GEOG309 Research Project

Future Management Plan to Enhance the Ecological Restoration and Biodiversity of the Chrystalwood Lane Red Zone, Governors Bay

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Contents

Executive Summary

- What would a management plan look like that enhances the ecological restoration and biodiversity of the Chrystalwood Lane Red Zone in Governors Bay?

- Methodologies included data collection from bird counts, vegetation plots, photography (on the ground and drone), LiDAR and GPS. Data was analysed in Rstudio through abundance and richness. GPS information was analysed using GIS, to produce a map. Secondary research also played a vital role in our project's findings.

- Our findings were limited by time restraints, preventing data collection at optimal times, such as the collection of bird data. With additional time we would have collected qualitative information regarding the desires of the Governors Bay community. Time constraints also limited our ability to conclude the total percentage of the area covered in the *Muehlenbeckia australis* species. However, the greatest limitation of our project has been constraints put in place by the Christchurch City Council (CCC) regarding safety concerns in the area. An updated geotechnical report needs to be completed (12- 24 months) before public access is permitted. This has meant that our recommendations for this management plan can only be advised to be undertaken following an updated geotechnical assessment.

- Future research could be done to investigate the success of our recommendations for the land. As there is limited research regarding restoration and management practices on areas of land smaller than 20 ha, further research in this area would be beneficial.

Introduction

Following the 2010 and 2011 Christchurch earthquakes, 1.65 Ha of steep gully at the end of Chrystalwood Lane in Governors Bay was red-zoned due to rockfall risks (Fig. 1). An ephemeral stream runs through the land which is covered in 15-year-old regenerating bush composed of varying vegetation types, including a small plantation of fir and eucalyptus trees. The regenerating native bush overshadows gorse. While the back section of the land was previously crown-owned, the lower portion was owned by Sally Tripp who contributed to much of the native and exotic planting in the area. Following the earthquake events, Tripp's house was demolished, and the land was passed from the Crown to the CCC. Community partner, Kerry Turner, resides in a property adjacent to this land and dedicates time to the bush, including cutting back invasive weed species, maintaining four pest traps, and developing an interconnected network of tracks. Turner's vision for the land is to create a space of rich biodiversity, community engagement, and enjoyment for the Governors Bay community.

The objective of this report is to outline recommendations and guidance on how to continue the development of the regenerating bush. Our research is structured around five main topics: regeneration planting, pest plant management, vertebrate pest management, track development, and community engagement. First, relevant background information of the Governors Bay and Banks Peninsula areas is outlined. Second, current and relevant literature for each of these topics is explored. Third, methods are outlined, and results are described including reference to full plant lists in appendices. Future recommendations for the management of the land are detailed last under the five main topics, with reference to information found in reviews of relevant literature and the results.

As there are few studies regarding management of small portions of land, this report holds value not merely to the community, but also fills a gap in current literature, leading as an example for the management of other small projects across Aotearoa.

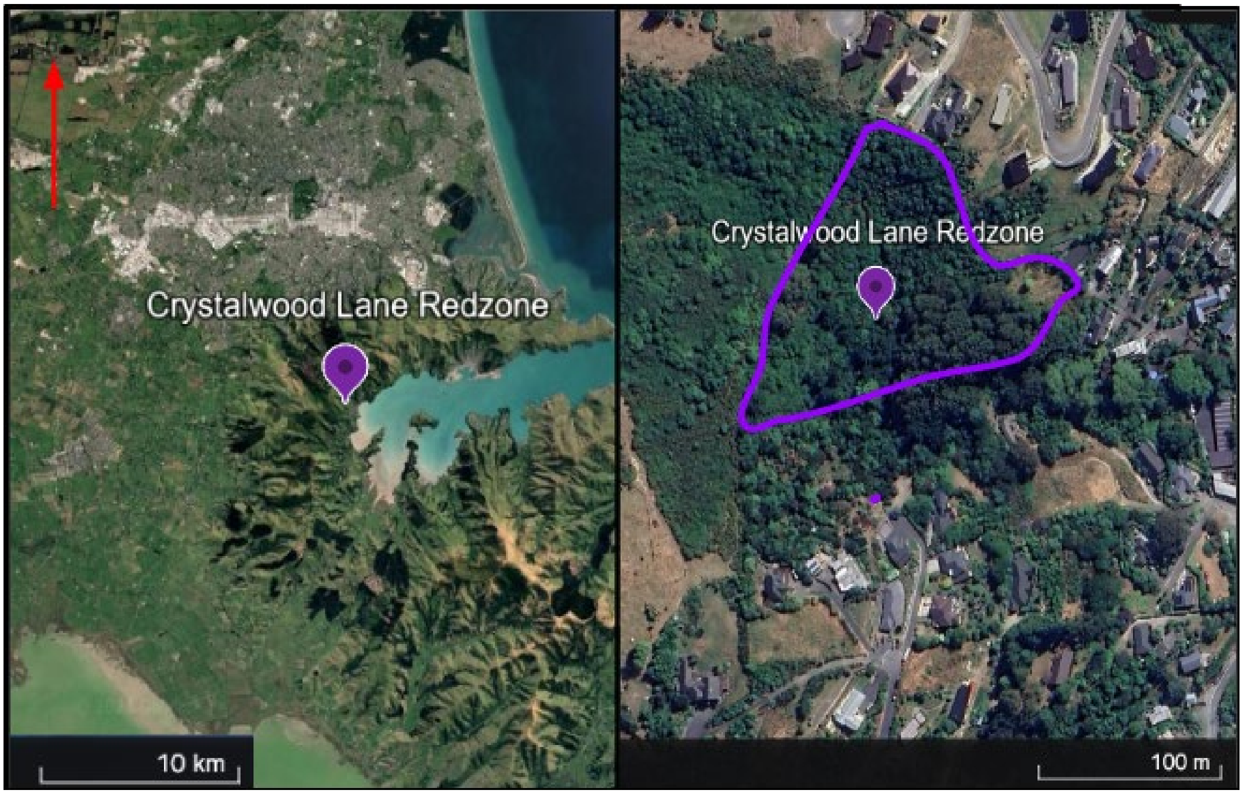

Figure 1. Location of Red Zone Area at end of Chrystalwood Lane in Governors Bay.

History of the Area

Banks Peninsula is primarily composed of lava flows and other volcanic products from two large Miocene-age volcanoes: Akaroa and Lyttleton (Wilson, 2013). These volcanoes formed over older terrain with some parts exposed in the Gebbies Pass area, which is approximately 11.5 km away from Governors Bay (Wilson, 2013). The oldest of these rocks dates back to 220 million years ago, in the late Triassic-age (Wilson, 2013). These sedimentary rocks form the geological backbone of the Aotearoa (Wilson, 2013). The oldest volcanic rocks found in Gebbies Pass are rhyolites that date back to 80 million years ago, from the Cretaceous times (Wilson, 2013). These are much older and of different composition from the rest of the Peninsula (Wilson, 2013). The main volcanic rock types that are found on Banks Peninsula consist of basalt, andesite, rhyolite, hawaiite, and trachyte which differ in the proportions of their main chemical compounds, particularly silica (Wilson, 2013).

