitoring (Luring & Lloyd 2020) and photo-point monitoring (Norton 2022) have been produced.

Goal 9: Better interpret the Tiromoana Bush project to the wider public.

Performance indicator: Interpretative material has been installed along the walkway and more information on the Tiromoana Bush restoration project has been made available through the Transwaste Canterbury web site.

Progress against goal: This work started in the last management plan period with the walkway upgrade and has continued into the current management period. Two new interpretation panels have now been installed, at Barbara's Lookout and Kate Pond, and the Pou Ika was installed at the coastal lookout, all in November 2018 (Figure 7). In addition, a general pamphlet on the walkway was produced (2019) which complements the main information sign at the car park, while a brochure specifically on the Tiromoana Bush restoration project was also produced (2020). The Transwaste Canterbury website has also been upgraded and includes information on both the walkway and the restoration project.



Figure 7. *Installing the interpretation panel at Kate Pond and the Pou Ika at the coastal lookout platform looking northeast up the coastline.*

In addition, Transwaste Canterbury commissioned Grant Mangin to produce a series of press releases on different issues relating to the Kate Valley Landfill, including the Tiromoana Bush restoration project. Over the last three years, seven press releases have been produced and

published in one or both of Northern Outlook and North Canterbury News (and some have also appeared on stuff.co.nz) focusing on the restoration work being undertaken in Tiromoana Bush. The topics covered in these articles have included restoring rare ecosystems, pest management, restoring kahikatea forest, photo-monitoring, bird conservation, mistletoes and considering Tiromoana Bush in the context of the wider Hurunui area.

Goal 10: Tiromoana Bush is used as part of local school and LEARNZ learning programmes.
Performance indicator: At least four visits by local schools to Tiromoana Bush occur each year.

Progress against goal: While LEARNZ did run a field trip that included a strong restoration focus in 2018, no formal school visits to the restoration project occurred.

Goal 11: Provide support to the development of a wider Motunau Ecological District conservation initiative.

Performance indicator: Support is provided towards the development of a wider Motunau Ecological District conservation initiative as appropriate.

Progress against goal: Transwaste Canterbury has supported the establishment and running of the Hurunui Biodiversity Trust which started in late 2018. Their mission is to inspire and enable Hurunui's landowners/kaitiaki/custodians and the wider community to understand, value and enhance our district's varied biodiversity, with particular focus on indigenous biodiversity. There has, to date, been no direct input from the Tiromoana Bush restoration project but there is ample opportunity for greater interaction in the future.

Overall assessment of progress against 5-year goals

We have made strong progress in several areas over the last five years, notably with Goals 1, 2, 3, 4 and 9. In fact with Goal 2, we have exceeded what was planned. We have also made some progress with four other goals (5, 6, 8 and 11), but have only made limited progress with Goals 7 and 10. The reasons for lack of progress with some goals are varied but include a stronger emphasis on other areas and a need for further resources to support them.

35-YEAR MANAGEMENT OUTCOMES

Successful restoration is dependent on having clearly defined goals. Goals are important as they enable the success of restoration to be quantified and reported on, as well as allowing the restoration manager to critically evaluate the methods that are being used. It is useful to set goals within a broader vision of what the site might be like at some stage in the future.

However, it is not possible to use such a vision to assess the success of restoration because of the long time-frames involved and because of the uncertainties over future conditions (e.g. as a result of changing climate). For the Tiromoana Bush restoration project, an overall vision of what the site might be like in 300 years was developed at the outset of the project as a general guide, with more specific 35-year and five-year goals identified to assess restoration success against. The five-year goals are the most specific, while the 35-year outcomes are more indicative and were thought likely to require modification depending on progress.

The vision and 35-year outcomes were specified in the 2004 decision of the Environment Court granting resource consents for operation of the Kate Valley (Canterbury) regional landfill.

This vision saw Tiromoana Bush in 300 years restored to a:

“Predominantly forest ecosystem (including coastal broadleaved, mixed podocarp-broadleaved and black beech forests) where dynamic natural processes occur with minimal human intervention, where the plants and animals typical of the Motunau Ecological District persist without threat of extinction, and where people visit for recreation and to appreciate the restored natural environment.”

This vision statement has been adapted for the interpretation panel at Barbara’s Lookout as follows:

Tiromoana – He Kitenga O Te Wāheke (A View To The Future)

Take a moment to imagine... standing here 300 years from now you will see before you a mosaic of forest and wetland. New Zealand’s tallest tree – kahikatea - towers above wetlands, their buttressed roots holding firm. Mighty tōtara clothe the hillsides leading down to the coast, with patches of tawhai/black beech on the dry ridges. Trees echo with the voices of korimako/bellbird, tūī and the whirr of kererū wings. Wildlife flourishes and people visit to learn, recreate and enjoy.

