MANA ISLAND

FLORAL DIVERSITY ENHANCEMENT REPORT

Stage 2

Commissioned by

FRIENDS OF MANA ISLAND Inc.

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Good things take time…

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Cover Photo: The excellent revegetation of the upper Forest Valley. Matt Ward 2016

EXECUTIVE SUMMARY

This report has been prepared on behalf of the Friends of Mana Island (FOMI). It outlines Stage Two of a three stage process to enhance the Floral Diversity of Mana Island (Appendix 1. in Clapcott & Gill, 2015). This stage involves the ground truthing of floral restoration work that has been undertaken in the past, and the desktop findings of the Stage One report by Clapcott & Gill (2015).

This report has been compiled from information gleaned from the island and its caretakers, those being FOMI, Ngāti Toa and the Department of Conservation (DOC), along with observations from fieldwork and past reports. Two trips were made to Mana Island to do survey work and spend time with people involved in the restoration project. Examples of each of the restored ecosystem types were visited and botanized to assess the progress made since restoration began in 1987. Some planting continues on the island but no longer as intensive as the early years. Since plans (Dobbie *et. al.*, 1986; Timmins *et. al.*, 1988; Nichols, 1989; Miskelly, 1999) to restore the island started, approximately 500,000 plants representing 77 species have been planted.

The plantings have been assessed as impressive in all aspects, although Waikoko Wetland has been noted as having some problems. There has been an overall growth in the number of floral species present on Mana Island. In some cases impressive canopies have formed, additional species have been suggested to plant in this new regime. Almost all of the species noted in an early botanical survey (Timmins *et. al.*, 1987) were located, with some additions. The naturally occurring plants both common and some threatened appear to be thriving without the burden of mammalian disturbance and seed predation.

After comparing similar mainland remnant areas botanical surveys with the new Mana Island list, additional species have been suggested that could be easily propagated and introduced to the restoration program.

The threatened plants that have been introduced on Mana Island have had mixed success. Maintenance lapses of these introductions have caused losses in some cases, while others were not suitable for the island in the first instance. The naturally occurring threatened species appear to be doing well in most cases. Suggestions have been made for further threatened species enhancement to improve the project, if suitable volunteer resources are available.

The Waikoko Wetland initially envisaged to operate with a complex system of weirs with inlets/outlets to be regularly maintained has settled into an unmaintained scenario. It has now silted up significantly due to a sporadic maintenance regime over the last decade. The regime of water available for these ponds has likely changed due to the surrounding plants. During the summer of 2015/16 the ponds were dry. Suggestions have been made for planting and re-purposing of the usable silt cakes in these dry basins. The replanting should be done from seed collected from plants on the island.

Several special cases have been discussed. These include the request for open grassed areas to be maintained and *Corynocarpus laevigatus* - Karaka to be managed as a cultural specimen in some places, and if agreed by local Iwi removed from others. Control of *Muehlenbeckia australis* – Pōhuehue should occur near new or low plantings, but left alone in mature vegetation situations. Light-welling of emergent canopy species should be monitored so that some controls and evidence of success can be proven. *Myoporum insulare* - Tasmanian Boobialla should be controlled on the island to prevent it hybridizing with the local *Myoporum laetum* - Ngaio trees.

Significant amazing work has been undertaken and maintained despite the difficulties experienced by volunteer organizers with the continual loss of institutional knowledge. Good handover practices including overlap to allow a smooth transition between managers will be critical to good outcomes. This document will assist in ensuring a sustained approach with clear outcomes across time with the inevitable changes of management that will occur on Mana Island. A general timeframe for the suggestions in this report is featured at its conclusion.

CONTENTS

EXECUTIVE SUMMARY iii
1. INTRODUCTION 1
2. FLORAL DIVERSITY ENHANCEMENT PROJECT BACKGROUND 2
3. METHODOLOGY 3
4. PLANTINGS 4
4.1 HEALTH OF PLANTINGS 5
4.1.1 HEALTH OF NATURALLY OCCURRING PLANTS 9
4.2 BOTANICAL SURVEY ANALYSIS 11
4.2.1 BOTANICAL LIST 11
4.2.2 ADDITIONAL SPECIES 13
4.2.3 RANGE INCREASES 14
5. COMPARATIVE BOTANICAL ASSESSMENT 16
5.1 SPECIES INTRODUCTIONS AND BOLSTERING 17
6. THREATENED SPECIES 19
6.1 INTRODUCED THREATENED PLANTS 19
6.1.1 NOT FOUND DURING SURVEY 19
6.1.2 FOUND DURING SURVEY 20
6.2 NATURALLY OCCURRING THREATENED PLANTS 23
6.2.1 NOT FOUND DURING SURVEY 23
6.2.2 FOUND DURING SURVEY 23
6.2.3 ADDITIONAL SPECIES 25
6.3 POTENTIAL ENRICHMENT TO THE THREATENED PLANT PROGRAM 27
7. WAIKOKO WETLAND 28
8. SPECIAL CASES 33
8.1 OPEN GRASSLAND POLICY 33
8.2 *CORYNOCARPUS LAEVIGATUS* - KARAKA 35
8.3 *MUEHLENBECKIA AUSTRALIS* – FRIEND OR FOE 36
8.4 LIGHT-WELLING 38
8.5 *MYOPORUM AFF. INSULARE* - TASMANIAN BOOBIALLA 39
8.6 *METROSIDEROS ROBUSTA* – NORTHERN RĀTĀ 40
9. SUMMARY & ACTION PLAN 41
9.1 TASKS 41
9.2 TIME FRAME 42
ACKNOWLEDGEMENTS 43
REFERENCES 44
APPENDICES 48
APPENDIX 1: Mana Island Botanical List 48
APPENDIX 2: Alphabetical order of contemporary names used in 2016 report 57
APPENDIX 3: Alphabetical order of original names used in earlier reports 60
APPENDIX 4: Mana Island Comparative Botanical Assessment 63
APPENDIX 5. Waikoko Wetland Workings (explanation J. Christensen) by L. Clapcott 79
APPENDIX 6. Wetland plant species for a restored wetland on Mana Island (Miskelly, 1999) 82
APPENDIX 7. Correspondence from Phil Marsh re: Takahe & Open grassland - May 9th 2016 83

1. INTRODUCTION

Mana Island is a 217 ha Scientific Reserve managed by the Department of Conservation (DOC). Situated about 4 km offshore from Titahi Bay (Figure 1), the island has one resident DOC ranger with numbers changing at various times. Ngāti Toa is the tangata whenua. The Friends of Mana Island (FOMI), a volunteer care group have been involved with the restoration efforts on the island since 1998.

Mana Island has a long history of human occupation initially by Māori and then farmed by Europeans from 1832 until the stock were removed in 1986. During the 154 years of intensive pastoralism the local ecosystem became highly modified, with any native remnant vegetation confined to the surrounding cliffs and a single steep valley catchment (Forest Valley).

The only remaining mammal after the farming was abolished were mice which were eradicated from Mana Island by extensive trapping in 1989/90. Since the island was cleared of all mammals (other than human) it has become a significant habitat for three resident threatened animal species (*Deinacrida rugosa* - Cook Strait giant weta, *Cyclodina macgregori* - McGregor's skink, and *Hoplodactylus chrysosireticus* - Goldstripe gecko) and numerous reintroduced species many of which are rare or endangered on the mainland.

Several nationally and regionally threatened plant taxa including *Lepidium olearaceum* - Cook's scurvy grass, *Streblus banksii* - Large-leaved milk trees, *Arthropodium cirratum* - Rengarenga and *Melicytus obovatus* survived on the island, and have continued to do so. Further threatened plants have been introduced along with an intensive restorative planting program of approximately 500,000 additional plants including 77 suitable species as outlined in earlier plans (Dobbie *et. al.*, 1986; Timmins *et. al.,* 1988; Nicholls, 1989; Miskelly, 1999).

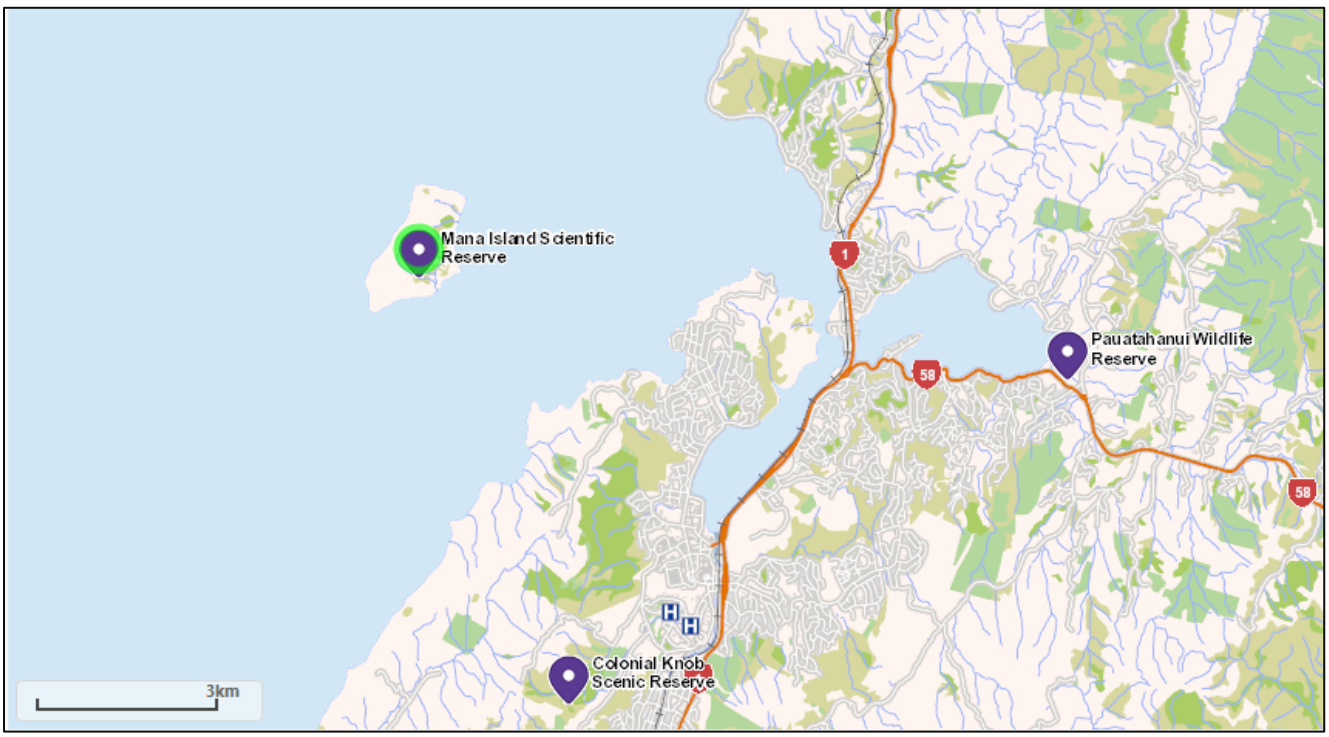

Figure 1. Location of Mana Island in context with the Mainland. (DOC, 2016)

2. FLORAL DIVERSITY ENHANCEMENT PROJECT BACKGROUND

FOMI have been working with the DOC and Iwi on various restoration projects on Mana Island since 1998. The largest of these projects by volume and scope would be the revegetation work, originally started in the late 1980's, involving several other community groups such as Forest and Bird, Wellington Botanical Society, Ngāti Toa and local schools.

FOMI has an active interest in the long term development of these projects. They have been progressing with the recommended actions from the Restoration Plan and consequent Review (Miskelly, 1999 & 2010) to advance the floral diversity of the island following several decades of propagation, primary and secondary planting and seed dispersal. The relevant flora based actions as highlighted in the 2010 review "Mana Island Ecological Restoration Plan Review" (Miskelly, 2010) are summarised simply in Table 1.

Table 1. **Excerpt from "Mana Island Ecological Restoration Plan Review"** (pages 8-12 Miskelly, 2010)

RESTORE FOREST It is presumed that most of Mana Island was forested originally. Restoration of forest to at least a third of the island will provide habitat for many plants, invertebrates, birds and reptiles, most of which are no longer present on the island and will have to be reintroduced. The original forest was likely to have been predominantly kohekohe, tawa, milktree, and northern rātā with associated tītoki, mahoe, pigeonwood, nīkau and emergent rimu. RESTORATION OF WAIKOKO WETLAND Wetlands on islands are a rare habitat, and so there are few wetland habitats in New Zealand that are free of the effects of introduced mammals. Restoring the wetland on Mana Island will provide habitat for a variety of threatened wetland plants, locally extinct birds (especially brown teal) and possibly the threatened brown mudfish. WEED CONTROL There is a real risk that plant communities on Mana Island will become dominated by inappropriate species before restoration has proceeded sufficiently far for natural processes to ensure the spread of plant species typical of the eastern Cook Strait Ecological District. While there will be a long term need for maintenance control of aggressive weed species, intensive weed control is crucial during the early stages of ecological restoration on Mana Island. Continual vigilance will be required to ensure that colonising (and recolonising) weed species are destroyed before they become established.

In this report the three main flora based actions will be further investigated as to the progress since the inception of the 1988, 1989 and 1999 plans, including progress since the 2010 review. It must be mentioned that the bulk of the weed work is undertaken by paid weed control contractors on behalf of DOC, therefore this report will only briefly mention other weed work that could be undertaken. Control work for many of the weed species is impractical for scheduled FOMI volunteer trips due to the intricacy and delicate timing of work required compared to the frequency of trips per year.

The content in this report has been compiled from knowledge gained by visiting the island and speaking with numerous people who have been involved in this project over the years. Some content has also been gained from past reports and studies of the island, and relevant published material all of which has been referenced in the text.

3. METHODOLOGY

Figure 2 shows the areas covered during the botanical survey trips undertaken for this report[1]. The first trip started with the Forest Valley, this is the richest remnant part of vegetation on the island which provided a benchmark for comparison to the planted gullies visited later in the trip. As many varied vegetation type areas were visited as possible so that a full range of the plantings health and original vegetation could be surveyed.