Human history began when Waitaha came to the upper reaches of Whakaraupō in the fifteenth century, setting into family groups rather than in sizeable pā (Robertson, 2016). They named the Peninsula ‘Te Pātaka o Rākaihautū’, after their chief and because of the abundance of food supplies (Robertson, 2016). They were soon joined by Ngāti Māmoe in the late sixteenth century, who settled in Governors Bay in significant numbers (Robertson, 2016). However, by this time, the Peninsula was already showing signs of depletion (Robertson, 2016). Around 30 species of bird, including moa, were all but extinct and about a third of the original podocarp forest cover of the Peninsula had been removed by fire (Robertson, 2016). Māori burning of the forest is evidenced by charcoal and buried forest soils (Robertson, 2016). This situation worsened from the 1790’s onwards when European sealers arrived to New Zealand shores (Robertson, 2016). Shortly after, flax traders and whalers were attracted to the land, which opened up opportunities for trading with Māori (Robertson, 2016). With this, European diseases spread to Ngāi Tahu on the Peninsula, leaving them vulnerable (Robertson, 2016). In between the arrival of Europeans and the 1900’s, almost all of the remaining forest was cleared by burning or milling (Robertson, 2016).

Current and Relevant Literature

It is crucial to critically analyse relevant research associated with our project to base our understanding on research findings. Literature was reviewed individually focusing on different areas to do with our project including the five main topics.

Regeneration Planting

A recurring finding in the literature is the importance of considering the original forest. Previously, Banks Peninsula was almost completely covered in podocarp and broadleaved angiosperm forest (Burrows, 1994). Due to human settlement, there has been significant natural habitat loss (Burrows, 1994). Close proximity to the Port Hills fires, presents a fire risk which needs to be mitigated through planting fire resistant species and creating a green firebreak (Reduce Your Fire Risk, n.d.). Meurk & Swaffield (2000) argue that introduced plants can be beneficial to native plants by creating a nursery for them. Native birds are vital to native forest regeneration therefore creating an environment where birds thrive is essential (Burrows, 1994). Most plants on Banks Peninsula produce fruit or seed that is attractive to birds (Burrows, 1994). Planting these species will increase bird and invertebrate abundance (Crisp et al., 1998).

Pest Plant Management

Invasive non-native plants threaten Aotearoa's biodiversity and ecosystems (Peterson, et al., 2020). Native flora and fauna have evolved in the absence of mammals, leaving endemic plant species vulnerable to introduced pests (Scanlan, 2011). The Department of Conservation (DOC) is the main body responsible for weed management in Aotearoa (Williams & West, 2000). Nationally, DOC oversees weed management of established reserves (Williams & West, 2000). In urban areas and local reserves, the responsibility of weed management is delegated to councils and private entities (McGarrigle, 1999). Despite a lack of public support for the use of agrichemicals in weed control, herbicide and pesticide treatments remain a popular choice (Peterson, et al., 2020). Pesticide use is not always an effective method of weed control. For example, in Wareheim Reserve, the vine *M. australis* continued to regrow despite the use of herbicides (Scanlan, 2011). A key component of weed management is raising awareness about invasive weeds within the community (Williams & West, 2000).

Vertebrate Pest Management

Studies have identified clear trends of biodiversity increasing substantially following invasive pest species control (Barney et al., 2021; Armstrong et al., 2017; Morgan et al., 2022). The Red

Zone falls under both Predator Free 2050 (Predator Free NZ, 2024) and Pest Free Banks Peninsula (Pest Free Banks Peninsula, 2023). There is no singular method of pest management that fits all. Small areas of land are greatly underrepresented in the literature but several papers considering fragmented sites (Barney et al., 2021; Morgan et al., 2022), and a few at larger sites (Johnstone et al., 2023; Patterson et al., 2024) provide knowledge relevant to the Red Zone. Both trapping and baiting are effective methods for control, however baiting may require more monitoring and have greater risks to domestic animals (Russsll et al. 2015). There is a consensus that management plans need to be adaptive towards technological advancements and prioritise monitoring not only for success of control methods but also the risk of reinvasion, non-target species release (Barney et al., 2021; Morgan et al., 2022), and residual populations following control (Patterson et al., 2024).

Track Development and Maintenance

The development and maintenance of walking tracks requires balancing accessibility, whilst also protecting and conserving the environment. The views of the local mana whenua, Te Hapū o Ngāti Wheke, must be considered to ensure the work is helping to restore mauri to the area's native forest (Cook and Harrison, 2002). The economic investment and evaluation of track forming practices must also be considered as it demands labour and resources (Cook and Harrison, 2002). Tracks attract locals to the area which can increase volunteer engagement, another reason why it would be a huge advantage to the area to have an accessible public walking track (Cook and Harrison, 2002). Unmaintained tracks can result in adverse environmental outcomes and poor visitors' experience, decreasing visits to an area (Hawkes et. al., 2013). Hawkes et. al. (2013) argues maintaining track systems, such as reliably predicting the stability of tracks, should be done using GIS-based technology. GIS would be useful for surveying the condition of the tracks if the area was to become too risky to enter due to rockfall or major slips, for example. Maintaining tracks amidst seasonal changes is vital. There are gaps in current literature which estimate how climate change, including increases in extreme weather events, will affect the maintenance of tracks, therefore regular inspections and upkeep is essential.

Community Engagement

Community engagement and collaboration is key for ecological regeneration project success to help boost a vibrant biodiverse Red Zone with abundance of native plant and bird species. Research suggests active community involvement, particularly with volunteers/community members, allows for adaptive management and education that fosters a long term social and ecological connection and kaitiakitanga of the place (McDonald, 2021). Building relationships between local communities, iwi, professionals and institutions is required for a successful outcome, but also relies on shared goals regarding both ecological or social priorities (Galbraith, 2021; Walker et al., 2019). Adaptive management that is supported by data gathering technologies is beneficial for monitoring and adjusting restoration efforts (Sullivan, 2016). Additionally, educating youth, volunteers and integrating indigenous knowledge are essential for long term stewardship (Chawla, 2023; Walker et al., 2019). Acknowledging tino rangatira, traditional practices as mana whenua customary rights (Conservation act 1987, ss. 23A). Sustainable and inclusive restoration needs to include clear, inclusive strategies, and involve stakeholders to emphasise the importance of both ecological and social wellbeing.

Methods

Vegetation Counts

Vegetation plot locations were chosen along a track on the south-facing slope for accessibility, each plot approximately 40 metres apart (Fig. 2.). Two of the locations were completed on the lower north-facing edge, to include eucalyptus and fir tree plantations. The centre of each plot was recorded using GPS, and a 50 m tape was used to mark out 10 x 10 m quadrats. All species present within these plots, and their percentage canopy cover, were estimated and recorded. Any species that were unable to be identified were photographed and loaded into the iNaturalist app. The data was digitised and analysed in RStudio. Species abundance and species richness were calculated. The latter was calculated as the number of unique species per plot. These measurements were graphed, but not analysed in RStudio, due to a lack of replicates.