Mō tātou, ā, mō kā uri, ā muri ake nei (For us and our children after us)

This adapted vision better articulates what we are trying to achieve with the Tiromoana Bush Restoration Project.

To meet this vision, a series of outcomes need to be achieved after 35 years of running this project. These outcomes can be seen as stepping-stones along the journey to achieving the vision. 35 years was chosen initially because it is the period of the resource consent for the Kate Valley (Canterbury) regional landfill, but it is also a good time-period over which we will be able to obtain a strong indication of how well the project is progressing. As 2022 is

approximately halfway through this 35-year period (18 years to be precise), it is timely to review progress against these outcomes.

Outcome 1: Vigorous regeneration will be occurring within the existing areas of shrubland and forest sufficient to ensure that natural successional processes are leading towards the development of mature lowland forest appropriate to local conditions.

Progress against outcome after 18 years: Both vegetation plot and photo-point monitoring is showing that there has been a strong response in terms of understorey regeneration, although the evidence to date suggests that this is primarily dominated by mahoe (Figures 8 & 9, Tulod et al. in submission) and we still have some way to go to obtain regeneration of other species, especially podocarps like tōtara and matai which would have been the dominant trees in the pre-human forests. It will require more active management interventions to introduce these species into the successions. Management interventions including gap creation and enrichment are likely to be the most successful and research by University of Canterbury PhD student Adrian Tulod has provided the basis for these interventions (see Tulod et al. 2019, Tulod & Norton 2020).



Figure 8. Dense māhoe and mingimingi regeneration in the understorey of a kānuka forest after 12 years of livestock exclusion. The two people are measuring one of the permanent vegetation monitoring plots that are located through these forests.

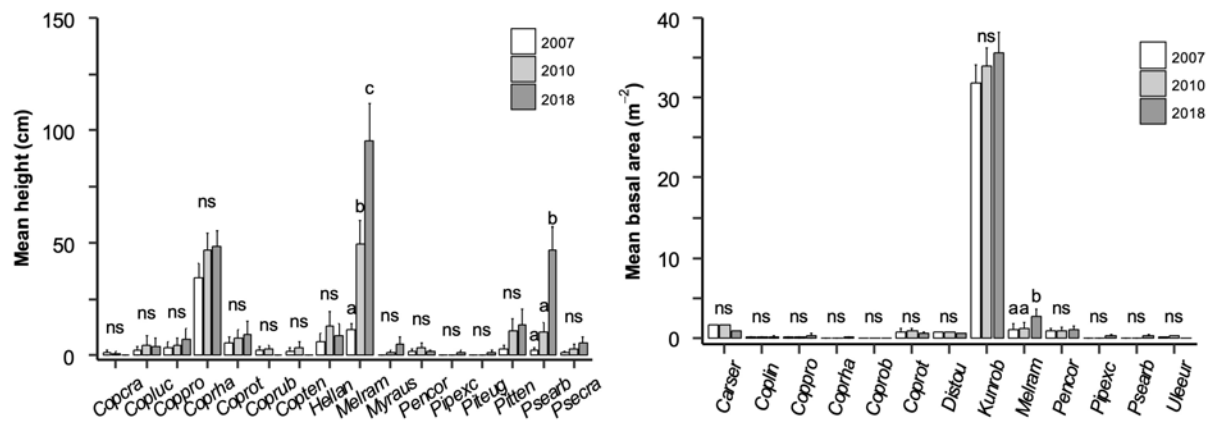


Figure 9. Change in seedling height (left) and tree basal area (right) in forest monitoring plots from 2007-2018. Both māhoe (Melram) and five-finger/whauwhaupaku (Psearb) have increased significantly in height, while māhoe is the only species to show a significant increase in tree basal area, joining kānuka (Kunrob) as a small tree in these forests.

Outcome 2: The existing korimako (bellbird) population has expanded, and kereru (native pigeon) are now residing within the area. The species and abundance of native water birds have also been enhanced.

Progress against outcome after 18 years: Water birds were added to this outcome in the 2017-2022 management plan as they are likely to respond to the wetland restoration efforts.

Results from monitoring showed that overall native forest bird counts changed little between 2005-2009 and 2017-2019. There was, however, a significant 24% decline for korimako/bellbirds, although tauhou/silvereye and piwakawaka/fantail mean counts increased by 104% and 52% respectively. The increase in kereru counts from zero at the start of monitoring to four in 2019, is not statistically significant, but implies it may be becoming a regular visitor or resident. The 1014% increase in ngirungiru/tomtit counts and 72% increase in pīpīwharauoa/shining cuckoo counts are significant. Both monitoring periods were undertaken prior to predator control being implemented and the decline in korimako may reflect predation, although anecdotal observations since we commenced active small mammal predator control suggests that korimako numbers are increasing, with groups of up to 20 korimako seen/heard together at times. Tui have also been heard and seen several times in lower Kate Stream in the last couple of years, having not previously been recorded in Tiromoana Bush.