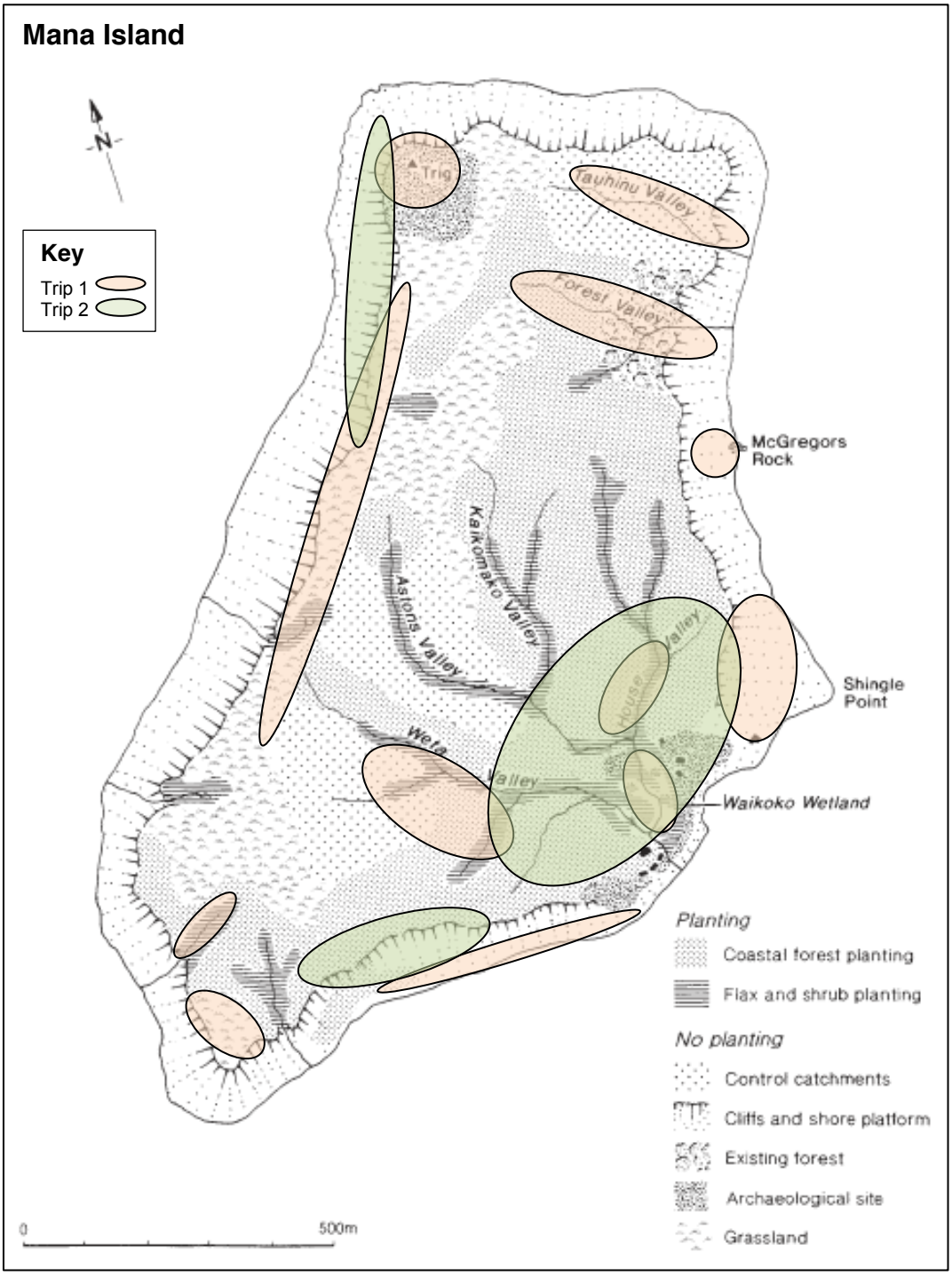

Figure 2. Map of Mana Island with general names of areas and planned planting/no planting (adapted from Miskelly, 1999 Page 12)

[1] Two survey trips were undertaken for this report (7-9 December 2015, 8-10 April 2016).

The more unusual 'funny little plants[2]' (examples Figures 3 & 4), found in harsher environments on the island are often overlooked. These occasionally represent threatened species, often herbaceous in nature and presumed weeds. These 'funny little plants', are generally sparse on the island, however all are valuable to the general health and biodiversity of the Mana Island Floral Diversity Project.

A botanical list was compiled for each unique area when visited. In areas that were similar to one another only new species were noted, to be added to the general botanical list for the island.

Figure 3. *Geranium brevicaule*.
A compact, sprawling herb, which enjoys coastal and subalpine open habitats. IMAGE - Matt Ward 2015

4. PLANTINGS

During the initial three day and follow up two day field trips, numerous areas of planted forest and coastal vegetation were botanised. The island has had around 500,000 plants planted (Miskelly, 2010) over parts of it since the stock were removed 1986. There have been 77 species of plants used, including 7 threatened species introductions which are still present. The sheer volume and density of those specimens which have survived and thrived is testament to the extraordinary effort put in by thousands of hours of DOC and volunteer labour over the years.

Figure 4. Discreet floral display of *Senecio hispidulus.*
Fireweed on a cliff ridge near 'Forest Valley'.
IMAGE - Matt Ward 2015

This planting has already created a canopy in some situations (the sections between wetlands for example) which in time will develop further as trees reach mature sizes and become more staged in height and spread. This could be complemented with additional planting of species suitable for forest complexity into the future; this will be discussed further in this section.

This section will also comment on the general health of the plantings observed during the 2015/16 field trips. A brief note about the 'funny little plants' is also included, as these are becoming more common due the planting efforts that have been undertaken. The wetland plantings are covered in Section 7.

There has been restoration planting trials undertaken on the island since 1987 (Dobbie *et. al.*, 1986; Timmins *et. al.,* 1988; Nicholls, 1989). The earliest implementation plan was produced by DOC landscape

[2] This refers to the numerous often herbaceous plant species which are often overlooked and disregarded as weeds or unimportant to biodiversity. In the Mana Island context these species have survived the decades of farming and human habitation without any consideration, help, or protection, they are truly 'funny little plants'.

architect M. Nicholls in 1989. In this plan he highlighted the need for a more detailed and comprehensive plan to achieve the long term restoration of floral diversity on the island. With the success of Nicholls draft implementation plan, the follow on comprehensive "Mana Island Ecological Restoration Plan" (Miskelly, 1999) was realised. From recommendations in these plans vast numbers of plants were annually planted, see Table 2.

Table 2. **Number of plants planted annually since the planting began in 1987**

YEAR	SPECIES	THREATENED SP.	PLANTS	Reference
1987	n/a	0	11,500	(Miskelly, 1997)
1988	n/a	0	27,000	(DOC, 1997)
1989	n/a	0	15,000	(DOC, 1997)
1990	n/a	0	20,000	(DOC, 1997)
1991	n/a	0	22,000	(DOC, 1997)
1992	n/a	n/a	(26,000)	Estimated from (Gay, 1999)
1993	n/a	n/a	(26,000)	Estimated from (Gay, 1999)
1994	n/a	n/a	(26,000)	Estimated from (Gay, 1999)
1995	n/a	n/a	(26,000)	Estimated from (Gay, 1999)
1996	n/a	n/a	(26,000)	Estimated from (Gay, 1999)
1997	n/a	n/a	(26,000)	Estimated from (Gay, 1999)
1998	n/a	n/a	24000	(Miskelly, 1998)
1999	n/a	n/a	25965	(Christensen, 2000)
2000	n/a	2	21257	(Christensen, 2000)
2001	n/a	1	11890	(Christensen, 2001)
2002	n/a	1	25475	(Christensen, 2002)
2003	n/a	1	26340	(Christensen, 2003)
2004	28	2	12355	(Christensen, 2004)
2005	n/a	2	14000	(DOC, 2005)
2006	9	4	11365	(DOC, 2006)
2007	n/a	n/a	7000	(FOMI, 2008)
2008	n/a	n/a	8000	(FOMI, 2009)
2009	11	3	10773	(DOC, 2009)
2010	n/a	n/a	6000	(FOMI, 2010)
2011	n/a	n/a	5000	(FOMI, 2011)

4.1 HEALTH OF PLANTINGS

This section will discuss in detail the species of plants which are present on the island, both planted and naturally occurring. The botanical survey of the Island during both the 2015 and 2016 trips provides a comprehensive record of change that has occurred since the last general botanical list was created by Timmins *et. al.* in 1987.

Some areas south-west of the Lockwood[3] were 'block' planted between 1986 and 1988, before the Mana Island Ecological Restoration Plan (Miskelly, 1999) was instigated and involved a single species at a time. This practice of mass monoculture planting was discontinued once the 1999 plan was created.

[3] Refers to a Lockwood house located amongst the many sheds which were part of the DSIR quarantine station. The Lockwood was originally used as a DSIR laboratory, and is now often used for volunteer accommodation.

The last of the bulk planting of several thousand specimens was undertaken in 2010/11, after this date fewer plants were placed. The earlier plantings, especially those in the area of the volunteer accommodation are now forming an impressive canopy in several places. These earlier plantings have become the favoured night roosting habitat of the *Eudyptula minor* - Little Blue Penguin. In areas like these where canopy has formed there is a good chance that presently absent understorey species could be added to enhance species diversity and richness. Table 3 includes suggestions for species which could be grown and planted in these areas.

Table 3. **Suggested understorey native trees, shrubs and lianes to enhance present planting.**

SPECIES	LOCATION	COMMENT	SOURCE
Astelia fragrans – Bush Flax	Plateau North of both Kaikōmako Valley and House Valley south east plateau, south of Weta Valley; north side of Weta Valley, Kaikōmako Valley, House Valley	Collection can be easy, check fruit as collected as this species sets empty fruit often	Karehana Scenic Reserve, Plimmerton
Brachyglottis repanda - Rangiora	Plateau North of both Kaikōmako Valley and House Valley; south east plateau, south of Weta Valley; north side of Weta Valley, Kaikōmako Valley, House Valley	Hardy species once established, spreads well	Plimmerton or Porirua remnants, Mana Island
Coprosma areolata – Thin leaved coprosma	Plateau North of both Kaikōmako Valley and House Valley	Easy to propagate, limited location use	Plimmerton or Porirua remnants
Coprosma grandifolia - Raurēkau	South east plateau, south of Weta Valley	Easy to propagate, limited location use	Plimmerton remnants
Coprosma rhamnoides	Low- lying areas west of houses, lower sections of Weta Valley and slopes to south	A good doer that handles understorey or exposed sites	Possibly Island stock from Forest Valley
Geniostoma ligustrifolium var. ligustrifolium - Hangehange	Low- lying areas west of houses, lower sections of Weta Valley and slopes to south; plateau North of both Kaikōmako Valley and House Valley	Not present on the Island yet, and it should be as an excellent proliferator	Plimmerton or Porirua remnants
Hedycarya arborea – Pigeon wood	Plateau North of both Kaikōmako Valley and House Valley; south east plateau, south of Weta Valley; north side of Weta Valley, Kaikōmako Valley, House Valley	Already used in planting program could use more in many places	Possibly Island stock, Plimmerton or Porirua remnants
Lophomyrtus bullata - Ramarama	Plateau North of both Kaikōmako Valley and House Valley	May be difficult to find seed but should be introduced to the Island	Plimmerton or Porirua remnants
Lophomyrtus obcordata - Rōhutu	Plateau North of both Kaikōmako Valley and House Valley	May be difficult to find seed but should be introduced to the Island	Karehana Scenic Reserve, Plimmerton
Passiflora tetandra – Native passionfruit	Anywhere apart from boggy ground	Can be slow to establish	Plimmerton or Porirua remnants
Piper excelsum subsp. excelsum - Kawakawa	Everywhere	An excellent species which once established proliferates readily	Plimmerton or Porirua remnants
Pseudopanax arboreus - Fivefinger	North side of Weta Valley, Kaikōmako Valley, House Valley	Already used in planting program could use more in many places	Possibly Island stock, Plimmerton or Porirua remnants
Pseudopanax crassifolius - Lancewood	low- lying areas west of houses, lower sections of Weta Valley and slopes to south	Careful selection of seed required so that hybrids are not selected, limited location use	Plimmerton remnants
Rhopalostylis sapida - Nīkau	Low- lying areas west of houses, lower sections of Weta Valley and slopes to south	This may be a suitable species to merely broadcast	Porirua Scenic Reserve or Nīkau Reserve, Paraparaumu
Ripogonum scandens – Supple jack	Plateau North of both Kaikōmako Valley and House Valley south east plateau, south of Weta Valley; north side of Weta Valley, Kaikōmako Valley, House Valley	Collection of fallen fruit from the ground is recommended	Plimmerton remnants

Although the areas below the dense canopy are in some cases not showing much regeneration, this is something that will change with time as more humus is built up and habitat becomes more suitable for colonising species already present (natural or planted) on the island. Many of the planted and naturally occurring species are at stages of reproduction with masses of potential seed (Figures 5, 6, 7) to be dispersed by the available vectors.

Figure 5. *Coprosma robusta* in fruit.
Numerous ripe fertile fruit ready for dispersal.
IMAGE - Matt Ward 2016

Figure 6. Prickly mingimingi in fruit.
A naturally occurring species, *Leptecophylla juniperina subsp. juniperina*, thriving and covered in fruit along the Western cliffs.
IMAGE - Matt Ward 2016

Figure 7. *Coprosma repens* in fruit.
IMAGE - Matt Ward 2016

Figure 8. Kākāriki Food.
Phormium cookianum ssp. hookeri - Mountain flax providing a good feed for a *Cyanoramphus auriceps* - Yellow crowned parakeet. IMAGE - Matt Ward 2016

One such obvious vector: the now richly diverse and abundant avian species are readily enjoying the seed and fruit available which will only increase as more flora specimens mature. These plantings also represent the diet of some of the avifauna without obvious benefit to the plant. Figure 8 shows a *Cyanoramphus auriceps* - Kākāriki devouring the seed within the seed pods of the *Phormium cookianum ssp. hookeri* - Mountain flax, while possibly merely offering to displace any dry seed from the pods to hopefully be caught by a gust of wind.

Weta Valley was the only planted valley that was visited during the 2015 survey. This area was impressive; much of the naturally harsh substrate had killed off those specimens not suited which created habitat for other native species. Most of the planted specimens were maturing well given the conditions. There was a considerable mass of naturally occurring *Muehlenbeckia australis* – Pōhuehue growing around and on much of this area. This will be further discussed in the 'Special Cases' section later in this report.

Figure 9. Surviving Rarity.
Linda removing *Convovulus* from a planted, threatened species, *Gahnia rigida*. This species is regarded as "Regionally Critical" (Sawyer 2004), and this specimen was thriving in the planted Waikoko wetland.
IMAGE - Matt Ward 2015

One particularly special find was the *Gahnia rigida* specimen (Figure 9) which was thriving. However, only one plant was seen though records show more were planted. This specimen was at a mature size of 2 metres high. At the time of planting many of the specimens in the wetland area were pulled up by *Porphyrio porphyrio* - Pūkeko (*Pers. Comm.* J Christensen, 2016). As many as possible were replanted, with protective guards, by DOC staffers at the time. This scenario explains the lack of *Gahnia rigida* survival as this species resents root disturbance (NZPCN, 2016b; Metcalf, 2008), therefore any replanting after being uprooted would have been too much disturbance to tolerate.