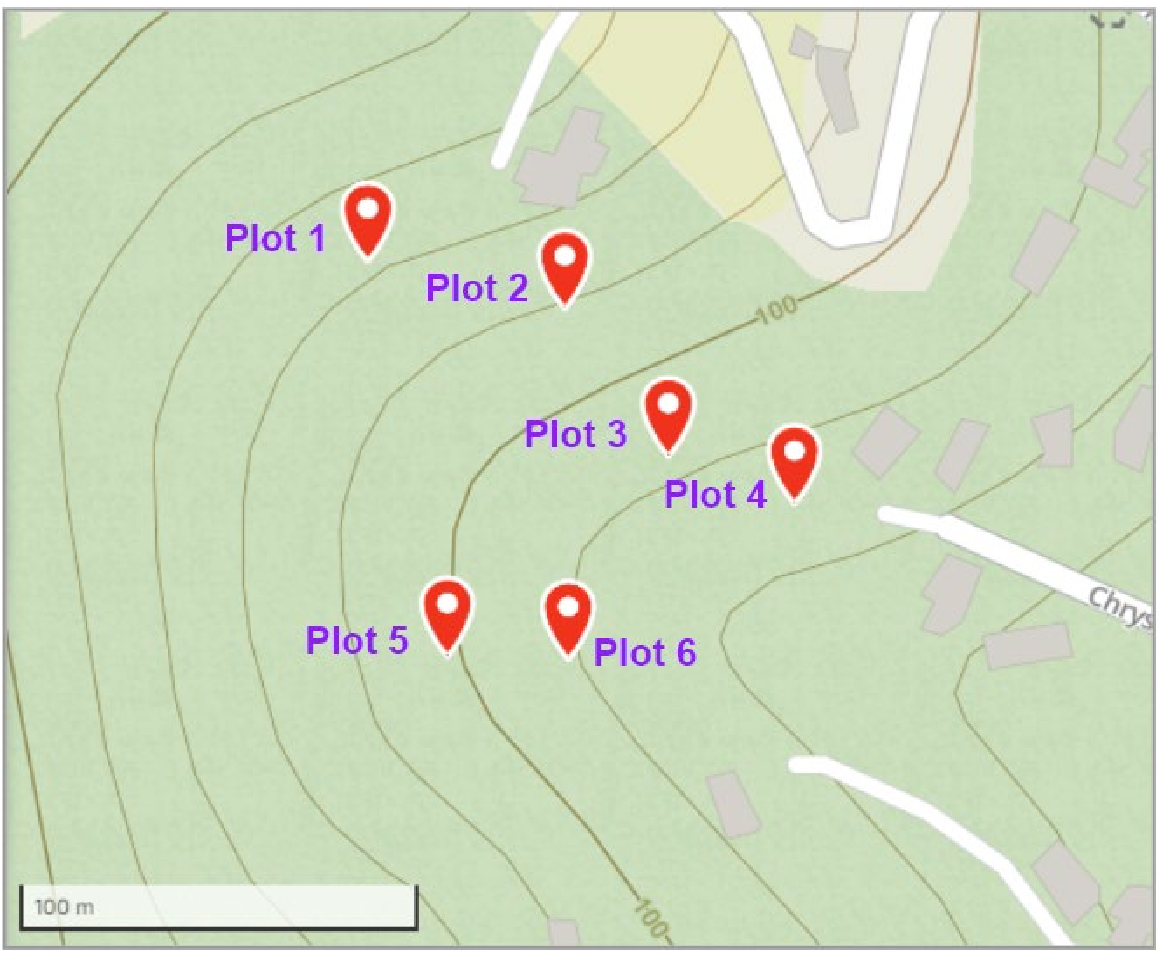

Figure 2. GPS locations of vegetation plots and five-minute bird counts.

Five-Minute Bird Surveys

For five minutes observers watched and listened for birds within 25 metres of the six vegetation plot GPS locations (Fig. 3.). Auditorily and visual observations of bird species were recorded, and those unidentifiable were also noted along with disturbance such as wind and other noises (construction) and sunlight. All participants in the count communicated where observations were coming from to avoid double-counting of individual birds. Prior to undertaking this data collection, all participants had completed the DOC online bird identification course (Bird Identification Online Course, n.d) and practised bird sound recognition through the New Zealand Birds Online resource (New Zealand Birds Online, n.d.) to increase recognition of individual bird species. The data was not analysed for significance due to a lack of replicates.

Photographic Surveys

Photographs of the current state of the Red Zone were taken on a Canon EOS 6D mark 2 with a 50mm 1.6 lens between 15 August and 29 September 2024. Wide images were taken as composites made of six or more images across a scene and combined as bigger image files using Adobe Lightroom photomerge tool. All images have been processed through Lightroom to adjust lighting and export as jpg file type.

Lidar Sensor Drone

With the assistance of the School of Earth and Environment at the University of Canterbury, we flew an aerial DJI Matrice 300 L1 lidar sensor drone over the area to collect lidar photography on 15 August 2024. The DJI Terra program was used to render the Lidar data and generate an LAS file. The LAS point cloud was classified in spantix, using terra solid. Agisoft metashape generated a mosaic of orthophotos, bringing individual images together into one, whilst correcting for colour, direction and terrain distortion. These corrections from global constellation RTKGNSS were in real-time and were connected with McQueen’s Valley Base Station which removed time corrections.

Track Mapping GPS

With training from Matt Cockcroft, we conducted Global Positioning System (GPS) tracking of existing tracks in the area using a Trimble Geox7 GPS on an extension pole. Point and line-generic data was collected through the guidance of Turner on 15 August 2024. The GPS coordinate system used was NZGD2000, MSL Geoid NZ Geoid 2016. This information was processed in GIS.

Results

Soil profile

According to Manaaki Whenua (2024) soil report, the soil in Governors Bay contains 70% Timaru silt, as well as rhyolite and melanic basalt from old volcanic rock (Fig. 3). Pallic soils form from loess, which have gradually been deposited via wind from the Southern Alps across Canterbury. The pallic soils found in this area are typically 'poorly to imperfectly' drained and have 'moderate soil water holding capacity', high density and penetration resistance (Manaaki Whenua, 2024). Planting can be difficult because of root depth, infiltration, and plant nutrient availability. Soils dry in the summer months and saturate during winter months, which can create dangerous working conditions. The soils geomorphology must be accounted for in the creation of a land management plan.

Figure 3. Soils below surface level. Photo was taken from the back of Turner's house.

Vegetation Data

Over the six sample locations, a total of 46 different plant species were found and are listed in appendix 1. 27 of these species were natives and 19 exotic. Plot 3 and 6 had the greatest species richness overall (Fig. 4). Native species richness was at a similar level across all plots with the exception of 4 and 5 which were completed at the site previously occupied by Trips house and the fir tree plantations (Fig.4). Douglas-fir, mahoe, mountain ash and gorse had the greatest percentage of canopy cover across all sites (Fig. 5).

Bird Count Data

Throughout the bird counts a total of 60 birds were observed, 46 identified by sound and 14 by sight. 58.3% of these individuals were natives and a total of 11 different species were identified. Species richness was well spread with each plot having an average of 6 species observed (Fig. 6). Bellbirds were the most abundant species across all sites, followed by sparrows (Fig. 7).