The slight but steady increase in native forest bird diversity at Tiromoana Bush is a positive sign for the restoration. This increase appears to be driven largely by colonization of new species such as tomtit and kereru and increases in rare species such as pīpīwharauoa. These changes may reflect an increase in habitat diversity as the kānuka forest understory regenerates in the absence of grazing. Further increases in diversity as well as abundance are expected with ongoing predator control.

Waterfowl and wetland bird counts from 2017-2019 establish a baseline to compare future trends against, particularly with predator control now implemented. Few significant changes were detected over the three years, due to high variability in counts and the flocking habit of many waterfowl. Matuku-hūrepo/bittern and mātātā/fernbird were not recorded confirming their absence from the site. However, four pūweto/spotless crane (Figure 10), one

koitareke/marsh crane and one unknown crane were heard. These ongoing observations of pūweto confirm the presence of a resident population of this Nationally Declining bird in Tiromoana Bush.



Figure 10. Pūweto/spotless crane (photo by Paul Le Roy and taken from <https://nzbirdsonline.org.nz/species/spotless-crake>).

Based on these results it seems likely that the site is moving in the right direction in terms of this outcome, but until we have a sustained period of predator control, we are unlikely to see a more substantial recovery of the avifauna. In the 2020 bird monitoring report (Luring & Lloyd 2020), the authors note that species diversity may provide an additional measure of success for Tiromoana Bush as well as the abundance of the initial species present. They note that other forest restoration projects have shown that many of the original species decline as new species establish and compete after predator control.

Outcome 3: The beech forest remnant known as “Remnant B” has been secured and enhanced in terms of the area of black beech and at least one additional black beech site has been established.

Progress against outcome after 18 years: This outcome was previously separated into two outcomes and were merged in the 2017-2022 management plan retaining the same wording. “Remnant B” is secured in that it is with the QEII covenant area and within the deer fence. Understory regeneration is good within this black beech remnant and we have also established three additional beech populations comprising 130 individual black beech plants in total that are on average 6–7.5 m tall, with the tallest nearly 10 m (Figure 6). All were sourced either from seed or seedlings collected from “Remnant A” (which has now gone) and “Remnant B” (seeds only). There is however a need to establish black beech around “Remnant B” to enhance it, and to do further plantings to expand the three planted beech forest patches.

Outcome 4: Restoration plantings and natural regeneration will have been sufficient to ensure good connectivity of regenerating forest between Remnant “B”, Ella Bush Significant Natural Area (SNA) and Tiromoana (Ella Peak) Scenic Reserve.

Progress against outcome after 18 years: Both restoration plantings and natural regeneration are enhancing connectivity between different areas of remnant native vegetation (Figure 11a). This is an ongoing process and will likely accelerate with time. The photo-monitoring (Norton 2020), coupled with aerial photography provides a good record of progress against this outcome.



Figure 11. 2004 (top) – 2021 (bottom) photo-point comparisons. 11a (left) shows both natural regeneration and restoration plantings reconnecting remnant forest areas while 11b (right) shows restoration plantings expanding coastal shrubland and forest.

Outcome 5: Restoration plantings have been used to re-establish locally rare vegetation types.

Progress against outcome after 18 years: All lowland forest types are rare in North Canterbury because of the impacts of human settlement, so all of our forest restoration work is addressing this outcome. The establishment of lowland kahikatea forest (Figures 4 & 5) and of coastal forest (Figure 11b) are good examples of this. The creation of Kate Pond and restoration of the wetland vegetation that now surrounds it is also addressing this outcome as wetlands are one of the rarest ecosystems locally, regionally and nationally. Some locally rare plant species have also been included in plantings, including tītoki and fierce lancewood.

Outcome 6: The area is being actively used for recreational, educational and scientific purposes.

Progress against outcome after 18 years: The redevelopment of the Tiromoana Bush Walkway has led to sustained use of this facility for recreation. A track counter was operating close to the main entrance to the walkway from early 2018 to mid 2020. Over this time and allowing for walkway closures due to fire risk and Covid lockdowns, an average of 50-60 people were recorded using the walkway each week. However, the counter was moved in late 2021 and positioned above the entrance gate. Over the period December 2021 – April 2022, the number of visitors to Tiromoana Bush has averaged 145 people per week. It is rare, even during weekdays, to not encounter someone on the walkway and the carpark can contain multiple cars in weekends.

Tiromoana Bush has been well used for university education and research over the last 18 years, primarily through Te Kura Ngahere/School of Forestry visits. Several students have used the bush as part of their postgraduate research, while numerous undergraduate and postgraduate classes have visited using the bush to better understand the principles and application of ecological restoration (Figure 12).