A noted planting health issue, was indicated by Witches Broom (Figure 10 & 11) growing on one specimen of *Streblus banksii* – Large-leaved milk tree that had been planted near House Valley. Witches Broom is a harmful infestation caused by a tiny mite – *Eriophyes paratrophis*, which injects hormone or enzymes into

Figure 10. Witches Broom on *Streblus banksii.*
Early stage of infected growth. IMAGE - Matt Ward 2016

Figure 11. Witches Broom on *Streblus banksii.*
Late stage of infected growth showing affected inflorescence.
IMAGE - Matt Ward 2016

the young inflorescence. This then limits the ability of the plant to produce viable fruit (Dawson *et. al.*, 2011; M. Ward, *pers. obs.*), which leads to failure in recruitment. It would be advantageous to contain this infestation before it infects the other planted specimens and possibly the original specimens; this would

safeguard future proliferation of this species. The suggested action is to prune the infected node back to a larger branch (Missouri Botanical Garden, 2016). The person(s) undertaking the pruning should avoid contact with other *Streblus banksii* – Large-leaved milk tree specimens after performing this task due to the microscopic size of the problematic mite, thus preventing further infections. The trimmed branches should be bagged, sealed, and removed from the island. Taking a photo of the specimens before and after the removal process would prove beneficial for checking specimen health each following visit. Both female and male inflorescences are shown in Figures 12 & 13, these healthy inflorescences show what to look for to compare with after control has been undertaken.

Figure 12. *Streblus banksii* female inflorescence.
Early stage of growth, the pollen receptors can be seen on the topmost flower (centre right of image). IMAGE - Matt Ward 2011

Figure 13. *Streblus banksii* male inflorescence.
Early flowering as well as back up inflorescences still maturing.
IMAGE - Matt Ward 2009

4.1.1 HEALTH OF NATURALLY OCCURRING PLANTS

The many 'funny little plants' which include rare or unusual species add to the diversity of the island. These species are best left to continue under their own steam. These plants are usually difficult to collect seed from, propagate and maintain which is not in the scope of a volunteer work schedule. Some of these plants, such as the orchids, are seasonal and are likely to be noticed more into the future as more habitats become less weedy and competition is reduced. A good example of this was the planted areas in Weta Valley where the ground had become mostly shaded out due to the plantings. The few plantings which had not survived due to the unsuitable substrate or conditions have then provided a space for colonisation. In particular

Figure 14. *Pterostylus montana agg.* - Greenhood.
This image shows the distinctive twisted labellum (tongue) which was a factor used to identify the recently spent flowers found on Mana Island. IMAGE - Matt Ward 2014

where moss spp. had proliferated, forming a relatively deep mat which contained three species of orchid, *Pterostylis montana agg.* (Figure 14) – Greenhood; *Microtis unifolia* – Onion orchid; and *Pterostylis australis* – Greenhood, two of which had not been recorded on the island before.

Figure 15. *Arthropodium cirratum* thriving on the Cliff habitat of "Tauhinu Valley". IMAGE - Matt Ward 2015

Tauhinu Valley, one of the control areas highlighted for 'No Planting' was thriving with *Arthropodium cirratum* - Rengarenga in full flower (Figure 15) during the visit which was an amazing sight. This area has re-generated significantly since the farming has ceased and will continue to do so of its own accord. Despite showing the effects of the harsh wind it had good ground cover (Figure 16) and appeared to be winning the competition with the introduced pastoral grasses. This area hosted three orchid species thriving in close proximity on a rock face, which had persisted for at least 30 years (Timmins et. al., 1987).

These areas, often used as control references, do not appear to be spreading outward, even without the pressure of seed predators. Instead they appear to be re-enforcing themselves within their current frontiers.

Figure 16. Tauhinu Valley from above.
Showing a dense mosaic of naturally occurring plants covering most of the substrate. IMAGE - Matt Ward 2015

4.2 BOTANICAL SURVEY ANALYSIS

This section will analyze findings in the original botanical species list (Timmins *et. al.*, 1987) with the newly compiled 2015/16 list. This section will also mention any new species observations during the recent botanical survey. Noteworthy range increases of originally observed native species will be briefly commented on, including passing mention about any species range reductions. A comprehensive botanical list has been compiled using the original guidelines/layout so that both may be compared, see Appendix 1.

4.2.1 BOTANICAL LIST

When compiling the lists for comparison, the most up to date names are used as shown on the New Zealand Plant Conservation Network website[4]. This includes several relatively recent changes with the former *Uncinia* sp. now being grouped in the *Carex* genus. The list compiled by Timmins *et. al.* (1987) was used, amended and added to where needed see Appendix 1. Names used on list have been changed in many cases, these original names can be seen attached as Appendix 2 & 3. There has been an overall growth in the number of floral species present on Mana Island presently, compared to 1987. Table 4 below shows the number changes.

Table 4. **Structural Class composition of species: Mana Island comparison.**

STRUCTURAL CLASS	1987	2016 Seen during survey	2016 Total Including planted
GYMNOSPERM TREES	0	0	5
MONOCOT TREES	1	1	2
DICOT TREES/SHRUBS	36	39	58
MONOCOT LIANES	1	1	1
DICOT LIANES	9	9	10
FERN & FERN ALLIES	32	32	41
ORCHIDS	7	8	10
GRASSES	7	5	9
SEDGES	11	13	16
RUSHES & ALLIED SPECIES	8	8	8
MONOCOT HERBS OTHER THAN ORCHIDS, GRASSES, SEDGES	6	5	7
DAISY-LIKE HERBS (COMPOSITES)	15	6	18
DICOT HERBS OTHER THAN COMPOSITES	37	25	37
TOTALS	169	157	222

AMENDMENTS OF NOTE:

- *Raoulia hookerii var. hookerii* – Scabweed: This species has been amended on the list as it was previously noted as *Raoulia sp.*, although this was unfortunately not found in the ground proofing trips. The New Zealand Plant Conservation Network website distribution maps showed it as recorded on Mana Island (NZPCN, 2016a). This species is also found in stable populations on the north-western most point of Whitireia Park, Titahi Bay, making the Mana Island population likely to be congruent.

[4] NZPCN website, an excellent source of information and images of New Zealand native plants www.nzpcn.org.nz

- *Elymus rectisetus agg.* – Australian wheat grass: The species recorded in the original botanical list may actually be a species which has naturalized from Australia (Barkworth & Jacobs 2011); this was proven to be the case after discovering *Anthosachne scabra* – Blue wheat grass, on the second trip growing well on north-western cliffs.
- There are several species recorded as native which are regarded now as 'Exotic'; including *Juncus bufonius* – Toad rush, and *Trifolium striatum* – Knotted clover.
- Conversely several of the species note in 1987 are now regarded as native species; *Cotula australis* - Common cotula, soldier's button; and *Wahlenbergia violacea* - Violet harebell.

OTHER SPECIES OF NOTE:

- *Coriaria arborea var. arborea* – Tree tutu: The single specimen noted by Aston in 1911 (Timmins, *et. al.,* 1987 page 65) has not been seen again since, suggesting this species is no longer present on the island.
- *Anogramma leptophylla* – Jersey or Annual fern: This species was not seen during this survey, this species is a winter dormant species so it may have not been present or not obvious when searched for in the south-eastern cliff area in 2015. It was also unsuccessfully searched for by J. Christensen and J. Sawyer in 1997 (J. Christensen, *pers. comm.* 2016), therefore likely no longer present on Mana Island.
- *Blechnum penna-marina subsp. alpina* - Alpine hard fern: This was not seen during this survey. Likely due to its small size, may easily have been overlooked.
- *Cyathea cunninghamii* – Gully tree fern: Not seen to have re-introduced itself, therefore still not present since commented on in Timmins *et. al.* (1987).
- *Lastreopsis velutina* – Velvet fern: This species was not seen in the forest and likely to have gone as only one plant noted in 1987.
- *Polystichum richardii* – Shield fern: Interestingly this species has since been split into two entities one of which was present *Polystichum neozelandicum ssp. zerophyllum* (Figure 17), and the likely species referred to in the 1987 survey.
- *Caladenia bartlettii* - Mauve fingers: A seasonal orchid; was not noted but may have been out of season during the survey or disappeared as it is often not persistent. This species may possibly have been misidentified also as its preferred habitat does not exist on Mana. Possibly may have been *C. alata.* A *Caladenia sp.,* was located during 2015 visit, but not added because could not be 100% sure of species.

Figure 17. *Polystichum neozelandicum ssp. zerophyllum* frond.
The identifying features for this species, dark centred sori and scales on the rachi. IMAGE - Matt Ward 2015

- *Isolepis cernua var. cernua* - Slender clubrush: Not seen during this survey, not searched for.
- *Arthropodium candidum* – Small renga lily: This small understorey may have easily been overlooked as it was not noted.
- *Triglochin striata*: Not noted this search; however damp habitat may have changed due to wetland construction works.
- Many of the composite species were not noted during this survey, of these, only *Raoulia hookerii var. hookerii* – Scabweed, was actively searched for, with none found.

- Many of the dicot herbs were not seen during this survey compared to the last survey. With more searching time, many of the species not noted are likely to still be present.

Despite less species being noted during this survey, there is no reason to think that many of these are no longer present. This is mostly due to only one botanist being present for the surveys, and the whole island was not covered as this was not the sole focus of this report. In general the various habitats were covered to provide a good indication given the botanizing time available. A further 20 species were added to the list that had not been recorded as naturally occurring, see Table 5. There may be some interest in making some effort by volunteers to search out those species on future visits to the island if they are in the vicinity of previously mentioned habitats.

4.2.2 ADDITIONAL SPECIES

The Table below shows new species that had not been noted in previous botanical surveys. These have likely been overlooked, or arrived relatively recently from the mainland or nearby Cook Strait Islands.

Table 5. **Naturally occurring species added to overall list from the 2016 botanical survey.**

SPECIES	COMMENT
Wahlenbergia ramosa - Coastal harebell	Easily overlooked when not in flower
Blechnum vulcanicum – Mountain hard fern	The cliff habitat where this species was residing is likely to not have been surveyed previously.
Dicksonia squarrosa - Whekī	Growing on the bank of the southern pond these specimens are likely to have travelled over on a zephyr.
Hypolepis rufobarbata - Sticky pig fern	Wind broadcast.
Microsorum scandens - Climbing hound's tongue	Wind broadcast.
Paesia scaberula - Lace fern, ring fern	Wind broadcast.
Polystichum occulatum	Likely overlooked as very similar P. *neozelandicum ssp. zerophyllum* when no spores are present.
Pterostylis australis – Greenhood orchid	Very seasonal and new habitat has become suitable
Pterostylis montana – Greenhood orchid	Very seasonal and new habitat has become suitable
Austroderia fulvida - Toetoe	Wind broadcast
Juncus sarophorus - Fan flowered rush	Possibly presumed as other Juncus sp. Present at time of original survey.
Phormium tenax - Harakeke	Possibly simply overlooked on the shingle spit where the specimens noted were present.
Carex testacea – Speckled sedge, trip me up	Likely to have been overlooked in the past.
Pittosporum tenuifolium – māpou	This species noted in Forest valley and of a substantial size must have simply been overlooked.
Pimelea cryptica - Pimelea	Likely this species was regarded as P. prostrata as the differences are subtle and until recently not very clear.
Senecio sterquilinus - Guano groundsel	A likely traveller in the wind as this species has been noted at Rocky Bay, Titahi Bay (NZPCN, 2016c).
Geranium brevicaule	This species is very likely to have been confused with *G. sessiliflorum var. arenarium*, which is not naturally found in this area.
Pittosporum crassifolium - Karo	This pest native species sticky seeds are likely to have travelled from the mainland via a bird.
Pseudognaphalium luteoalbum	Easily overlooked , or possibly windblown form nearby mainland populations
Ranunculus acaulis - Sand or shore buttercup	This species may have floated onto the island or been overlooked in the past.

4.2.3 RANGE INCREASES

Several species were noted to have increased in the range they were previously recorded from.

- *Freycinetia banksii* – Kiekie (Figure 18), a great find considering only one specimen was noted in the earlier 1987 botanical survey, "*One closely-browsed stump with 5cm green sprouts, in Kaikōmako Valley (1984)*" (Timmins *et. al.,* 1987 page 66). This find upon the second visit to the Waikoko Wetland showed a couple of locations where individuals were growing well in the understorey of the southern-most part of the plantings. These were naturally occurring as they had definitely not been planted (J. Christensen, *pers. comm.* 2016).

Figure 18. *Freycinetia banksii* – Kiekie.
This is an example of a specimen displaying fruit on in a remnant on the mainland.
IMAGE - Matt Ward 2012

Figure 19. *Coprosma propinqua* islands.
These hillock looking growths are natural revegetating shrubs evident in large numbers on the Northern section of the plateau near the trig.
IMAGE - Matt Ward 2016

- *Coprosma propinqua* – Mingimingi (Figure 19): Thriving in particular on the plateau area towards the north-western cliffs. This area was marked as "No Planting" (see Figure 52) as potential habitat for *Porphyrio hochstetteri* – Takahē, therefore making the incredible regrowth of the *Coprosma propinqua* natural (J. Christensen, *pers. comm.* April 9th 2016). These shrubs have recovered from decades of nibbling by stock, displaying extensive knobs of vegetation amongst the grasslands, and in some cases solid mats of vegetation. It appears that the shrubs are being utilised by the local birdlife as tracks were noted at the time.

Figure 20. *Brachyglottis repanda* – Rangiora, Bushman's friend.
This image shows the underside of a large leaf (150 mm long) which alludes to the common name for this large tree daisy species. IMAGE - Matt Ward 2010

- *Brachyglottis repanda* – Rangiora, Bushman's friend (Figure 20): This species has increased its range from only being found in the Forest Valley in the initial survey, now being noted on the north-eastern shore area. This has likely spread via the wind as it is a wind dispersed species, and no planting of this species has ever been undertaken.
- *Blechnum filiforme* – Thread or climbing hard fern (Figure 21): Has additionally been noted in Weta Valley. Previously only being noted in the Forest Valley (Timmins, *et. al.,* 1987). This has likely spread due to dispersal by wind, much like the new fern species arrivals.
- *Phormium tenax* – Harakeke, flax (Figure 22): Added as naturally occurring, this may be questionable, however, as it is recorded in the initial survey as only planted on the island. The shingle spit has not ever had any planting on it (J. Christensen, *pers. comm.,* April 8th 2016), which is where it was noted growing during this survey.

There appears to have been only one dramatic reduction in range by a species noted in earlier surveys.

- *Ozothamnus leptophylla* – Tauhinu: Reduced its range, likely because this species is an initial coloniser and is now being overgrown by planted primary species which are more aggressive, thus becoming of taller stature.

The increase of range by the species mentioned above suggests that the island is continually providing more suitable habitat for species to further their range. This is induced by human efforts and sets a good tone for future progression by both plantings and naturally existing species on the island. Aside from extreme weather or un-natural events this natural progression will continue to occur as time goes by.