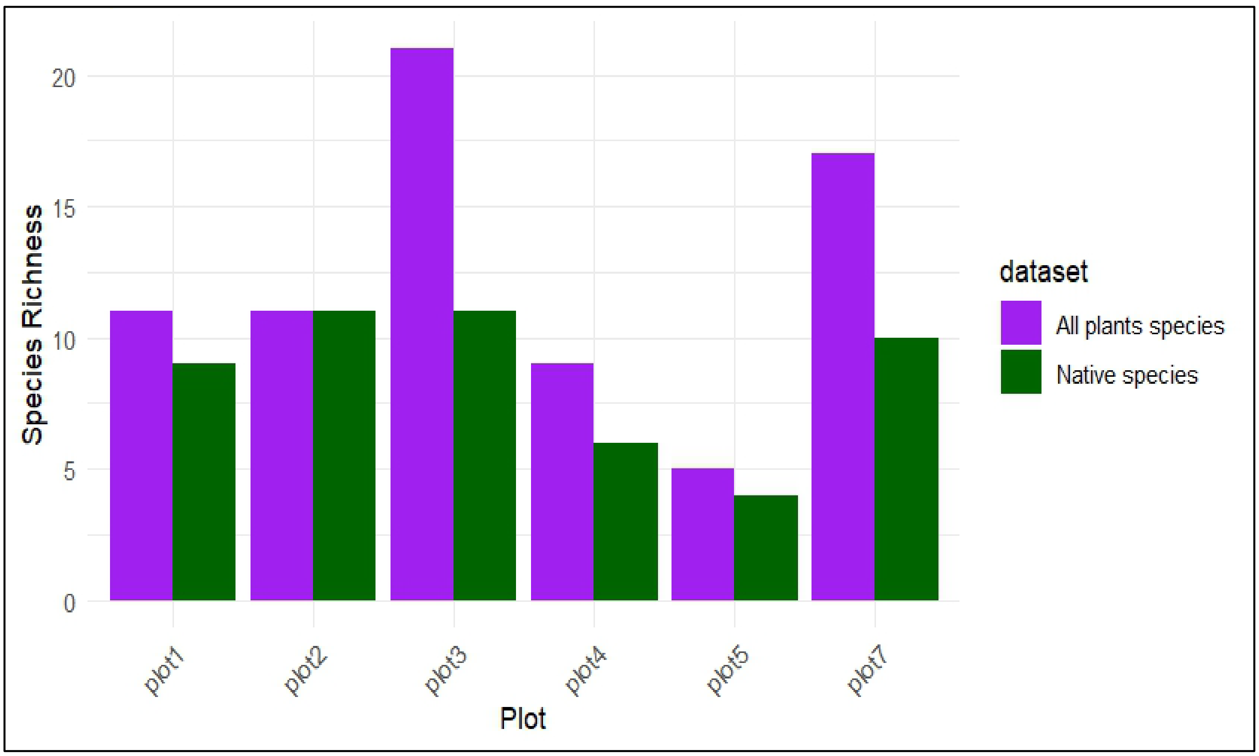

Figure 4. Overall vegetation species richness (purple) and native vegetation species richness (green) across sample plots.

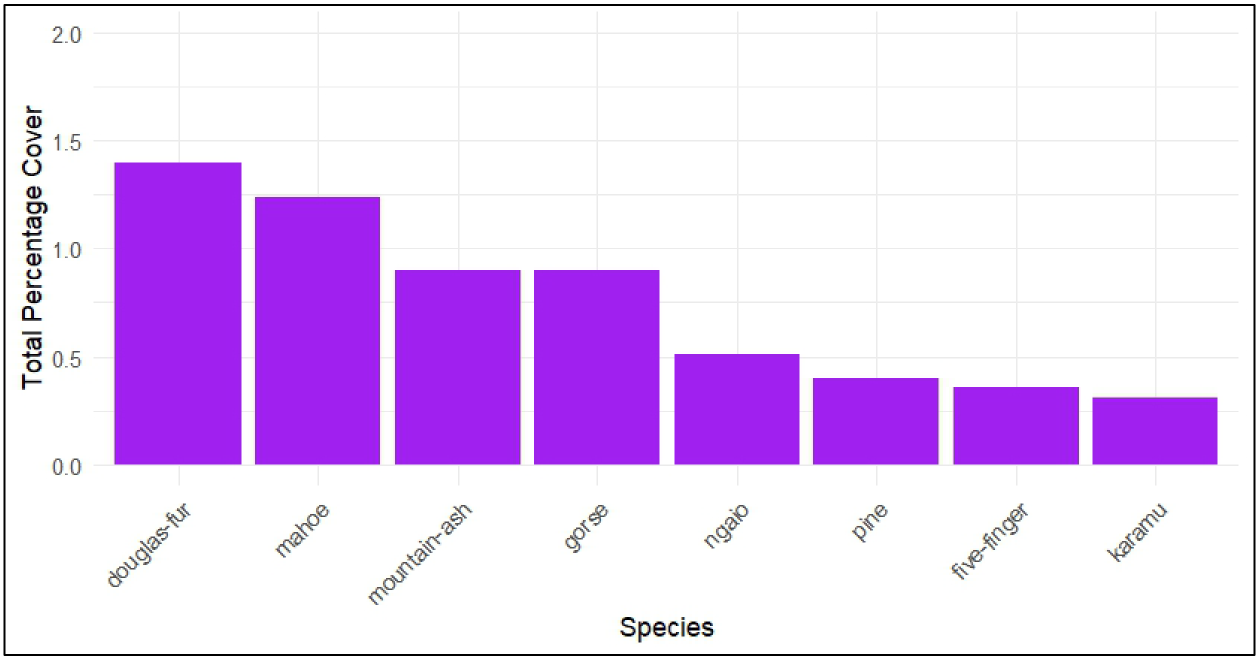

Figure 5. Total Vegetation cover of species with greater than 30% cover across sample sites.

Figure 6. Bird species frequency distribution across six sites.

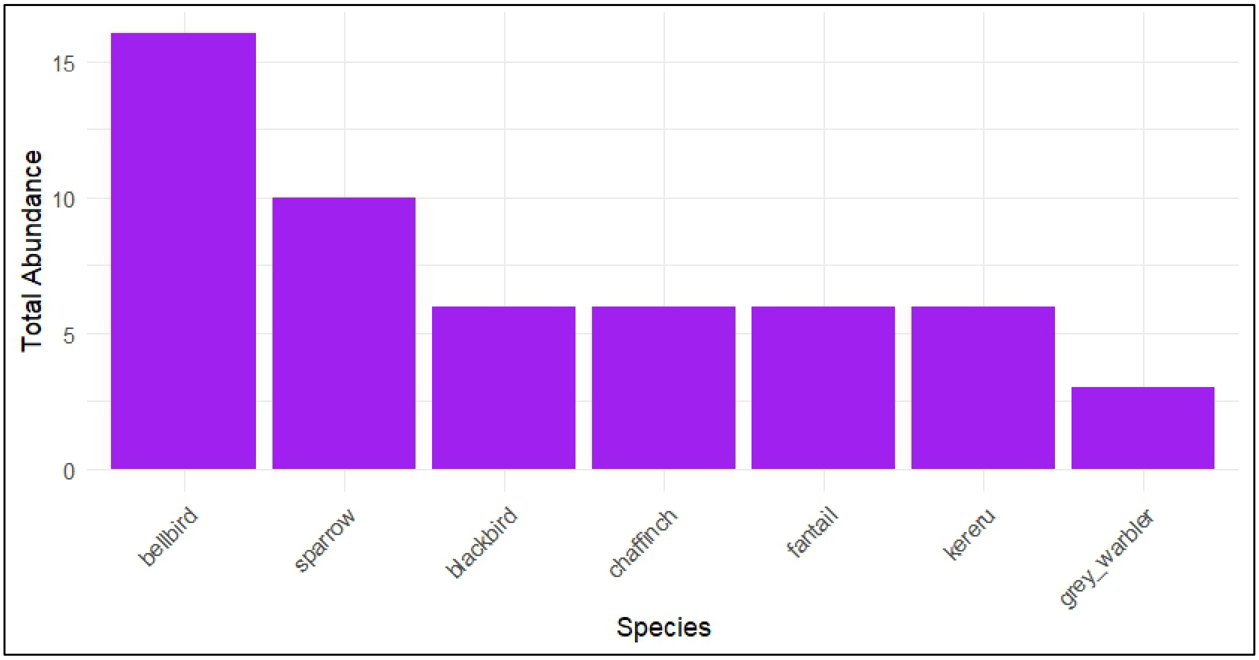

Figure 7. Bird species abundances of the seven most frequent bird species.