Figure 12. Environmental forestry class at the Pou Ika in September 2021.

Use of Tiromoana Bush by local schools appears limited, although the LEARNZ programme has visited the area on a few occasions. However, use of the area by schools is something that requires more attention.

CONCLUSIONS

We have made considerable progress towards meeting the 35-year outcomes for the Tiromoana Bush restoration project which even now at only 18 years into the project gives considerable confidence that the project is tracking in the right direction.

- From an ecological perspective this can be seen in the strong biodiversity outcomes that have been achieved – restoration of rare ecosystems, healthy forest understories, abundant natural regeneration in pasture areas, presence of native birds including some species that were rare or absent at the start of the project.
- From a recreational perspective, the walkway is well used, especially following the substantial upgrade that occurred in 2016-2019.
- Since the start of the project, Tiromoana Bush has been regularly used for university education although this has been primarily by Professor David Norton who has now retired. Attention needs to be given to how the area might continue to be used for university education, and how this might be expanded in the future.
- A process of engagement with Ngāi Tūāhuriri has started, especially with the commissioning of the Pou Ika. There is, however, considerable room to build on this relationship.

But there is much we still need to do to both consolidate what we have achieved to date and to make sure that the project continues to move forwards and eventually fulfills the vision. Key areas where more focus is required over the next ten years include:

- Continuation of animal pest control, especially keeping small mammal predators including feral cats at low levels, eradicating the final few deer and if possible, exterminating pigs from the site.
- As well as the current focus on kahikatea forest restoration, more emphasis needs to be given in restorative management to expanding black beech and to facilitating succession within the existing restoration plantings and in naturally regenerated shrubland and forest areas towards a more diverse forest state. This should involve planting mature canopy trees like tōtara and matai around forest edges and in gaps to enhance their dispersal into these areas.
- While some locally rare or absent native bird species appear to be returning to the site (e.g. tomtit and tui), and some species are becoming more abundant, several bird species are unlikely to return without a formal re-introduction programme. Possible candidates for this are the South Island robin/toutouwai and the little blue penguin/kororā. With kororā there is a real opportunity to do this in collaboration with Glenafric Station who have a similar area of coastal habitat that is suitable for this species.
- A dedicated effort is required to make local schools aware of the opportunities Tiromoana Bush offers and to facilitate them utilising this. Today's children will be tomorrow's tax payers and decision makers, and having the local community fully engaged with this project will be a massive boost for insuring its long-term success.
- There is also a need to further promote Tiromoana Bush to tertiary institutions (Canterbury and Lincoln Universities and Ara Institute)

- While the walkway is well used, there is still ample opportunity to boost its popularity with local and regional communities in Canterbury.
- Further engagement with Ngāi Tūāhuriri must be positive for the long-term future of the Tiromoana Bush project.
- Developing the role of Tiromoana Bush as a hub for conservation in the wider area and especially across Mt Cass, Dovedale and Glenafric Stations and on the land along the Mt Cass ridge owned by MainPower.

And to do all of the above, it is important that the current biodiversity monitoring is continued and where appropriate expanded (e.g. reptiles) and takes advantage of new technologies (e.g. acoustic bird recorders), and that the project continues to receive adequate financial support.

LITERATURE CITED

Kernahan A 2021. An analysis of growth and mortality of planted indigenous tree and shrub species in the Tiromoana Bush Reserve. Unpublished M.Fopr.Sc. report, University of Canterbury, Christchurch.

Lurling JJF, Lloyd B 2020. Monitoring birds at Tiromoana Bush Conservation Management Area 2019. Unpublished report.

Madigan F 2018. Results of first pre-control tracking tunnel monitoring session - undertaken November 2018. Unpublished report.

Norton DA 2019. The Tiromoana Bush restoration project, Canterbury, New Zealand. Published on the EMR Project Summaries web site 2 February 2019.
<https://site.emrprojectsummaries.org/2019/02/02/the-tiromoana-bush-restoration-project-canterbury-new-zealand/>

Norton DA 2022 Tiromoana Bush photo-point summary 2005-2021. Unpublished report.

Tulod AM, Henshaw A, Norton DA 2020. Succession of native woody species within an early-successional forest following the removal of domestic livestock grazing. Submitted to NZ Journal of Ecology.

Tulod AM, Norton DA 2020. Regeneration of native woody species following artificial gap formation in an early-successional forest in New Zealand. *Ecological Management and Restoration* 21, 229-236.

Tulod AM, Norton DA, Sealey C 2019. Canopy manipulation as a tool for restoring mature forest conifers under an early-successional angiosperm canopy. *Restoration Ecology* 27, 31-37.