Figure 21. *Blechnum filiforme* – Thread or climbing hard fern.
This image shows the dual morphological appearance of fronds on display. This species changes its frond appearance once it has climbed a trunk, seen here as the yellow-green frond in the middle of the image, earlier form fronds are on display above and below, and are darker green here.
IMAGE - Matt Ward 2016

Figure 22. *Phormium tenax* – Harakeke, flax.
This image shows the impressive three metre high floral display of this species, a favourite food of both Tui and Bellbird.
IMAGE - Matt Ward 2008

5. COMPARATIVE BOTANICAL ASSESSMENT

This involved comparing as many other botanical lists as possible from the nearby mainland (Figure 23) and off shore islands (especially any that are unmodified/contain remnant areas) from the same ecological district (see Appendix 4). It is important to note, that just because a species has been noted in an area at some time during a botanical survey, it does not suggest that that species is always present or in fact present in a contemporary sense. Most forested or shrub-land areas are in continual transition due to natural and un-natural disturbances they may have encountered, therefore continual species composition change occurs overtime.

Figure 23. Mainland View from Forest Valley.
This is view of the remnants and reserves that would likely have the seed needed for further enhancement of the Floral Diversity. IMAGE - Matt Ward 2015

Figure 24. Potential seed source of *Veronica parviflora* (Paekakariki Hill Road).
View above the tree hebe species which may become a source for the project in the future. IMAGE - Matt Ward 2012

This study will provide a list of practical missing species that could be considered for reintroduction (Figure 24), a follow on from Gabites (Molloy, 1999) original work/assessment, listed in Appendix 4, of Clapcott & Gill (2015). The comparative list can be found as Appendix 4 in this report. A good selection of species was gathered in Appendix 4 of Clapcott & Gill, 2015, which are relevant and had been mentioned in other earlier reports, comments, and reviews (Sawyer, 1996; Molloy, 1999; Molloy 2010).

5.1 SPECIES INTRODUCTIONS AND BOLSTERING

This section will suggest some further species that could be added to the Island including increasing some of the populations of species which are already present. These are suggestions from comparative botanical list study. Figure 25 shows the distribution of the soil types on Mana Island. This is relevant to which species are likely to survive. The suggested species in Table 6 occur in similar soil type situations on the mainland as described by Gabites (1994) and Ogle (1985).

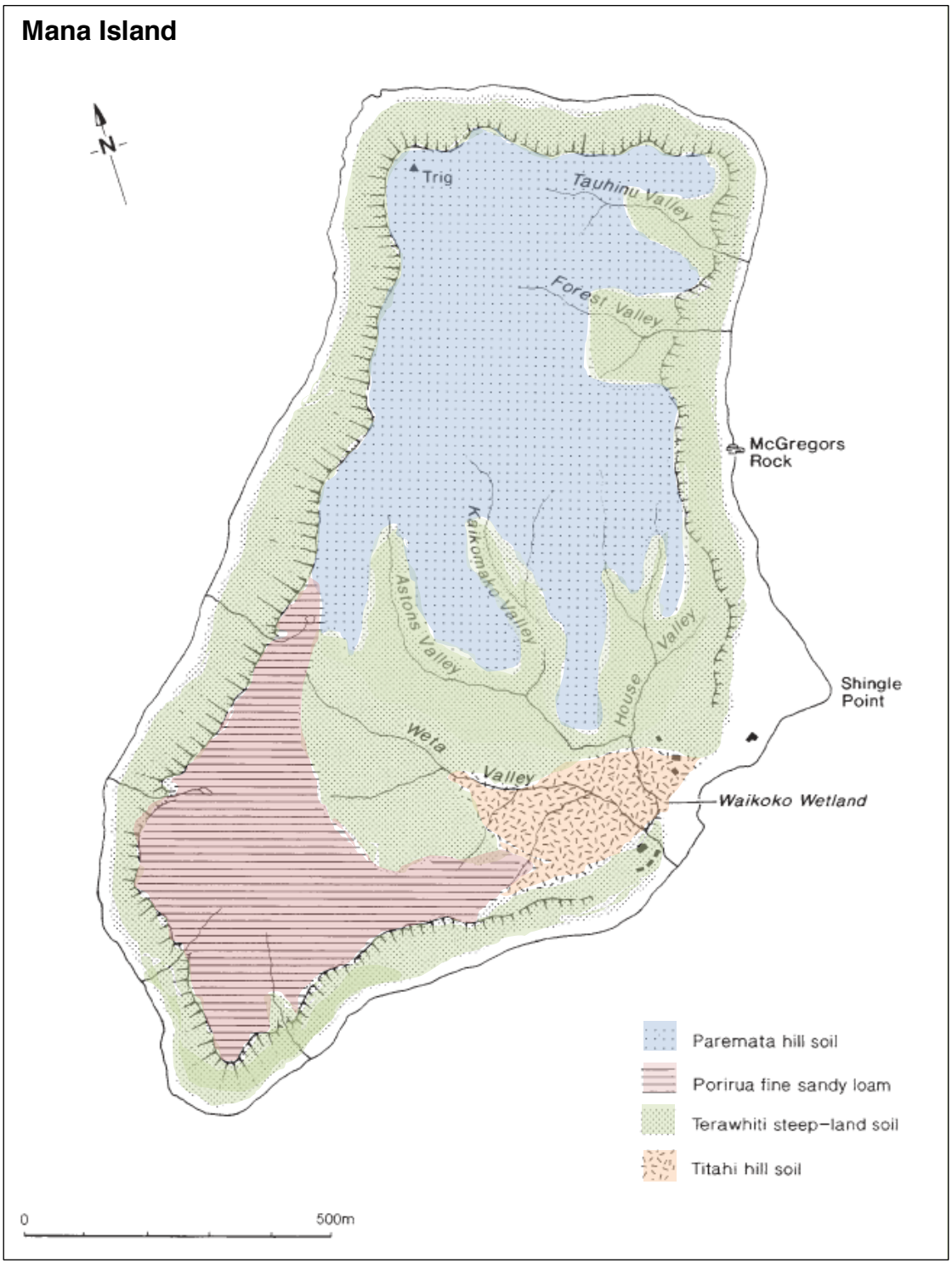

Figure 25. Map of Mana Island with distribution of soil types (adapted from Miskelly, 1999 Page 17).

Table 6. **Potential Mana Island floral diversity species (Adapted and updated from Appendix 4 of Clapcott & Gill, 2015,)**

Key **A = Paremata Hill Soil** Plateau North of both Kaikōmako Valley and House Valley **B** = **Porirua Fine Sandy Loam** South east plateau, south of Weta Valley **C = Terawhiti Steep-land Soil** North side of Weta Valley, Kaikōmako Valley, House Valley **D = Titahi Hill Soil** Low- lying areas west of houses, lower sections of Weta Valley and slopes to south

SPECIES		Suitable for this area				
GYMNOSPERM TREES	COMMENT	SOURCE	**A**	**B**	**C**	**D**
Podocarpus totara - Tōtara	Present (only a few in Weta Valley) - This is a hardy species once established and appears to be underutilized on the island presently.	Plimmerton & Porirua remnants				
MONOCOT TREES						
Rhopalostylis sapida - Nīkau	As suggested in the understorey species list this is another underused species that could have much more individuals present.					
DICOT TREES/SHRUBS						
Aristotelia serrata - Wineberry	Not present - Great plant for food and speed of growth, and die off, useful succession species.	Plimmerton & Porirua remnants				
Brachyglottis repanda - Rangiora	Only presently found in two sites on the Island – Hardy species once established, spreads well.	Mana Island, Plimmerton & Porirua remnants				
Carpodetus serratus - Marbleleaf	Not present – Limited use, provides habitat for weta and food for birds, easy to grow.	Karehana Scenic Reserve Plimmerton, Porirua Scenic Reserve				
Coprosma areolata – Thin leaved coprosma	Present in limited area - Easy to propagate, limited location use.	Plimmerton or Porirua remnants				
Coprosma grandifolia - raurēkau	Not present - Easy to propagate, limited location use.	Plimmerton remnants				
Geniostoma ligustrifolium var. ligustrifolium - Hangehange	Present in small numbers - Should be used as a very good doer especially as understorey and edge dweller.	Plimmerton or Porirua remnants				
Fuchsia excorticata – Tree fuchsia	Not present – Limited very suitable for the edges of the wetland restoration areas. Lower section of Weta valley also.	Karehana Scenic Reserve Plimmerton, Taupo Mire, Porirua Scenic Reserve				
Leucopogon fasciculatus – Tall mingimingi	Not present – Excellent edge plant which for food and shelter. Needs good drainage, limited use.	Plimmerton or Porirua remnants				
Lophomyrtus bullata - Ramarama	Not present - May be difficult to find seed but should be introduced to the Island.	Plimmerton or Porirua remnants				
Lophomyrtus obcordata - Rohutu	Not present - May be difficult to find seed but should be introduced to the Island.	Karehana Scenic Reserve Plimmerton				
Nestegis lanceolata – White Maire	Not present – Difficult to find specimens with fruit but worth keeping an eye out.	Motuhara, Karehana Scenic Reserve, Porirua Scenic Reserve				
Schefflera digitata - Patē	Not present – Limited use, needs stratification for germination, great food source for birds.	Karehana Scenic Reserve Plimmerton, Porirua Scenic Reserve				
Syzygium maire - Swamp maire	Not present – Great plant for the wetland complex provides nectar and fruit.	Kapiti Area				
Veronica parviflora - Kōkōmuka tāranga, Koromiko	Not present – Long lived hebe, plentiful nectar at high tier of canopy (see Figure 18)	Motuhara, Pukerua Bay, Paekakariki Hill				
LIANES/VINES						
Clematis paniculata -	Not present - Provides nectar for the birds, locate this species when in flower, returning when in seed; prefer roots to be sheltered/ slightly damp.	Karehana Scenic Reserve, Porirua Scenic Reserve				
Freycinetia banksii - Kiekie	Present but could do with more.	Motuhara & Karehana Scenic Reserve Plimmerton, Porirua Scenic Reserve				
Metrosideros diffusa – white rātā	Not present – common on mainland would take patience to collect seed, nectar.	Plimmerton or Porirua remnants				
Passiflora tetandra – Native passionfruit	Not present - Once established grows quickly, nectar, fruit.	Plimmerton or Porirua remnants				
Ripogonum scandens – Supple jack	Not present - Collection of fruit from the ground is recommended	Plimmerton remnants				
HERBACEOUS						
Astelia fragrans – Bush Flax	Not present – Amazing understorey plant, fruit, pollen, nectar.	Karehana Scenic Reserve Plimmerton				

The ferns from Clapcott & Gill, 2015 were omitted from Table 6 as they add little to the ecological value of the project for effort/input required. Ferns do however contribute to the overall biodiversity of an area, therefore if someone in FOMI has a particular interest in raising ferns or learning about the practice, those suggested species originally listed would be very suitable. Growing ferns is time consuming, yet rewarding once they establish. Ferns are iconic to the New Zealand natural landscape, and make up approximately 8% (De Lange & Rolfe, 2010) of the vascular flora species. Despite ferns naturally finding their way to the island, giving them some help would be advantageous for the future.

Table 3 and 6 could inform future propagation and planting on Mana Island. All of the suggested species will improve floral diversity and resources for the island fauna, and are achievable species for volunteers to propagate and plant.

6. THREATENED SPECIES

Any species with their status having been referred to as Nationally Threatened are referenced from the New Zealand Plant Conservation Network. Regionally Threatened species have been referenced from Sawyer "*Plant Conservation Strategy: Wellington Conservancy (excluding Chatham Islands)"* 2004.

6.1 INTRODUCED THREATENED PLANTS

The documentation records that 20 of the 22 species total listed in the Restoration Plan (Miskelly, 1999) have been planted/trialled (see Table 7). Table 7 shows what has been actioned and how they are presently surviving when compared to the review (Miskelly, 2010). To give the reader an idea of population status, further information has been added, see key. Some plants have not been located during these recent trips, it is likely some have been overgrown and died due to the discontinuation of staffing and information transfer on the island.

6.1.1 NOT FOUND DURING SURVEY

Only three species have not been seen by either of these expeditions or L. Clapcott when undertaking weed work on the Island during November 2015.

- *Coprosma acerosa* – Sand Coprosma: This species was known to have been planted beside the boat shed on the Eastern side of the Island. During brief searches it was not located. In the opinion of the author *C. acerosa* is not a suitable species for planting on Mana Island as it is naturally a dune dweller. There is no sand present on the island, the beaches are of pebble composition.
- *Fuchsia perscandens* – Fuchsia: Believed to have been planted between the Office and the House formally occupied by J. Christensen. An extensive search on the 2016 trip utilising all four of the group failed to locate this vine, therefore it is presumed gone.
- *Rubus squarrosus* – Leafless lawyer, yellow-prickled lawyer: Sighted by a weed temp in 2015 (L. Clapcott, *pers. comm.* 2016). After meeting Grant Timlin by chance on the island, the team was instructed where the location to search to find the specimens of the original plantings. This is the location pointed out in the reading material, which is available, which was briefly searched on the

first trip. Unfortunately the area was re-searched and proved fruitless during the second trip. This may suggest a reduction in original range may have occurred.

Table 7. **Nationally / Regionally threatened species on Mana Island**
'Thriving' refers to the original planted specimens only. 'Regenerating' refers to species known to be producing healthy seedlings, or spreading vegetatively (Miskelly, 2010).

Key: **F = Fewer** than five plants noted in less than five sites; **S = Some** 5 – 50 specimens noted at several sites; **M = Many** plants 50+ in several sites; **A = Abundant** many plants in many different areas.

SPECIES	THRIVING?			REGENERATING?		
	2010	2015/16		2010	2015/16	
Blechnum zeelandicum (formally Doodia squarrosa)	Yes	Yes			Yes	F
Carex litorosa – Sea sedge	Yes	Not really				
Coprosma acerosa - Sand coprosma	Yes	Not seen				
Discaria toumatou – Matagouri	Yes	Not seen				
Dodonaea viscosa – Akeake	Yes	Yes	M	Yes	Yes	M
Entelea arborescens - Whau	Yes	Yes	S	Yes	Yes	S
Euphorbia glauca - Shore spurge	Yes	Yes	S	Yes	Yes	S
Fuchsia perscandens		Not seen				
Gahnia rigida	Yes	One specimen	F			
Lepidium oleraceum - Cook's scurvy grass	Yes	Yes	F			
Leptinella nana – Pygmy button daisy	Yes	Yes	F	Yes	Yes	F
Melicytus obovatus	Yes	Yes	A	Yes	Yes	A
Muehlenbeckia astonii - Shrubby tororaro	Yes	Yes	F			
Pimelea aff. aridula (Pipinui Point)	Yes	Yes	S			
Rubus squarrosus – Leafless lawyer	Yes	Present	S			
Sophora molloyi - Cook Strait kōwhai	Yes	Yes	S			
Sophora chathamica – Kōwhai	Yes	Yes	M		Yes	M
Streblus banksii - Large-leaved milk tree	Yes	Yes	S	Yes	Yes	F
Trisetum antarcticum	Yes	Yes	M		Yes	M
Tupeia antarctica - Tupia		Not seen				
Veronica elliptica - Kōkōmuka, Shore hebe *(formally Hebe elliptica var. crassifolia)*	Yes	Yes	F	Yes	Not seen	

6.1.2 FOUND DURING SURVEY

- *Leptinella nana* – Pygmy button daisy (Figure 26): Nationally "Threatened - Nationally Critical". Found in two locations (Lockwood garden and driveway to office) this species appears to be stable in its locations. Very susceptible to competition therefore making it a species which should be continually monitored in both locations each visit to the island.
- *Muehlenbeckia astonii* - Shrubby tororaro: Nationally "Threatened – Nationally Endangered". Several

Figure 26. *Leptinella nana* – Pygmy button daisy.
This tiny specimen is in flower (Lockwood garden).
IMAGE - Matt Ward 2015

locations where this species had been planted were checked to find only a specimen or two. This would appear to be the result of a maintenance lapse, especially in pastoral grass rich areas. This species needs several years of care once planted so that it may become large enough to out compete neighbouring grasses. More work could be done on replanting, with a regular maintenance schedule in place.