Site Photographs

Site photographs, figures 8 to 15, show variation in the distribution of vegetation and land use.

Figure 8. Photograph taken at the bottom of the Red-Zone bush facing East towards the site previously occupied by Sally Tripp's house. A small wooden bike jump construction is visible in the foreground.

Figure 10. Photograph facing West from the upper part of the fur tree plantation on the northern-facing side of the valley.

Figure 9. Photograph taken facing southeast looking into the Eucalyptus plantation and the undergrowth of native plant species from the Fur tree plantation.

Figure 10. Photograph facing north down valley from the edge of the eucalyptus plantation bordering on the fur plantation. Native plant species form undergrowth in the foreground and a flax plant is on the left.

Figure 11. Photograph facing south down a track on the south-facing slope among native plants regrowth.

Figure 12. Photograph Facing southeast downslope along a track cleared through thick gorse previously shrouded by a thickening canopy of native tree species.

Figure 13. Photograph facing West up a section of thick gorse and M. Australis (mid-left) cut back by Kerry in the central area of the redzone.

Figure 14. Photography facing west into the lower part of the fur tree plantation.

Figure 15. Photograph taken near the centre of the red zone facing north through an area of *M. Australis* down a path cut through by Kerry. Note *M. Australis* photographed during winter in a non-leafy dormant state.

Track map

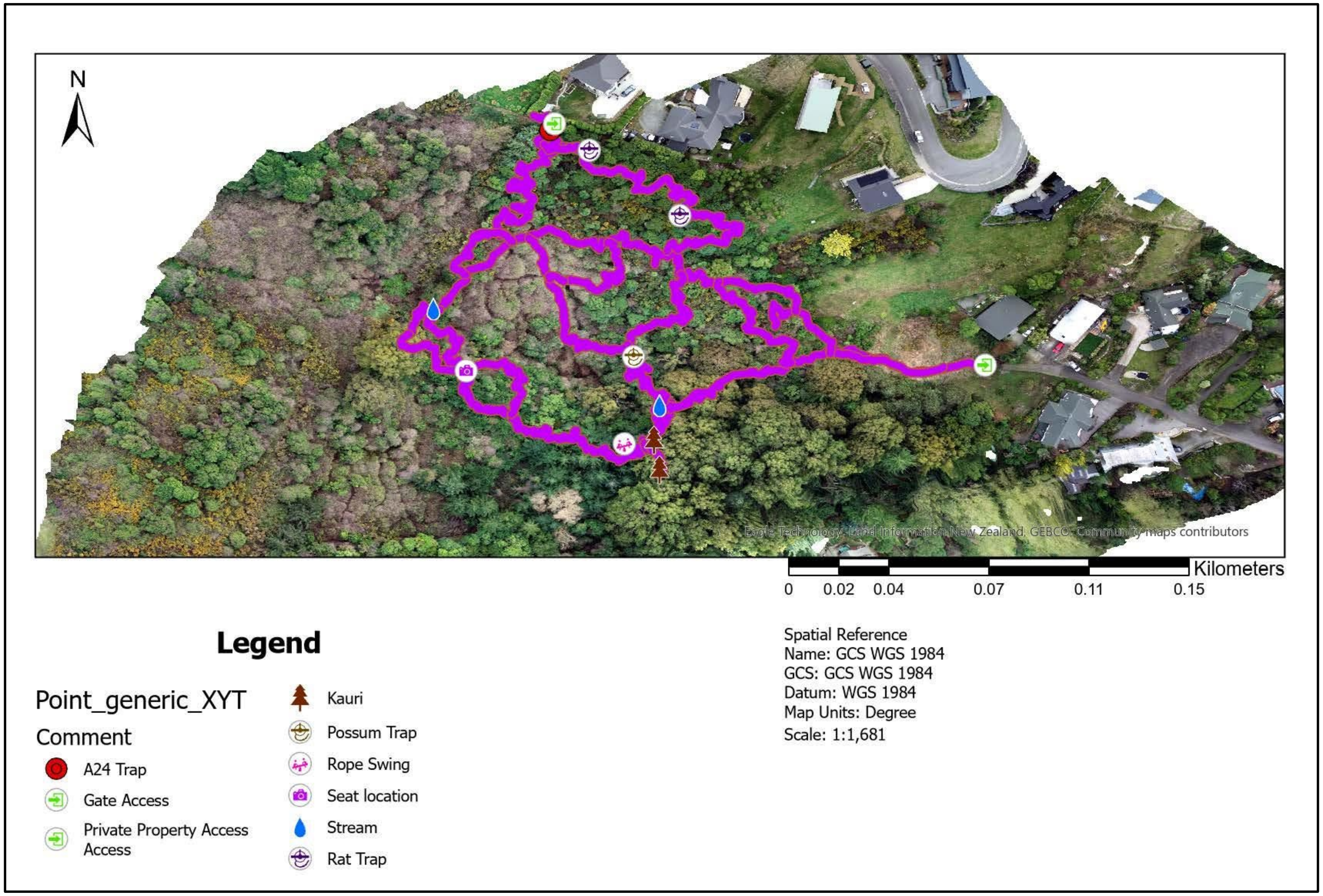

Figure 16. GPS tracks overlaid on top of drone footage data of Red Zone at the end of Chrystalwood Lane, Governors Bay. Legend indicates the location of key features including pest traps, stream crossings and the location of a future potential seat with a view of the bay.

Future Recommendations

Health and Safety

The Red Zone ranger, Zane Lazare, recommends the "community stay out of the Red Zone" due to safety concerns (personal communication, August 23, 2024; Newsline, 2024). There is a lack of budget for planning the Port Hills Red Zone, and for an up-to-date geotechnical assessment. A comprehensive geotechnical assessment provides information of rock fall hazards, how land acts in drought, flood, and an earthquake. It is worth more to pay contractors compared to enlisting the help of community groups, as they can spend more hours on site than the geotechnical report deems as safe. Contractors have more hours allowed on site because they have their own health and safety protocols, risk management and liability insurance.

Another option for the community to undertake now is a transitional lease agreement for Red Zones (CCC, n.d). This provides a legal relationship between community and council. Local communities can adopt a small area to maintain and upkeep, however, there remains a restrictive number of hours for people to work on the site given by a lease. There is also a cost for the person who takes the lease to maintain the area.

Lazare estimated a geotechnical report will be available in 12-24 months. In the meantime, this report's recommendations could be modified for use by council-paid professionals to complete with the exception of track building and maintenance. The report's recommendations could also be transferable to other Red Zones or residents to use in their area. Otherwise, with the geotechnical report pending, this report is looking to the future to develop a management plan.

Invasive Plant Control

Many of the weeds located by Chrystalwood Lane are common garden weeds and exotic plants which have continued to grow from Tripp's garden (Fig. 17). Turner has been volunteering his time to control weeds in the area. Lazare recommends that community members could use the 'cut and paste' method for high-priority weeds. Glyphosate gel could be used for ivy, old man's beard and Japanese honeysuckle which are high priority weeds found in the area (Williams & Timmins, 1990). Glyphosate is the active ingredient of Glimax gel which works well on most green leafy weeds (Cut'n'Paste Weed Gels, 2024). Glyphosate can stay in the soil for up to six months after exposure, making it a good choice to use before planting (Duke, et al., 2012). Glyphosate is one of the most commonly used herbicides worldwide, however there is a step to move against its use in the agricultural sector across Europe due to its concerns of toxicity and potential carcinogenic nature (Metcalfe, et al., 2024). Use of appropriate PPE will be important to mitigate its harmful effects (Müller, et al., 2014). This project does not propose to use large amounts of this chemical, instead use it in a controlled environment for high priority weed control.

It is important to encourage the Governors Bay community to remove weeds from their own gardens since they are not currently allowed in the Red Zone to help reduce seed spread (CCC, 2024). Governors Bay could utilise resources such as Weedbusters 'plant me instead' booklets (Table. 1) (Weedbusters, 2007), and herbicide gel that Weedbusters offers to the community at cost price (Governors Bay Landcare Group, 2024).

The native climbing vine *M. australis* tends to outcompete other plants and is known as a native weed (Howell, 2008). This vine can provide shelter to birds and lizards and prevent erosion, however, its fast-growing nature means it can quickly sprawl and smother other plants thus requires trimming to maintain size and shape (Cameron, et al., 2022). When in the canopy, this vine can prevent light from reaching the forest floor, hindering native seedling growth, as well as constricting the trees it climbs (Cameron, et al., 2022). A method used to control *M. australis* is cut the vine at ground level, and soak the tips in poison, however, despite considerable effort to remove the vine, it continues to regrow (Scanlan, 2011). Therefore, further research is required to find an effective herbicide approach, or to look at other options for managing *M. australis*.

Table 1. Some recommendations from Weedbusters Plant Me Instead of weeds found in the red zone area (Weedbusters, 2007).

Common Name	**Scientific Name**	**Location within Red Zone**	**'Plant me instead' recommendations (Weedbusters, 2007)**
English ivy	Hedera helix L.	Minimal coverage throughout	NZ Jasmine (*Parsonsia heterophylla*)
Old man's beard	Clematis vitalba	Northwest Corner moving south down the valley from neighbouring property	Small white clematis (*Clematis paniculata*)
Japanese honeysuckle	Lonicera japonica	property neighboring area on Chrystalwood Lane	Yellow clematis *(Clematis tangutica)*
Aluminum plant	Pilea cadierei	Minimal coverage throughout area	Kiwakiwa *(Blechnum fluviatile*)

Figure 17. Various weed species photographed and identified throughout the Red Zone.

Vertebrate Pest Control

Aotearoa's unique wildlife is highly vulnerable to introduced predators making community involvement crucial for trapping. Aligning with the existing pest management plans, such as Predator Free 2050 and the Pest Free Port Hills (PFPH) initiatives, will provide the community with information, guidance and a long-term strategy aiming to eradicate possums, rats, and mustelids. Trapping is the best approach for the small area, as it is safer and allows for community participation. Subsidised traps can be sourced through partnership with local organisations such as the Summit Road Society, CCC, ECAN, DOC or local fundraisers. Partnering with PFPH (2022) is beneficial as they use NAWAC-approved humane traps.

Curnow & Kerr (2017) recommends rat trap grids, a dense layout that impacts home range and behaviour. The concept is effective to understand and monitor predator density, food availability, and habitat type. A 100 m x 25 m grid in the Red Zone would need seven traps, placed 25 m apart along on ridges, spurs, near water sources and bush edges. Monitoring will be key for progress using apps such as Trap.NZ. PFPH suggests alternate ways to prevent pests through rodent-proofing surrounding properties to address the challenge of reinvasion and meso-predator release (Morgan et al., 2022). Hence the importance of community engagement and conservation groups, to support and educate the community on effective trapping.

Best Track Forming Practices

Turner has created an interconnected network of tracks throughout the bush from a pre-existing farm track. These tracks require evaluation before being open to public use. GPS and drone footage data was used in collaboration to map existing tracks, providing a foundation for future planning (Fig. 16.). Areas on either side of the ephemeral stream could be considered ‘safer’ areas for human activity, with the greatest rockfall risk being through the middle of the land where the gully forms. There is potential for these areas to be deemed safe for walking tracks to be developed. Regular ground maintenance should be conducted in combination with GIS technology, which brings environmental factors such as track elevation, vegetation type and cover and soil types into consideration (Hawkes et. al., 2013).

Future Planting

We recommend planting vegetation that will restore the land to its original state while also creating a diverse ecosystem (Burrows, 1994). This can be done by planting species that will attract frugivorous birds, a list of native plants which have fruit and seeds can be found in Appendix 2 (Burrows, 1994). This will enhance the biodiversity in the area, which will attract wildlife. Tripp (1998) created a book of plants found on Banks Peninsula and identified several ecosystem types around Banks Peninsula. Governors Bay would fall under the ‘Mataī, Tōtara, Kererū, moist forest ecosystem’ (Tripp, 1998). In Appendix 2, all species that come under this ecosystem type, are recommended to be planted (Tripp, 1998). Many of the species recommended have been identified in high abundance within the area already. A list of fire-resistant plants can also be found in Appendix 2 (Reduce your fire risk, n.d.). High-flammable species, such as Mānuka and Kānuka, should be planted sparingly (Reduce your fire risk, n.d.).

Community Involvement

The restoration project aims for long-term ecological and social impact. However, limited time and lack of public access to the Red Zone limited the ability of this project to engage extensively with the community. When possible, organise practical workshops and working bees focused on weed control, native planting, pest trapping, gathering and monitoring data. These activities will provide opportunities for learning and co-creation among locals, conservation organisations, Cholmondeley, youth, and iwi. The Governors Bay Community Association should share updates on their website and manage mailing lists for activities. Contact Te Tira Kāhikuhiku (Red Zone Transformative Land Use Group) for advice, potential grant funding and other resources available (CCC, 2020).

Collaboration with Ngāti Wheke is essential for sustainable restoration of the Red Zone. For co-design and co-decision-making to protect indigenous vegetation, respecting ancestral land relations, customary rights, and promote kaitiakitanga and environmental quality (RMA, 1991 ss.6 & 7). It is recommended to establish kaupapa and customary use zones managed by mana whenua through joint agreements in the area. When possible, the project combines ecological restoration with social enrichment, creating a space that supports both biodiversity and community well-being for the future.