- *Euphorbia glauca* - Shore spurge: Nationally "At Risk - Declining". Several specimens were thriving near the footing of the old jetty and landing area. This is a decline in the range of these plantings. However, the specimens appeared to be stable in the location they grow in, no need for further action at this stage.
- *Carex litorosa* – Sea sedge (Figure 27): Nationally "At Risk – Declining". Not noted on the first trip search was eventually found on the second trip. The surviving plants which were present had survived inside the original protective core flute, which is not ideal. However, these specimens would have long since vanished if they were not in the protection. The situation in which they were placed was also not ideal as there is still pastoral grasses everywhere which will always out compete this species. For this plant to thrive on the island it would be best placed in a situation where exotic grasses are not present and potentially in closer proximity to the coast, as they can tolerant saline environments.

Figure 27. *Carex litorosa* Sea sedge.
This specimen is one of several remaining in the original planting protection tubes.
MAGE - Matt Ward 2016

Figure 28. *Blechnum zeelandicum.*
Planted below Kanuka in "Forest Valley" and nearby a juvenile was present.
IMAGE - Matt Ward 2016

- *Blechnum zeelandicum* (Figure 28): Nationally "At Risk - Naturally Uncommon". Located in the Forest Valley with evidence of a new specimen growing, near the original plantings. In good health in generally, no need for further action.
- *Sophora molloyi* - Cook Strait kōwhai (Figure 29): Nationally "At Risk – Naturally Uncommon". The only

Figure 29. *Sophora molloyi* – Cook Strait kōwhai.
Newly formed seed pods are present.
IMAGE - Matt Ward 2015

known population near the 'hole in the rock' appeared to be thriving with seed present when observed. Monitor these specimens annually.

- *Entelea arborescens* – Whau: "Regionally Critical" (Sawyer, 2004). This species is thriving wherever it has been planted on the island including excellent next generation being observed in numerous situations. No action required.
- *Gahnia rigida* (Figure 9): "Regionally Critical". One specimen located in the Waikoko Wetland. Surviving well, however no signs of proliferation. Could do with further specimens being planted as suggested in this report (Table 8).

Figure 30. *Pimelea aff. aridula* (Pipinui Point).
Planted trackside bank of the Tirohanga track.
IMAGE - Matt Ward 2016

Figure 31. *Pimelea aff. aridula* (Pipinui Point).
Up close shot of the hairy leaf margins, a distinguishing feature.
IMAGE - Matt Ward 2016

- *Pimelea aff. aridula* (Pipinui point) (Figures 30 & 31): "Regionally Critical" (Sawyer, 2004). This species, yet to be named appears to be stable in the location it is planted. There is not yet evidence of proliferation. However, this genus is notorious for being slow growing. This species should be monitored annually.
- *Sophora chathamica* – Coastal kōwhai: Regionally "Range Restricted" (Sawyer, 2004). This species is thriving in numerous locations around the tracks near the buildings. There are many examples of new specimens growing without intervention. No action required.
- *Veronica elliptica* – Kōkōmuka, shore Hebe (Figure 32): Regionally "Range Restricted" (Sawyer, 2004). During this survey only one specimen was noted in the Lockwood garden. This species is likely not a good source to collect seed from for further planting as other *Veronica sp.* present will have hybridised the seed. Collection from other isolated mainland population could be undertaken to increase the range of this species on the island.

Figure 32. *Veronica elliptica* – Shore Hebe.
This specimen was the only one seen ion the island during the survey.
IMAGE - Matt Ward 2016

As mentioned at the beginning of this section there are likely losses in the planting of the "Threatened Plant" species due to lack of continuity in the staffing of the island and dedicated specialist volunteers. Despite best efforts, this is only one of the facets of the islands restoration, therefore likely not becoming a priority of the only resident DOC staffer in the near future. For the planted specimens to survive into the future, more work will be needed in checking their health whenever possible.

6.2 NATURALLY OCCURRING THREATENED PLANTS

The threatened species which managed to survive on Mana Island through the many years of use as a farming station should have priority over introduced threatened species to focus efforts in ensuring their survival, as suggested in Miskelly (1999).

The five originally noted "Nationally" threatened plant species that survived on Mana Island were *Arthropodium cirratum* – Rengarenga; *Lepidium oleraceum* - Cook's scurvy grass; *Melicytus obovatus; Anogramma leptophylla* - Jersey fern; and *Streblus banksii* – Large leaved milk tree. Some of these threatened plants would be suitable for planting in further locations on the island. Each of these threatened species is highlighted with specific comments, and with new species noted from the 2015/2016 field trips.

6.2.1 NOT FOUND DURING SURVEY

- Anogramma leptophylla - Jersey fern: Nationally "Threatened – Nationally Vulnerable". This species was not noted during the 2015 and 2016 field trips. Its present status is likely "no longer present" as has been suggested by J. Christensen.

6.2.2 FOUND DURING SURVEY

- *Lepidium oleraceum* - Cooks scurvy grass: Nationally "Threatened - Nationally Endangered". Would benefit from some more effort from volunteers/ ranger to successfully sustain the population. A couple of plants were observed that had been planted (Figure 33 & 34) and are

Figure 33. *Lepidium oleraceum* - Cook's Scurvy Grass
The original site at the 'hole in the rock' site. Possibly several plants make up these two photos. IMAGE - Matt Ward 2015

Figure 34. *Lepidium oleraceum* - Cook's Scurvy Grass
The original site at the 'hole in the rock' site. Possibly several plants make up these two photos. IMAGE - Matt Ward 2015

thriving away from the original population on the "Hole in the Rock" outcrop (Figures 35 & 36). However, this is a limited population which could easily be lost due to unforeseen circumstances. It would be ideal for as many populations as habitat permits be established. The seed is known to germinate easily (J. Christensen, per. Comm., 2016), yet does not survive well once planted out. It has been suggested by Sawyer (2006) that further populations should be attempted when more bird colonies have been established. This would provide more potential for seed collection therefore increasing the chances to maintain existing population into the future. Internal facsimiles and meeting minutes between DOC's J. Christensen; R. Empson and J. Sawyer (Christensen, 1995; Sawyer, 1995) during the mid to late 1990's convey the directions and huge amount of effort that has already been exerted to get to the situation present today. However, this is a specialised task and may be out of the scope of the volunteer efforts of FOMI

Figure 35. *Lepidium oleraceum* - Cook's Scurvy Grass
At the site beside the Fluttering shearwater colony. Close up shot.
IMAGE - Matt Ward 2015

Figure 36. *Lepidium oleraceum* - Cook's Scurvy Grass
At the site beside the Fluttering shearwater colony. Several plants were thriving at this site. As can be seen a great flowering and hopefully numerous seed set. IMAGE - Matt Ward 2015

- *Trisetum antarcticum* (Figure 37): Nationally "At Risk – Declining". This compact grass also appears to be doing as well as expected. There were several specimens noted on the tops of the western Cliffs and there are likely to be many more as the harsh coastal escarpment type habitat is exactly suitable for this species. No action needed.
- *Streblus banksii* - Large leaved milk tree: Nationally "At Risk – Relict". The only forest dwelling threatened species noted in Miskelly (1999 & 2010). This species had been successfully planted in the Weta Valley with numerous specimens observed to be all in good health. There were also other large specimens noted near the buildings beside tracks; some of which were as tall as 4.5 metres. The original specimens in the Forest Valley were also healthy and of an impressive

Figure 37. *Trisetum antarcticum*.
A compact grass found in coastal habitats, nationally classified as "At Risk – Declining". One of the few threatened plant species which has survived the farming of the island in the past. IMAGE - Matt Ward 2015

Figure 38. *Melicytus obovatus*.
One example of many specimens noticeably covered in fruit during the April 2016 trip. IMAGE - Matt Ward 2016

size with one female plant having a dbh of 45 cm. However one specimen was seen which had an infection of Witches broom, see 'HEALTH OF PLANTINGS' section 4.1.

- *Melicytus obovatus* (Figure 38): Nationally "At Risk – Naturally Uncommon" Appears to be doing well of its own accord. During the 2015 visit its presence was noted in at least four locations, three being naturally occurring: Shingle Spit; Forest Valley; and the Cliff habitats. The fourth location where it was planted in Weta Valley it also appeared to be thriving. During the April 2016 trip it was noticed to be covered in fruit, safegurding its future with the abundance of seed dispersers present on the island.
- *Arthropodium cirratum* - Rengarenga lily (Figure 39): "Regionally Endangered" (Sawyer, 2004). Were seen mostly in the Tauhinu Valley vicinity. It is approximated that thousands of specimens are present here. Therefore, this population does not require further work or plans for their continued survival at this stage.

Figure 39. *Arthropodium cirratum* - Rengarenga.
In full bloom this was one of hundreds growing en-mass in Tauhinu Valley. IMAGE - Matt Ward 2015

Figure 40. *Senecio sterquilinus,* Guano groundsel.
Another yellow daisy to confuse issues, this species may need further confirmation. It will need a re-visit in October – November. IMAGE - Matt Ward 2015

6.2.3 ADDITIONAL SPECIES

Several species can be added to the threatened plant program which have been newly located in this survey, or have recently had their status changed.

- *Senecio sterquilinus* - Guano groundsel (Figure 40): Nationally "At Risk – Relict". An addition noted during this survey this species appears to have turned up and established in great numbers since

the earlier comprehensive botanical survey. This is likely because of the efforts involved in seabird colony restoration on the island which has led to increased guano deposits (Jones, 2010). Whilst the colonies of seabirds are still in their building stages, plants which may not have been able to take hold on Mana Island are now utilising the increased nutrients in particular locations. This species will continue to spread without interaction.

- *Aciphylla squarossa var. squarossa* – Taramea, Speargrass (Figure 41):"Regionally Vulnerable" (Sawyer, 2004). This species threat status has changed since 1987. It is present on the island and is also found in small populations along the nearby coastal cliffs in intermittent populations, such as Whitireia Park and Rocky Bay, Titahi Bay; and the Pukerua Bay gorge. The Mana Island population comprises of hundreds making it relatively vast. Thanks mostly to land use change, the unusual specimens are dotted throughout the cliff and cliff edge habitats over much of the island now making it possibly one of the strongholds of the region. No action required.

Figure 41. *Aciphylla squarossa var. squarossa,* Speargrass.
A very healthy specimen displaying multiple flower spikes. This specimen was seen on the Southwestern slopes of the Island. IMAGE - Matt Ward 2015

- *Plagianthus divaricatus* – Salt-marsh ribbonwood: Regionally "Sparse" (Sawyer, 2004). This species has been planted very successfully around the Waikoko wetland. It is in a stable situation with no management required. It has been suggested in 'Section 7' as a species which could be propagated and planted to further improve the Waikoko Wetland.

Figure 42. *Pimelea cryptica.*
In flower in April showing the pink base to the flowers and dense hairy branch, identifying features for this species. IMAGE - Matt Ward 2016

- *Pimelea cryptica* (Figure 42): "Data Deficient" (NZPCNd, 2016). This species naturally occurs on the north-western and south-western cliffs and cliff tops. This species was first described recently (Burrows, 2011). Therefore, until its range is completely understood, it will remain a likely rarity. This species has survived all of the farming decades making it a niche occupier requiring no action, other than adoration.

Excepting the *Lepidium olearaceum* - Cooks scurvy grass, which appears to be a successfully propagated (J. Christensen, *pers. comm.* 2016) then problematic species to keep healthy, all of the other species present are in good health. The guano groundsel may need further investigation during the season which it appears to see

what sort of range it has. As with most of the other general planting and naturally regenerating plants on Mana Island the lack of predation and increase in dispersers is proving a winning formula as can be seen in Figure 43.

Figure 43. The Change of View.
A view of planted areas, compared to the foreground which has remained pastoral grasses. IMAGE - Matt Ward 2015

6.3 POTENTIAL ENRICHMENT TO THE THREATENED PLANT PROGRAM

If any further work is going to be undertaken to enrich the threatened plants programme on Mana Island Table 8 below has suggestions and comments about those which could work on the island. The author does however re-emphasize that this type of work is both specialised and time consuming, which would likely take a regular island presence which may not be practical for FOMI. The table consists of the options requiring least effort of those that have been undertaken or suggested in Molloy 1999; 2010.

Table 8. Best value Threatened Species for FOMI.

SPECIES	LOCATION	COMMENT	SOURCE
Rhabdothamnus solandri - NZ Gloxinia	Understorey in semi shade. Plateau North of both Kaikōmako Valley and House Valley south east plateau, south of Weta Valley; north side of Weta Valley, Kaikōmako Valley, House Valley	*Regionally Critical*. Further discussion with DOC may be needed for the introduction of this species	Battle Hill (Pautahanui), Smith's Creek (Makara)
Gahnia rigida	Waikoko Wetland edges	*Regionally Critical.* Seed has been collected and sewn, from the Island survivor; if these germinate they should be repatriated to the Island. In the future other seed from the original mainland populations may wish to be collected.	Mangaroa Swamp, Upper Hutt.
Muehlenbeckia astonii - Shrubby tororaro	Near locations already present.	All populations could do with some bolstering to promote regeneration which has not yet occurred	Sinclair Head, Paraparaumu (ex. Sinclair head)
Sophora molloyi – Cook strait kōwhai	Coastal cliffs, among grey scrub.	*Nationally "At Risk – Naturally Uncommon"* Further populations of this species could be achieved relatively easily from the seed of the plants already present on the Island	Mana Island

Other options from the earlier Restoration Plan (Molloy, 1999: Pages 33-40) like the now regionally "Range Restricted" Papakōwhai local species *Sophora chathamica* – Coastal kōwhai (Sawyer, 2004), are well established and reproducing, so require no further work.

7. WAIKOKO WETLAND

> "*Wetlands on islands are a rare habitat, and so there are few wetland habitats in New Zealand that are free of the effects of introduced mammals. Restoring the wetland on Mana Island will provide habitat for a variety of threatened wetland plants, locally extinct birds (especially brown teal) and possibly the threatened brown mudfish.*" (Miskelly, 2010 Pg. 9)

The Waikoko Wetland complex (Figure 44[5] & 45) on Mana Island was constructed in 1998 (Figures 46 & 47). These wetlands were originally constructed with a complex system of stop banks and weirs to effectively slow and hold water (Figures 48 & 49) draining out to sea and to create comparable ponds and

Figure 44. Waikoko Wetland aerial photo.
"Waikoko Wetland" seen from a birds eye view, with plenty of water in all of the ponds. IMAGE - DOC Archive 2001

[5] In the centre left of this image is a marker pen line which looks similar to the ponds in colour, this is however an original bird survey line and should be ignored in this the context of this report. The author has put a yellow line along it to highlight its location.

habitats to those found in mainland situations. Each pond was named (Figure 44), generally referring to its purpose or location within the complex; these names are referred to in "Appendix 5 – Waikoko Wetland Workings". The actual aerial photo of the wetland (Figure 44) when compared with the conceptual plan (Figure 45), allows one to admire the accuracy of the construction. The ponds now appear to have settled and exist without any maintenance of the weir levels. As suggested in Miskelly (2010), once this settling process had occurred it would be suitable to consider further work that could be completed with species suitable to the new regime. After having a detailed description and presentation (Christensen, *pers. comm.*

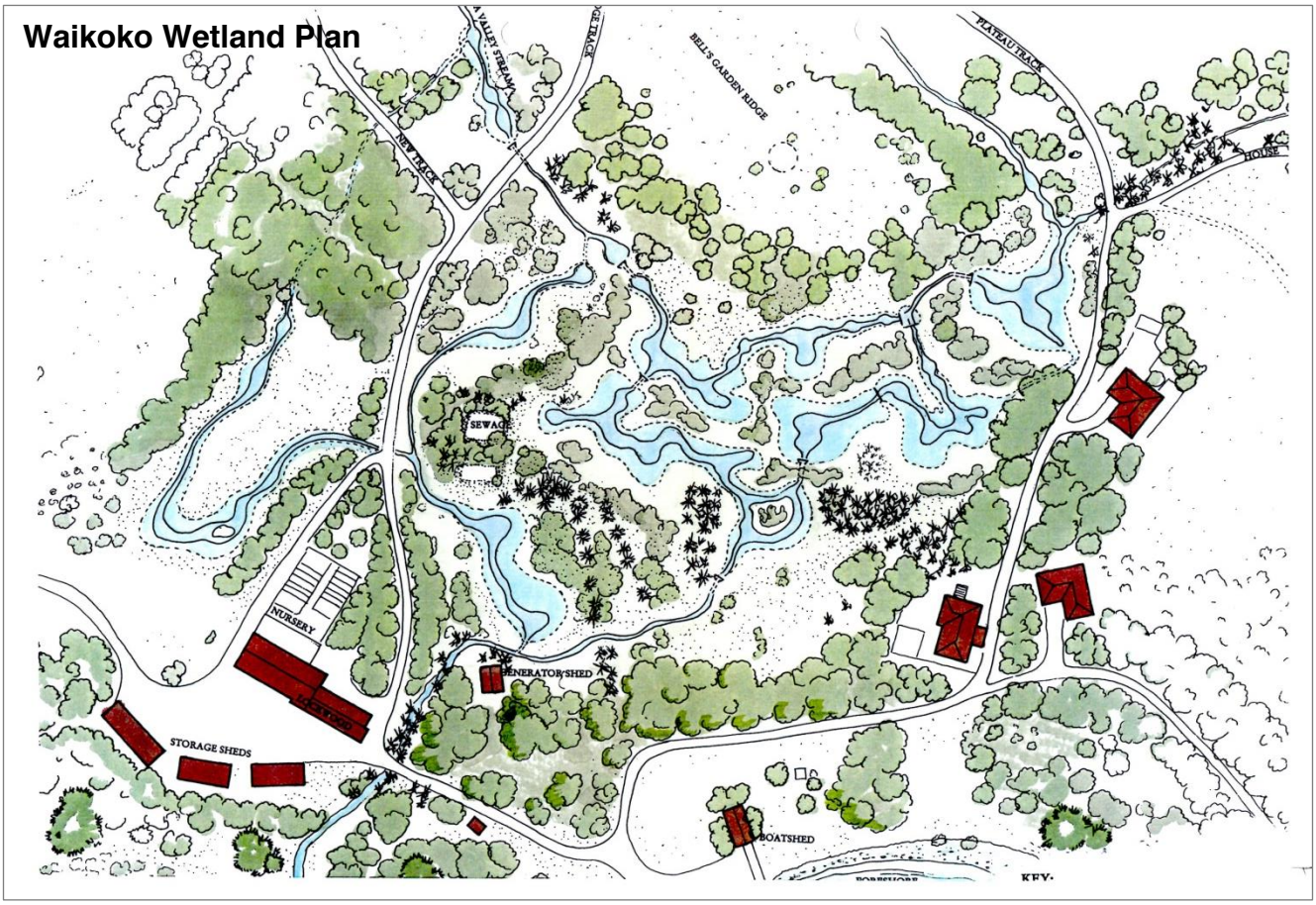

Figure 45. Waikoko Wetland Conceptual Plan.
"Waikoko Wetland" as envisaged by designers.
IMAGE - DOC Archive 1998

Figure 46. Preceding Construction
The area where the "Waikoko Wetland" was built prior to construction.
IMAGE – DOC Archive 1997

Figure 47. Before the Water
The "Waikoko Wetland" construction prior to flooding with water.
IMAGE - DOC Archive 1998

Figure 48. Filled to the brim of the weir.
The photo above also shows some of the early *Phormium tenax* planting of this area. IMAGE – DOC Archive 1999

Figure 49. Aerial View of Waikoko Wetland.
This image shows the volume of water in the "Waikoko Wetland" ponds shortly after construction in 1999 during the maintenance of the designed weir system. IMAGE – DOC Archive 1999

April 9th 2016 see Appendix 5) of the methodology behind the design of the Waikoko Wetland complex it would appear that most of the weir system is present to aid draining in high daily rainfall times.

Presently, altering/maintenance of weir levels is not being undertaken by DOC. The hydrologic regime of each pond area should be assessed to understand the amount of water fluctuation and availability, so that suitable floral species could be introduced to each area for further ecological restoration. This could include some simple monitoring methods such as photo points of each pond each time a FOMI trip visits the Island, or get the DOC ranger to record particularly after heavy rain events.

It appeared from observations made in December 2015 that only one of the ponded areas remained filled with water year round. Other ponds had already become partially or totally dried out when observed in December. On the subsequent trip it was obvious that even the last water filled pond had been dry for some time prior to the visit (Figures 50 & 51).

Figure 50. Recently Dried Up – April 2016.
This pond was filled with water in December, now only silt cakes remain. IMAGE – Matt Ward 2016

Figure 51. Vegetation reclaiming a Pond – April 2016.
The pond at the bottom of Weta Valley which also had a small amount of water present in December. Now full of native Poroporo- *Solanum aviculare* and invasive weedy *Aster subulatus*. IMAGE – Matt Ward 2016

The work undertaken, by Chague-Goff (2000) which involved sampling each of the ponds, then analysing the composition for nutrient and cations presence may no longer need to be re-visited. They found that at the time of sampling variations were present from pond to pond, with three ponds having unusually high concentrations of nitrate, ammonium, and phosphate. This was attributed to catchment runoff, bird

droppings, fertiliser and seepage from the former oxidation pond. More analysis work so that the suitability of the pH and salinity levels could be accurately measured may prove invaluable.

Figure 52. Healthy Planting in Waikoko Wetland.
This area between two of the ponds shows mature Harakeke, Toetoe and Ti kouka in the back ground. IMAGE – Matt Ward 2016

The planting that had been undertaken around the wetland complex showed mixed results. In some areas, plantings appeared to have survived very well (Figure 52). Conversely according to the volumes of plants originally used compared to the volume of those species which are now present there had been vast areas of losses. According to Jason, a myriad of these fatalities were caused by the then resident Pukeko's (mentioned previously). A lack of maintenance plan is also likely to have contributed to some of the losses. Plantings around water are always susceptible to weed species invasion due the excellent resources available, water and light. Those species which have survived could provide seed stock for further planting efforts.

After much discussion amongst the 2016 field trip members agreed that the plants themselves are likely to have contributed to the reduced water availability to the wetland; their needs will be consuming thousands of litres per annum. This changed regime suggests that in reality these large ponds of sitting water are likely to decrease and infill in the future. Reducing the original expanse of each pond by piling up silt cakes (Figure 53) to form tongues protruding from the existing edges could provide extended planting sites and allow some smaller concentrated areas to remain wetter. This principal of piling silt cakes could also be used to form small islets within the pond formations.

Figure 53. 'Silt Cakes' in Waikoko Wetland.
These nutrient rich cakes of silt can be used to redefine the edges of the pond areas.
IMAGE – Matt Ward 2016

The original plan for further planting in the wetland (Miskelly, 1999) suggests that a comparative list from the Taupo Mire, Plimmerton, and the wetland on Kapiti Island be used as a source for species recommendations (Appendix 6). This list is very comprehensive and useful for the long term, however, it does contain very specific and threatened species which would take considerable specialist knowledge to recognise and propagate; this may possibly be beyond the scope of FOMI presently. However, in the short term using seed gathered from species already present would provide immediate gains.

The Waikoko Wetland area would benefit from further rehabilitation work. There are many tasks which could be readily achieved by volunteers to improve this area to make it more enjoyable for visitors to experience the wildlife.

- A simple access track could be put through the area without much effort. This would improve accessibility therefore benefiting any future planting, weeding, and monitoring work.
- There are a few areas identified in the wetland that are in need of manual weed control. The notable weed species affecting plantings the most appeared to be *Calystegia silvatica* - bindweed. This could be pulled off the planted specimens initially by hand by volunteers and piled up, then with a suitably qualified herbicide applicator controlling it thereafter.

Table 9 below includes suggestions and locations these species may be collected from. Without further analysis or study some interim seed collection and propagation on the island could easily be undertaken.

Table 9. **Species suitable for collection and propagation for the improvement of Waikoko Wetland.**

SPECIES	LOCATION	COLLECTION TIME/COMMENT	SOURCE
Austroderia toetoe - Toetoe	Islets, tongues, drier areas, ridges	January to May – Collect entire seed head and lay on damp seed raising mix, then water in.	Waikoko Wetland
Carex secta – Pukio	Edges, damp areas, islets	January/February - Collect entire seed spike using secateurs. Scrunch up seed heads to release the seed, make sure there is no green colour on the seed, too early if so.	Jason's Pond
Carex virgata – Swamp sedge	Edges, islets and tongues	February - Collect entire seed spike using secateurs (be careful as these panicles are sharp)	Waikoko Wetland
Gahnia rigida - Gahnia	Edges	Year round - Whenever the seed falls readily from the panicle. Very difficult species to grow, so keep hopes for success in check. In the future other seed from the original mainland populations may wish to be collected.	Waikoko wetland; Mangaroa Swamp (Upper Hutt)
Hedycarya arborea – Pigeonwood	USED SPARINGLY Drier areas between ponds	Mostly during summer (usually site specific) - If there are specimens large enough, collect orange fruit from Dec-March. Sow immediately.	Waikoko wetland
Juncus species	Edges, islets	February/March - collect any species which are seeding and available. Keep the same species together and apart from others to avoid confusion. The seed is minute so store the heads in a paper bag while collecting, then shake to release the seed, this tests whether seed is available yet.	Waikoko Wetland
Leptospermum scoparium – Manuka	USED SPARINGLY Edges, damp areas, drier areas between ponds	Year round - collect seed that is plump and looks like a hot cross bun. The specimens collected from need to be growing in the habitat you wish to replant, for example - wet or dry. Store pods in paper bag or envelope for approximately two weeks until pods open and release seed.	Forest Valley
Olearia solandri – Coastal tree daisy	USED SPARINGLY Seasonally wet areas, edges	April to November – Collect by shaking seed from plant; low germination rate so collect plenty of seed.	Southern Pond
Phormium tenax - Harakeke	Track edges, drier sites	February to May – Collect as pods are opening not before, collect from numerous specimens; grows readily	Waikoko Wetland
Plagianthus divaricatus – Saltmarsh ribbonwood	Seasonally wet areas, edges	January to April – Seed easy to collect, ensure multiple specimens are selected; best sown in April so that seed can receive 4 weeks of natural cool stratification.	Waikoko Wetland

8. SPECIAL CASES

In this section we look at some of the ongoing issues relevant to the Floral Diversity Project which are somewhat peripheral to the restoration of Mana Island, but could be potentially tackled by FOMI. These are situations relatively unique to Mana Island and other off shore projects that can be influenced by human input.

8.1 OPEN GRASSLAND POLICY

Since the inception of the 1999 Restoration Plan, areas on the island were highlighted as areas to "no planting" (Figure 54). These areas are those which would suit *Porphyrio hochstetteri* – Takahē as food sources, therefore sustaining a managed breeding program. Most of these areas are on the plateau. The lack of natural water sources is a problem that has been helped by artificial water troughs, as well as creating ponds with native planting around them which provide both shelter and water for *Porphyrio hochstetteri* – Takahē.

"The only sites where regeneration of native shrub and tree species will be actively prevented is on archaeological sites unless Mana Island remains a key site for the conservation of takahe."
(Miskelly; page 11, 1999)

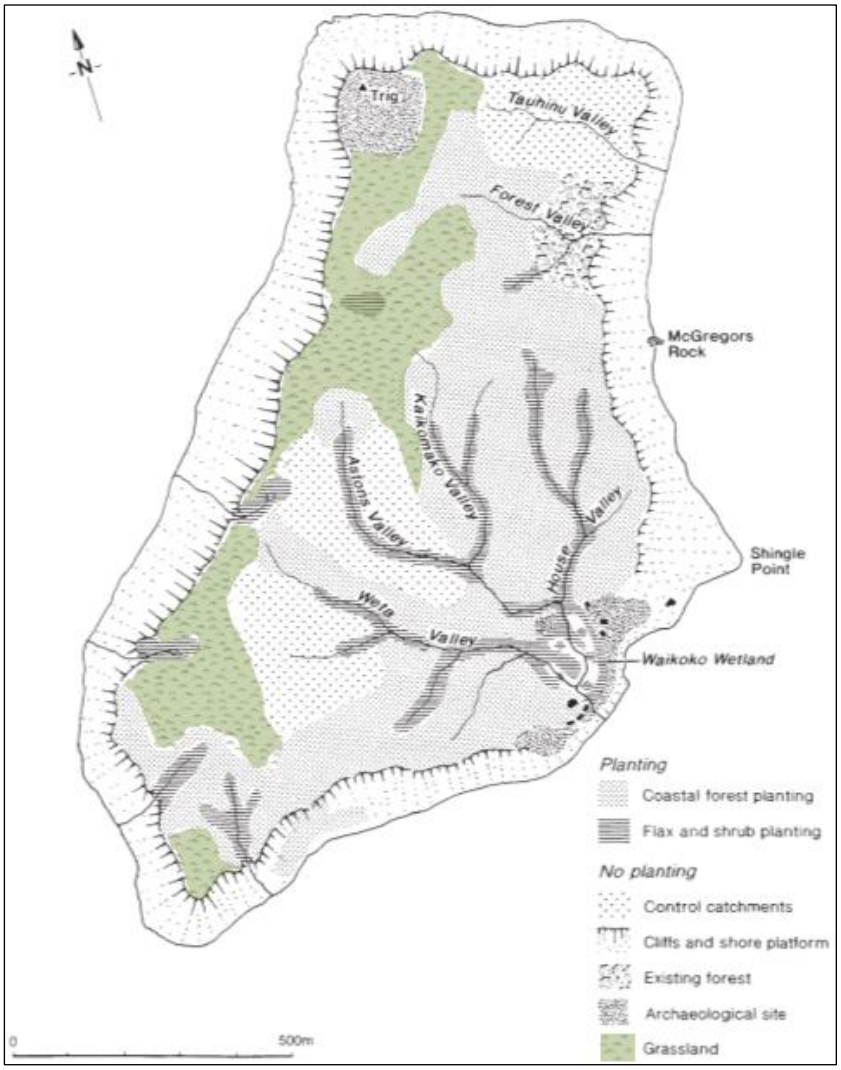

Figure 54. Areas of Mana Island Planned for planting tree and shrub species as part of the restoration programme. (Miskelly, 1999: Page 12.)