Conclusion

Although this area has huge potential, it has not been deemed safe for people to be present inside it yet, hence the recommendations for the project have been affected by health and safety concerns. It is recommended to wait for an updated geotechnical assessment to be completed (12-24 months), which would provide an updated rockfall risk assessment within the area. It is recommended to continuously evaluate the condition of walking tracks, plant fire-resistant natives, cut back on *M. australis*, utilise Weedbusters for controlling high priority weeds as invasive plants act as a significant barrier for native plant regeneration. In addition, NAWAC humane traps should be utilised for controlling vertebrate pests. Small and achievable projects, which engage the community, such as plantings, are important for keeping locals active and engaged in the area. Literature highlights the importance of community engagement, collaboration, adaptive management, and education in the long-term success and wellbeing of ecological restoration projects. The local mana whenua, Ngāti Wheke, should be consulted throughout all stages of working within this area.

Acknowledgements

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Appendices

Appendix 1: Plants present

Scientific name	Māori Name	Common name
Agapanthus praecox		Agapanthus
Aristatelia serratus	Makomako	Wineberry
Bambusa		Bamboo
Clematis vitalba		Old man's beard
Coprosma propinqua	Mingiming	
Coprosma repens	Taupata	Mirror bush
Coprosma robusta	Karamu	
Coprosma vivescenes	Mingimingi	
Cordyline australis	Tī kōuka	Cabbage-tree
cornycarpus laevigatus	Karaka	New Zealand laurel
Corokia x virgata		Frosted-Chocolate
Cupressus macrocarpa	Houhere	Macrocarpa
Dodonaea viscosa	Akeake	Hop Bush
Echium candicans,		Pride of Madeira
Eucalyptus regnans		Mountain-ash
Fatsia-Japonica		Japanese-aralia
Foeniculum vulgare		Fennel
Fuchsia excorticata	Kōtukutuku	Tree-fuchsia
Griselinia littoralis	Kāpuka	Broadleaf
Hedera helix	Hetera heriki	Ivy
Hoheria sexstylosa	Houhere	Lacebark
Kunzea ericoides	Kanuka	White tea-tree
Lonicera japonica		Japanese honeysuckle
Melicytus ramiflorus	Mahoe	Whiteywood

Muehlenbeckia australis	Pohuehue	
Myoporum Laetum	Ngaio	Mousehole tree
Oleria nummulariifolia		Daisy-bush
Phormium	Flax	Harakeke
Pilea cadierei		Aluminum plant
Pinus radiata		Pine
Piper excelsum	Kawakawa	
Pittosporoum ralphi		Ralphs_Kohuhu
Pittosporum Euginoides	Tarata	Lemmonwood
Pittosporum tenuifolium	Kōhūkōhū	Black matipo
Pittosporus crassifolium	Karo	Stiffleaf cheesewood
Pleioblastus hindsii		bamboo
Podocarpus totara	totara	
Proteacea		Protia
Pseudopanax lessonii	Houpara	
Pseudopanax arboreus	Whaupaku	Five-finger
Pseudopanax crassifolius	Horoeka	Lancewood
Pseudotsuga menziesii		Douglas-fir
Ranunculus repens		Creeping buttercup
Roldana petasitis		Californian-geranium
Roldana petasitis		Velvet groundsel
Roseacea	Rōhi	Rose
Rubus fruticosus	Parakipere	Blackberry
Sambucus nigra		Black elderberry
Solanum chenopodioides	Raupeti,	Nightshade
Sophora microphylla	Kowhai	
Teucrium fruticans		Tree germander
Ulex europeus	Kōhi	Gorse
Urtica ferox	Onga onga	Tree nettle

Appendix 2: Recommended plants

Scientific name	Māori name	Common name	Purpose
Aciphylla subflabellata	Taramea	Speargrass	- Mataī, Tōtara, Kererū, moist forest ecosystem
Alectryon excelsus	Tītoki	New Zealand ash	-Mataī, Tōtara, Kererū, moist forest ecosystem
Alsophila tricolor	Ponga	Silver fern	-Mataī, Tōtara, Kererū, moist forest ecosystem
Anemanthele lessoniana		Gossamer grass	-Mataī, Tōtara, Kererū, moist forest ecosystem
Anthosachne solandri	Pātītī taranui	Blue wheat grass	-Mataī, Tōtara, Kererū, moist forest ecosystem
Aristotelia fruticosa		Mountain wineberry	-Attracts frugivores
Aristotelia serrata	Makomako	Wineberry	-Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Asplenium appendiculatum		Ground spleenwort	-Mataī, Tōtara, Kererū, moist forest ecosystem
Asplenium bulbiferum	Mouku		-Mataī, Tōtara, Kererū, moist forest ecosystem
Astelia fragrans	Kakaha	Bush lily	-Mataī, Tōtara, Kererū, moist forest ecosystem
Austroblechnum penna-marina	Kiokio	Small kiokio	-Mataī, Tōtara, Kererū, moist forest ecosystem
Austroderia richardii		Toetoe	-Mataī, Tōtara, Kererū, moist forest ecosystem
Brachyglottis sciadophila		Climbing groundsel	-Mataī, Tōtara, Kererū, moist forest ecosystem
Carex forsteri		Forster's sedge	-Mataī, Tōtara, Kererū, moist forest ecosystem
Carex solandri		Forest sedge	-Mataī, Tōtara, Kererū, moist forest ecosystem
Carex silvestris		Hook sedge	-Mataī, Tōtara, Kererū, moist forest ecosystem
Carex uncinata	Kamu		-Mataī, Tōtara, Kererū, moist forest ecosystem

Carmichaelia australis	Tainoka	NZ broom	-Mataī, Tōtara, Kererū, moist forest ecosystem
Carmichaelia kirkii		Climbing broom	-Mataī, Tōtara, Kererū, moist forest ecosystem
Carpodetus serratus	Putaputawētā	Marbleleaf	-Mataī, Tōtara, Kererū, moist forest ecosystem
Clematis foetida		Clematis	-Mataī, Tōtara, Kererū, moist forest ecosystem
Clematis marata		Clematis	-Mataī, Tōtara, Kererū, moist forest ecosystem
Clematis paniculata	Puawānanga	White clematis	-Mataī, Tōtara, Kererū, moist forest ecosystem
Coprosma areolata		Thin-leaved coprosma	-Mataī, Tōtara, Kererū, moist forest ecosystem
Coprosma crassifolia	Mingimingi		-Mataī, Tōtara, Kererū, moist forest ecosystem
Coprosma linariifolia	Mikimiki	Yellow wood	-Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Coprosma lucida	Karamū	Shining Karamū	-Mataī, Tōtara, Kererū, moist forest ecosystem
Coprosma propinqua	Mingimingi		-Green firebreak -Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Coprosma rhamnoides	Mingimingi	Twiggy coprosma	-Mataī, Tōtara, Kererū, moist forest ecosystem
Coprosma rigida		Stiff mikimiki	-Mataī, Tōtara, Kererū, moist forest ecosystem
Coprosma robusta	Karamū		-Green firebreak -Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Coprosma rubra		Red-stemmed coprosma	-Mataī, Tōtara, Kererū, moist forest ecosystem
Coprosma virescens	Mingimingi	Pale green coprosma	-Mataī, Tōtara, Kererū, moist forest ecosystem
Cordyline australis	Tī kōuka	Cabbage tree	-Mataī, Tōtara, Kererū, moist forest ecosystem