Though the areas highlighted as “no planting” have been adhered to, as predicted, these habitats are diminishing through natural revegetation (Figure 55). *Coprosma propinqua* – Mingimingi, is proliferating at a great rate in these areas which has become somewhat of a hindrance to the habitat of *Porphyrio hochstetteri* – Takahē.

“There will be an inevitable decline in the area of grassland on the island, but the only threatened species likely to be adversely affected by this is the takahe.” (Miskelly; page 26, 1999)

Figure 55. Rampant natural revegetation.
Regenerating shrubs naturally, yet thriving.
IMAGE – Matt Ward 2016

Figure 56. *Porphyrio hochstetteri* – Takahē Habitat.
Open grassland as it was planned in the short term.
IMAGE – Matt Ward 2016

Phil Marsh a DOC expert on the Takahē Recovery Programme suggested that if possible maintaining these ‘no planting’ areas as grassland (Figure 56) to aid *Porphyrio hochstetteri* – Takahē in their survival.

Islands like Kapiti and Maud have recently started to regenerate at such rates that habitat favoured by *Porphyrio hochstetteri* – Takahē are no longer viable, meaning more competition and conflict occurs between pairs (P. Marsh, *pers. comm.* 2016). Further discussion with Phil would clarify the extent of regeneration control that he feels appropriate (Appendix 7).

8.2 *CORYNOCARPUS LAEVIGATUS* - KARAKA

The situation regarding the presence of *Corynocarpus laevigatus* – Karaka (Figure 57) is an issue on Mana Island. This species is not local to the Wellington Region, although it is thought to be native to the North of the North Island and has been moved from there by humans for centuries (Jones, 1987). Much of the Karaka present on the island was planted by DOC, Ministry of Agriculture and Fisheries staff as well as some by Iwi prior to the "Restoration Plan" (Miskelly 1999).

C. laevigatus – Karaka has the unfortunate reputation of being a 'weedy' species, as qualified in Costall *et. al.* (2006). *C. laevigatus* – Karaka is fast growing and has a high germination rate if the seed remains intact (Burrows, 1996). It also has large leaves which create shade preventing other species from germination; and thus changes the forest structure of the area in which it grows, creating a homogenous composition.

Figure 57. *Corynocarpus laevigatus* - Karaka.
Displaying lush foliage and prolific fruiting of Karaka. IMAGE – Matt Ward 2007

C. laevigatus – Karaka was moved around the New Zealand mainland and off shore islands as food for New Zealand's earliest settlers, Moriori and Māori (Sawyer, 2003). The *C. laevigatus* – karaka have originally been brought to the island by Māori (Leach & Stowe, 2005). This is considered to be the case as *C. laevigatus* – Karaka specimens known to have been present prior to any planting, occurred within 500 metres of a known Māori settlement making them 'Cultural' not 'Natural (Leach & Stowe, 2005). There is evidence to suggest that Māori selected specimens that had the largest sized fruit (van Essen & Rapson, 2005) that could then be used as kai for their hapū. Each population was 'gardened' by using only seed from the trees that appeared to grow the largest fruit for that particular habitat, similar to the process which has been used for many commonly eaten contemporary fruit and vegetables. This would then make each isolated population unique. This then suggests that the largest original specimens on Mana Island may have larger fruit than so called 'Natural' specimens nearby.

C. laevigatus – Karaka can be a problematic species in restoration, however, cultural sensitivities must be considered in this case first and foremost. If the local Iwi were happy to have this species eradicated from the island then it would be appropriate to do so. However, it has been planted to a greater range than it was "culturally occurring" when the island was retired as sheep station, these specimens realistically have no historical value.

One management option would be to set aside an area surrounding some or all of the original specimens of *C. laevigatus* – Karaka as a unique grove that could be maintained as a homogenous patch. If this was

adopted it would need to be agreed that any outliers were controlled/removed, due to the weedy habits of this species. This option would need to be weighed up against the labour resources available to undertake this work as it would be a significant and ongoing task given the abundance and spread of seedlings across the island.

8.3 *MUEHLENBECKIA AUSTRALIS* – FRIEND OR FOE

Muehlenbeckia australis - Pōhuehue, Large leaved muehlenbeckia is one of three members of this New Zealand genus represented on Mana Island. Like *M. complexa* - Small-leaved pōhuehue, it is a naturally occurring "Not Threatened" species, whereas the other representative *M. astonii* - Shrubby tororaro is a "Threatened - Nationally Endangered" species which has been introduced to the island as part of the rare plant ex-situ conservation plan. *M. australis* - Pōhuehue is a species which is regarded as both friend (Patrick, 2005; QE II, 2006; TERRAIN 2016; Forest & Bird, 2013) and foe (Environment Southland, 2007; G.W.R.C., 2009; Otatara Landcare Group, 2016) by many different aspects of the national population.

M. australis - Pōhuehue is a semi-deciduous (Dawson, 1988) vine found throughout New Zealand and mostly occurs on the margin of forests. *M. australis* - Pōhuehue is a common fast growing vine which can reach heights of 30 metres (Dawson, 1988) when using other smaller trees to reach a crown. The tangle of vines it produces are covered in dark green heart shaped leaves (Figure 58) where exposed to the light, stems below a canopy are usually bare and may grow to 10 cm in diameter. The juvenile leaves are fiddle shaped (Figure 59) until a plant matures. Female plants produce a three-angled single seed attached externally to a fleshy white fruit which is enjoyed by lizards (Figure 60), possibly explaining the success of the species on the island. The fruit provides a sweet reward to its disperser for long periods of the year from December to April. The fruit was also regarded as a sweet treat consumed by Māori children in the past (Ngā Tipu Whakaoranga database, 2016).

Figure 58. *Muehlenbeckia australis* – Pōhuehue.
Mature leaf form. IMAGES – Matt Ward 2009

Figure 59. *Muehlenbeckia australis* – Pōhuehue.
Juvenile leaf shape. IMAGE – Matt Ward 2012

Figure 60. *Muehlenbeckia australis* – Pōhuehue.
Mass of ripening fruit with seed beginning to appear.
IMAGE – Matt Ward 2008

This species has both pro and cons, many of which are similar, as are outlined in the Table 10.

On Mana Island *M. australis* - Pōhuehue can be seen in many places, the population with the largest area being found in Weta Valley (Figure 60). The island provides much habitat which is perfect for this species to thrive, *M. australis* - Pōhuehue particularly favours human disturbed habitat of which there are many on Mana Island.

Figure 61. *Muehlenbeckia australis* – Pōhuehue.
Covering vegetation in Weta Valley.
IMAGE – Matt Ward 2016

Table 10. **Aspects of habit for *Muehlenbeckia australis* – Pōhuehue.**

PROS	CONS
Fast growing out competes ground dwelling weeds.	Fast growing out competes new plantings.
Providing wind shelter to edges of vegetation.	Smothers young plantings not allowing light for growth of host.
Favours growing on edges and modified habitats.	Prevents natural expansion of edge habitat.
Food source for native butterflies, moths, lizards and birds.	Grows as a mat on ground preventing other native species from establishing naturally.
Living habitat for native butterflies particularly the copper family (Patrick, 2006) other insects and lizards.	
Deciduous habit allowing seasonal light to be attained by host crown.	
Deciduous habit provides increase of organic material for humus production.	

To summarize the table above, this species can be both problematic and advantageous in a restoration project. It is quick growing which allows fast establishment and can provide benefits for the numerous benefactors, mostly insects, lizards, and birds. This rapid establishment makes it problematic when it corresponds with new or recent plantings as they may become easily overgrown, stunted, and even killed by the mat forming vegetative habit. The ability of *M. australis* - Pōhuehue to seal in an edge has benefits for forest habitat not to become desiccated; it may also prevent new colonization of desired species. It provides great habitat for native butterflies, and during the visits to the island *Anthornis melanura* - Bell bird and *Cyanoramphus auriceps* - Kākāriki were seen feeding from a vine in House Valley.

If control or removal is undertaken, consideration of the situation must be carefully thought through as there is a high likelihood that any bare ground or opening of canopy will then allow weed species a chance to infiltrate, take hold, and then also need removal or control. Each case of *M. australis* - Pōhuehue control should be considered independently. There is definitely a case for control in some situations, for example when a planting has had *M. australis* - Pōhuehue competing with it from a very early age; in this situation the *M. australis* - Pōhuehue often smothers a planting completely due to the lack of height accidentally killing its host.

The massive growth in Weta Valley has "always been there and doesn't seem to have increased in range (J. Christensen *pers. comm.,* 2016)". However, it has grown over the newer plantings, which has now been experimentally controlled so that more planting can be undertaken (Figure 62). This experiment along with others nearby should be carefully monitored so that any other invaders do not become a problem. In other cases there is good reason to leave the vine and monitor the health of the specimens upon which it is growing; for example where plantings are reaching mature heights they become robust and therefore proving difficult to be overwhelmed.

Figure 62. Controlled *Muehlenbeckia australis* - Pōhuehue.
This population in Weta Valley has been partially controlled to provide a new area to plant, note the Poroporo already colonising the new vacancy.
IMAGE – Matt Ward 2016

8.4 LIGHT-WELLING

Light welling is the practice of opening up the canopy above a plant so that it may receive more light in the hope it will grow more speedily, joining the canopy above. This is a practice which has little information available other than anecdotal evidence of its success. Conversely light welling can cause problems. If the canopy is opened up too much in a situation where the canopy is not overly tall and the planted area is near weed species which travel mostly by wind, a weed infestation may rapidly occur creating a problem. Unfortunately an example of this was seen on Mana Island during the April trip; a very large canopy had been opened up and had become infested with weeds, *Phytolacca octandra* - Ink-weed and *Conyza sumatrensis* - Fleabane.

If light-welling is going to be undertaken it would be a good idea to take a photo of the area and specimen the light-well has been made for, and the hole in the canopy that has been made. This could then be revisited to see whether in fact anything has been achieved by the activity, which would benefit the process by either confirming or condemning its practice for the future. This may seem like a lot of effort, but the reward of knowing either way if the effort is worth it has to be beneficial.

The reality is that most NZ species are not fast growers and will not take up a light gap quickly. Therefore it would be prudent to wait until a specimen is of a considerable size before giving it the option of joining the canopy. Matai for example are very happy to grow in the understorey for years often reaching three metres or more before the mature growth habit even begins.

8.5 *MYOPORUM AFF. INSULARE* - TASMANIAN BOOBIALLA

Another unusual issue noted is a tree species which is problematic if it remained on the Island, *Myoporum aff. insulare* - Tasmanian Boobialla (Figure 63 & 65). An introduced species from Australia which has mistakenly been planted in several parts of New Zealand, in particular the Porirua area. On Mana Island this species has grown to such a size that it is likely to be interbreeding with the New Zealand endemic species *Myoporum laetum* – Ngaio (Figure 64 & 67). If any of the Boobialla hybrid seeds germinate and mature (see Figure 66), it can be difficult to tell them apart from the local, making future control very challenging. It is recommended that these specimens be controlled as soon as practicable. The most obvious being on the bank diagonally opposite the generator shed. This should be undertaken by or under supervision of trained staff.

Figure 63. *Myoporum aff. insulare* - Boobialla.
Green growing tip. IMAGE – Matt Ward 2009

Figure 64. *Myoporum laetum* - Ngaio.
Dark growing tip, and obvious oil glands. IMAGE – Matt Ward 2009

Figure 65. *Myoporum aff. insulare* - Boobialla.
Flowering in July. IMAGE – Matt Ward 2009

Figure 66. *Myoporum* Hybrid.
This hybrid displaying some character of both parents, lacking obvious oil glands ,while displaying some colour at growing tip. IMAGE – Matt Ward 2009

Figure 67. *Myoporum laetum* – Ngaio.
Flowering in November. IMAGE – Matt Ward 2009

8.6 *METROSIDEROS ROBUSTA* – NORTHERN RĀTĀ

Mana Island originally had only one *Metrosideros robusta* – Northern rātā (Figure 68) specimen present. This specimen is located "*near the top of the South-Eastern cliffs*" (Timmins *et. al.*, 1987). This situation posed two problems: firstly the fact there is only one tree, making any cuttings or offspring from a single genetic source; secondly the planted *Metrosideros excelsa* – Pōhutukawa, which is present on the island may possibly hybridise preventing future proliferation. Naturally these two species would not co-exist; human interaction has drastically increased the range of *M. excelsa*.

The issue of a genetic bottleneck was combatted early in the planting schedule, by obtaining specimens from Taupo Native Plant Nursery (TNPN). These were sourced from the lower North Island's Tararua Mountains (P. Smith, *pers. comm.*, 2016). This ensured that a number of parents would be present to proliferate with the remnant specimen. Early on in this process of planting stock from TNPN it was thought that some of the supplied stock were hybrids of *M. robusta* and *M. excelsa*, this was later proven not to be the case (P. Smith, *pers. comm.*, 2016).

Figure 68. *Metrosideros robusta* – Northern rātā.
The dramatic bloom on display in December the same time as *M. excelsa* – Pōhutukawa, Waikanae. IMAGE – Matt Ward 2010

The second issue proved to be the case as mentioned above. Seed that was collected from the island's original specimen early on in the restoration of the Island was in fact hybridised (J. Christensen, *pers. comm.*, 2016). This somewhat surprised the DOC rangers at the time, as they thought the distance between the *M. excelsa* and *M. robusta* populations would be sufficient to prevent hybridising (J. Christensen, *pers. comm.*, 2016). The original *M. excelsa* which were planted hold importance to one of the original farming families, and are therefore not going to be removed. Outliers from these memorial plantings were removed and numerous *M. robusta* have been planted nearby to try to contain the transfer of pollen to the other planted *M. robusta* including the original specimen.