Corokia cotoneaster	Korokio tāranga	Wire-netting bush	-Mataī, Tōtara, Kererū, moist forest ecosystem
Corynocarpus laevigatus	Karaka	New Zealand laurel	-Attracts frugivores
Cyathea smithii	Kātote		-Mataī, Tōtara, Kererū, moist forest ecosystem
Dacrycarpus dacrydioides	Kahikatea	White pine	-Mataī, Tōtara, Kererū, moist forest ecosystem
Dicksonia fibrosa	Whekī ponga	golden tree fern	-Mataī, Tōtara, Kererū, moist forest ecosystem
Dicksonia squarrosa	Whekī		-Mataī, Tōtara, Kererū, moist forest ecosystem
Elaeocarpus dentatus	Hīnau		-Attracts frugivores
Elaeocarpus hookerianus	Pōkākā		-Mataī, Tōtara, Kererū, moist forest ecosystem
Festuca "blue tussock"		Banks Peninsula blue tussock	-Mataī, Tōtara, Kererū, moist forest ecosystem
Festuca novae-zelandiae		Hard Tussock	-Mataī, Tōtara, Kererū, moist forest ecosystem
Ficinia nodosa	Wīwī	Knobby clubrush	-Mataī, Tōtara, Kererū, moist forest ecosystem
Fuchsia excorticata	Kōtukutuku	Tree fuchsia	-Green firebreak -Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Griselinia littoralis	Kāpuka	New Zealand Broadleaf	-Green firebreak -Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Griselinia lucida	Puka	Shining broadleaf	-Mataī, Tōtara, Kererū, moist forest ecosystem
Hedycarya arborea	Porokaiwhiri	Pigeonwood	-Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Helichrysum lanceolatum	Niniao		-Mataī, Tōtara, Kererū, moist forest ecosystem
Hoheria angustifolia	Houhi puruhi	Narrow-leaved lacebark	-Mataī, Tōtara, Kererū, moist forest ecosystem

Hoheria populnea	Houhere	North Island Lacebark	-Mataī, Tōtara, Kererū, moist forest ecosystem
Hypolepis millefolium	Huarau	Thousand-leaved fern	-Mataī, Tōtara, Kererū, moist forest ecosystem
Ileostylus micranthus	Pirita	Green mistletoe	-Attracts frugivores
Kunzea ericoides	Kānuka		-Mataī, Tōtara, Kererū, moist forest ecosystem
Leptospermum scoparium	Mānuka		-Mataī, Tōtara, Kererū, moist forest ecosystem
Libertia ixioides	Mīkoikoi	Golden libertia	-Mataī, Tōtara, Kererū, moist forest ecosystem
Lophomyrtus obcordata	Rōhutu	NZ myrtle	-Mataī, Tōtara, Kererū, moist forest ecosystem
Melicope simplex	Poataniwha		-Mataī, Tōtara, Kererū, moist forest ecosystem
Melicytus micranthus	Manakura		-Mataī, Tōtara, Kererū, moist forest ecosystem
Melicytus ramiflorus	Māhoe	Whitey-wood	-Green firebreak -Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Microlaena polynoda		Creeping rice grass	-Mataī, Tōtara, Kererū, moist forest ecosystem
Myoporum laetum	Ngaio	Mousehole tree	-Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Myrsine australis	Māpou	Red matipo	-Green firebreak -Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Olearia fragrantissima		Fragrant tree daisy	-Mataī, Tōtara, Kererū, moist forest ecosystem
Olearia paniculata	Akiraho	Daisy bush	-Mataī, Tōtara, Kererū, moist forest ecosystem
Parablechnum procerum	Kiokio		-Mataī, Tōtara, Kererū, moist forest ecosystem
Parsonsia spp.		NZ jasmines	-Mataī, Tōtara, Kererū, moist forest ecosystem

Passiflora tetrandra	Kōhia	NZ passion vine	-Mataī, Tōtara, Kererū, moist forest ecosystem
Pennantia corymbosa	Kaikōmako	Duck's foot	-Green firebreak -Attracts frugivores -Mataī, Tōtara, Kererū, moist forest ecosystem
Phormium tenax	Harakeke		-Mataī, Tōtara, Kererū, moist forest ecosystem
Phymatosorus pustulatus	Maratata		-Mataī, Tōtara, Kererū, moist forest ecosystem
Piper excelsum	Kawakawa	Pepper tree	-Mataī, Tōtara, Kererū, moist forest ecosystem
Pittosporum eugenioides	Tarata	Lemonwood	-Mataī, Tōtara, Kererū, moist forest ecosystem
Pittosporum tenuifolium	Kōhūhū	Black Matipo	-Mataī, Tōtara, Kererū, moist forest ecosystem
Plagianthus regius	Mānatu	Lowland ribbonwood	-Mataī, Tōtara, Kererū, moist forest ecosystem
Poa cita	Wī	Silver tussock	-Mataī, Tōtara, Kererū, moist forest ecosystem
Podocarpus laetus	Tōtara Kōtukutuku	Hall's Tōtara	-Mataī, Tōtara, Kererū, moist forest ecosystem
Podocarpus totara	Tōtara		-Mataī, Tōtara, Kererū, moist forest ecosystem
Polystichum neozelandicum	Pikopiko		-Mataī, Tōtara, Kererū, moist forest ecosystem
Prumnopitys ferruginea	Miro	Brown pine	-Mataī, Tōtara, Kererū, moist forest ecosystem
Prumnopitys taxifolia	Mataī	Black pine	-Mataī, Tōtara, Kererū, moist forest ecosystem
Pseudopanax anomalus		Shrub pseudopanax	-Mataī, Tōtara, Kererū, moist forest ecosystem
Pseudopanax arboreus	Whaupaku	Five finger	-Green firebreak -Mataī, Tōtara, Kererū, moist forest ecosystem
Pseudopanax crassifolius	Horoeka	Lancewood	-Green firebreak -Mataī, Tōtara, Kererū, moist forest ecosystem

Pseudowintera colorata	Horopito	Pepper tree	-Mataī, Tōtara, Kererū, moist forest ecosystem
Pteridium esculentum	Rarauhe		-Mataī, Tōtara, Kererū, moist forest ecosystem
Ranunculus reflexus	Mārūrū	Native buttercup	-Mataī, Tōtara, Kererū, moist forest ecosystem
Ripogonum scandens	Kareao	Supplejack	-Green firebreak -Attracts frugivores
Rubus cissoides	Tātarāmoa	Bush lawyer	-Mataī, Tōtara, Kererū, moist forest ecosystem
Rubus schmidelioides	Tātarāmoa	White-leaved lawyer	-Mataī, Tōtara, Kererū, moist forest ecosystem
Rubus squarrosus	Tātarāmoa	Leafless lawyer	-Mataī, Tōtara, Kererū, moist forest ecosystem
Rytidosperma spp.		Danthonia bunch grasses	-Mataī, Tōtara, Kererū, moist forest ecosystem
Solanum aviculare	Poroporo	NZ nightshade	-Mataī, Tōtara, Kererū, moist forest ecosystem
Solanum laciniatum	Poroporo	Kangaroo apple	-Attracts frugivores
Sophora microphylla	Kōwhai	Small-leaved Kōwhai	-Mataī, Tōtara, Kererū, moist forest ecosystem
Streblus heterophyllus	Tūrepo	Small-leaved milk tree	-Mataī, Tōtara, Kererū, moist forest ecosystem
Tupeia antarctica	Tāpia	White mistletoe	-Attracts frugivores
Veronica salicifolia	Koromiko		-Mataī, Tōtara, Kererū, moist forest ecosystem