This situation is not one which needs any time or effort spent on it. However, it does need to be noted in this report so that future collection of seed from any of the island *N. robusta* is not attempted for propagation.

9. SUMMARY & ACTION PLAN

The effort that has been undertaken thus far in the restoration of Mana Island is phenomenal. Few projects in New Zealand have had such an extensive and consistent effort embarked on toward a multi-faceted goal. Numerous fauna species relocations have been undertaken in direct response to the efforts made to restore habitat to accommodate them. No other publicly funded off-shore island project has planted as many trees, flax, grasses, sedges and shrubs see Table 11. The huge cost that should be associated with such a mammoth task has largely been limited by dedication and intelligent decision making by FOMI volunteers and DOC staff. The foresight of many individuals in the early stages of this project has contributed to a delivered success which will continue to grow and become more resilient as time goes by.

Table 11. **The largest off-shore Restoration Projects in New Zealand.**

Location	Number of plants
Mana Island	over 500,000
Motutapu Island	over 440,000 (The Motutapu Restoration Trust, 2015)
Tiritiri Matangi Island	between 250,000 & 300,000 (Tiritiri Matangi Open Sanctuary, 2016)

With continued effort, will come continued reward. More than 500,000 plants of some 77 various species have been planted since 1987. Future planting should involve secondary and understorey species to continue the excellent improvements to the islands biodiversity. More specialised, focused efforts are required to replace the bulk planting of the earlier days; this will also require patience and a deal of accuracy. Continued recording and analysis of those specialized efforts will prove beneficial for ongoing success. Paper trails and photography of all efforts made will add to the resource for future efforts as well as provide evidence of those methods, either accomplishments or disappointments.

9.1 TASKS

This report is the second stage of this three stage project. It does contain suggestions that may be sufficient for FOMI to start creating worksheets for specific tasks. The next stage will have more details for action than have been suggested here. However, from the suggestions made in this report there are some straight forward practical tasks that could be undertaken by FOMI volunteers during the next visit. These include:

- Anyone with good botanical knowledge could take time to seek out more of the species not noted in this report to confirm or deny their existence.
- Seed collection and propagation could be planned for immediately.
- Waikoko Wetland could have a lot of effort put into preparation for future planting, mostly weed control.
- The on-island nursery would benefit from an upgrade, repairing weed-matting and wind cloth especially in the outdoor hardening off area.
- Provide a section in the FOMI newsletter for plant based, efforts, profiles, lessons, collect relevant photographic information each visit to the Island
- Tackle the witches broom on the *Streblus banksii* – Large leaved milk tree, recording all that is undertaken for future reference

9.2 TIME FRAME

The speed at which further work to increase the floral diversity of Mana island is undertaken is solely reliant on the number, skill and efforts of volunteers, primarily FOMI members. This then becomes dependant on the number of boat trips and space available. Table 12 has been constructed in two year time blocks as a general guide and measure.

Table 12. **Time Frame for Actions from 2016 – 2025.**

		YEAR BLOCK				
GENERAL	TASK	2016/17	2018/19	2020/21	2022/23	2024/25
New species	Seed sourcing research	Intensive[1]	Continued[2]	Continued[2]	Continued[2]	Continued[2]
	Planting		Gap filling and edge species	Lianes, gap filling and edge species, Maintenance	Lianes, gap filling and edge species, Maintenance	Lianes, gap filling , Maintenance
Understorey	Seed sourcing research	Intensive[1]	Continued[2]	Continued[2]		
	Planting		Intensive	Lianes, Evaluate 2018/19, Intensive	Lianes, Evaluate 2020/21, Intensive	Lianes, Evaluate 2022/23
Wetland	Seed sourcing research	Intensive[1]	Continued[2]	Continued[2]	Continued[2]	Continued[2]
	Cake shifting	Bulk effort	Continue if progress can be made	Assess		
	Planting	Some, if weeding allows	Intensive in gaps and on new cake edges & islets	Assess, fill gaps, maintenance	Assess, fill gaps, maintenance	Assess, fill gaps, maintenance
	Weed control	Intensive	Intensive	Intensive	Maintenance	Maintenance
Threatened Plants	Seed sourcing research	Intensive[1]	Continued[2]	Continued[2]		
	Planting	Maintenance of earlier efforts	Seed collected in 2017[3], Maintenance	Seed collected in 2019, Maintenance	Maintenance	Maintenance
Light-welling		Experiment, take records	Monitor, reassess form records	Continue if records show success	Continue if records show success	Continue if records show success
Witches Broom	Removal	Cut and bag, and photograph	Monitor, repeat if necessary, photograph	Monitor, repeat if necessary, photograph		

1. Find sources suggested in this report, GPS locations and monitor phenology for accurate collection time, multiple specimen sources per species required.
2. Continue to find alternative sources of seed to continue parent gene stock growth.
3. Refers to planting of plants which have had 18-24 months to gain a good size for optimum chance of survival.

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Figure 69. So…that's where're we're going!!!
Linda Kerkmeester, Lisa Clapcott and Jason Christensen look over the years of graft on Mana Island. IMAGE – Matt Ward 2016

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APPENDICES

APPENDIX 1: Mana Island Botanical List

MANA ISLAND Botanical List 2016

Site S - Shore, C - Cliff, V - Valley, P - Plateau, B - Buildings, W - Wetland; SS - Shingle Spit; WC - Western Cliffs; SC - Southern Cliffs; WV - Weta Valley; FV - Forest alley; TV - Tauhinu Valley; SP - Southern Pond

Key: F - Few; M - Many; A- Abundant; (p) - planted

Latin name	Māori name	Common name	Timmins *et. al.*					Ward *et. al.*									
			S	**C**	**V**	**P**	**B**	**S**		**C**		**V**				**P**	**B**	**W**
									SS	WC	SC	WV	FV	HV	TV	SP		
GYMNOSPERM TREES																		
Dacrydium cupressium	Rimu	Red pine										(p)						
Dacrycarpus dacrydioides	Kahikatea	White Pine										(p)						(p)
Podocarpus totara	Tōtara	Tōtara										(p)						
Prumnopitys ferruginea	Miro	Brown pine										(p)						
Prumnopitys taxifolia	Mataī	Black pine										(p)	(p)					
MONOCOT TREES																		
Cordyline australis	Tī kōuka	Cabbage tree		F	(p)		(p)	F	F			(p)				(p)		(p)
Rhopalostylis sapida	Nīkau	Nīkau										(p)						(p)
DICOT TREES/SHRUBS																		
Alectryon excelsus var. excelsus	Tītoki	Tītoki			F							(p)	F					
Beilschmedia tawa	Tawa	Tawa										(p)						
Brachyglottis repanda	Rangiora	Tree daisy			A			F					M					
Carmichaelia australis		Common broom			M							(p)	F			F		
Coprosma areolata		Thin-leaved coprosma			F(1)								F					(p)
Coprosma lucida	Karamū	Shining karamū		F	M							(p)	A	F		(p)		
Coprosma propinqua var. propinqua	Mingimingi	Mingimingi	A	A	A		M	A	A	A	A	(p)	A				A	(p)
Coprosma repens	Taupata	Mirror leaf	A	A			(p)	A	A	A		(p)				F(p)		(p)
Coprosma rhamnoides		Coprosma rhamnoides		F	A							(p)	A				(p)	(p)
Coprosma robusta	Karamū	Karamū			M		F(p)	F				(p)	M			(p)		
Coriaria arborea var. arborea	Tutu	Tree tutu	1 plant (Aston 1911)															

Latin name	Māori name	Common name	S	C	V	P	B	S		C		V				P		B	W
									SS	WC	SC	WV	FV	HV	TV	SP			
Corynocarpus laevigatus	Karaka	Karaka		F	M		(p)	F				(p)	F						(p)
Dodonaea viscosa	Akeake	Akeake																	(p)
Dysoxylum spectabile	Kohekohe	Kohekohe			F							(p)	F(p)						(p)
Elaeocarpus dentatus	Hīnau	Hīnau												(p)					(p)
Entelea arborescens	Whau	Cork tree										(p)		(p)					
Geniostoma ligustrifolium var. ligustrifolium	Hangehange	New Zealand privet																	(p)
Griselinia lucida	Puka	Broadleaf		F	F			F			F	(p)							
Hedycarya arborea	Porokaiwhiri	Pigeonwood																	(p)
Knightia excelsa	Rewarewa	New Zealand honeysuckle										(p)							
Kunzea robusta	Kānuka	White tea tree		M	M							(p)	A			F			
Laurelia novae-zealandiae	Pukatea	Pukatea																	(p)
Leptecophylla juniperina subsp. juniperina	Mingimingi	Prickly mingimingi		M	M					M			M						
Leptospermum scoparium	Mānuka	Tea tree		A	A							(p)	A			F			(p)
Leucopogon fraseri	Pātōtara	Dwarf mingimingi		M	M					M	M								
Melicope ternata	Wharangi	Wharangi		F	F			M				(p)	M						(p)
Melicytus crassifolius		Thick-leaved mahoe	A	A	F				M	M									
Melicytus obovatus			F(1)	M(8)					M	M			F						(p)
Melicytus ramiflorus	Māhoe	Whiteywood	F	F	M			F	F			(p)	A			F			(p)
Metrosideros excelsa	Pōhutukawa	NZ Christmas tree												(p)					
Metrosideros robusta	Rātā	Northern rātā		F							F	(p)							
Muehlenbeckia astonii		Wigiwig										(p)							
Myoporum laetum	Ngaio	Ngaio		F(1)	F(1)	(p)	(p)		F	F		(p)	F			(p)			(p)
Myrsine australis	Matipo, māpou	Red mapou	F(10)	F(6)	F(2)							F(p)	F						(p)
Olearia paniculata	Akiraho	Golden akeake		M	M			F				(p)	M						
Olearia solandri		Coastal tree daisy		F(2)	M			F				(p)	M						
Ozothamnus leptophylla	Tauhinu	Cottonwood	A	A	A		M		M	A		M	F			F			
Pennantia corymbosa	Kaikōmako	Kaikōmako	F(9)	F(4)	M			F	M			(p)	M						(p)
Pimelea cryptica		Pimelea								M	M								
Pimelea prostrata ssp. prostrata	Wharengāngara	Strathmore weed		M	M					M									

Latin name	Māori name	Common name	S	C	V	P	B	S		C		V				P	B	W
									SS	WC	SC	WV	FV	HV	TV	SP		
Pimelea aff. aridula (pipinui point)																(p)		
Piper excelsum ssp. excelsum	Kawakawa	Pepper tree		F	A			M	F			(p)	F					(p)
Pittosporum crassifolium	Karo	Karo								F								(p)
Pittosporum eugenioides	Tarata	Lemonwood																(p)
Pittosporum tenuifolium	Kōhūhū	Black matipo							(n)			(p)	F			(p)		(p)
Plagianthus divaricatus	Mākaka	Saltmarsh ribbonwood	F(1)						F									(p)
Pseudopanax arboreus	Whauwhaupaku	Five finger					(p)	A(p)	F			(p)	M			(p)		
Pseudopanax crassifolius	Horoeka	Lancewood										(p)						(p)
Solanum aviculare var. aviculare	Poroporo	Poroporo	M(?)	F	M			M				M				F		M
Solanum laciniatum	Poroporo	Poroporo	M(?)	F	M				F									
Sophora chathamica	Kōwhai	Coastal kōwhai										(p)						(p)
Sophora microphylla	Kōwhai	Kōwhai										(p)						(p)
Sophora molloyi	Kōwhai	Cook Strait or Molloy's kōwhai	(P)					(p)										
Streblus banksii	Turepo	Large leaved milk tree		F	F							(p)	M					
Urtica ferox	Ongaonga	Tree nettle	F		M							F						
Veronica elliptica	Kokomuka	Shore hebe, shore koromiko															(p)	
Veronica stricta var. macroura	Koromiko	Koromiko		M				F		M		M	M			F		
Veronica stricta var. stricta (atkinsonii)	Koromiko	Koromiko										(p)						
MONOCOT LIANES																		
Freycinetia banksii	Kiekie	Kiekie			F(1)													F
DICOT LIANES																		
Calystegia sepium ssp. roseata	Rauparaha	Pink bindweed					F	F	F									
Calystegia soldanella	Panahi	Shore bindweed	A					A	M									
Calystegia turguriorum	Pōwhiwhi	Climbing convolvulus	M		F			M	A			F	F					
Clematis forsteri	Puataua	Small white clematis	F		F(1)			F	F	F		F	F			F		
Metrosideros perforata	Akatorotoro	Small white rātā		M	F					F								
Muehlenbeckia australis	Pōhuehue	Large leaved muehlenbeckia	F		F		F					A						
Muehlenbeckia complexa	Pōhuehue	Wire vine	A	A				A	A	A		A	F					

Latin name	Māori name	Common name	S	C	V	P	B	S		C		V				P		B	W
									SS	WC	SC	WV	FV	HV	TV	SP			
Parsonsia heterophylla	Akakiore	New Zealand Jasmine		F	F(1)	F												F	
Rubus squarrosus		Leafless lawyer, yellow-prickled lawyer															(p)		
Tetragonia implexicoma	Kōkihi	NZ spinach	A	A	M			M	A	A		M				F			F
FERN & FERN ALLIES																			
Adiantum cunninghamii	Puhinui	Common maiden hair			M								M						
Anogramma leptophylla		Jersey fern, annual fern	F																
Asplenium appendiculatum ssp. appendiculatum		Ground spleenwort	F	A	F				M			F	M						F
Asplenium appendiculatum ssp. maritimum		Coastal spleenwort	F					F		M		F							
Asplenium bulbiferum	Pikopiko	Hen & chickens										(p?)	(p?)						(p?)
Asplenium flabellifolium		Butterfly fern, necklace fern		M	M							F	M						F
Asplenium flaccidum	Makawe o Raukatauri	Hanging spleenwort		F	F							F	F						
Asplenium gracillimum		Hen and chicken fern			F								F						
Asplenium hookerianum var. hookerianum		Spleenwort			F								F						
Asplenium oblongifolium	Huruhuruwhenua	Shining spleenwort	F	M	M		F(p?)	M	F			(p?)							(p)
Asplenium polyodon	Petako	Sickle spleenwort			F(1)								F(7)						
Azolla rubra		Pacific azolla, red azolla			F														F
Blechnum chambersii	Nini	Lance fern			M								F						
Blechnum filiforme	Pānako	Thread fern			F(1)							F							
Blechnum membranaceum					F							F							
Blechnum minus	Kiokio	Swamp kiokio			F											F			
Blechnum novae-zelandiae	Kiokio	Palm leaf fern			F								F		F				
Blechnum penna-marina subsp. alpina		Alpine hard fern			F		F(p?)												
Blechnum vulcanicum	Korokio	Mountain hard fern									F								
Blechnum zeelandicum												(p)	F					(p)	
Cheilanthes sieberi ssp. sieberi		Rock fern		F	F														
Cyathea cunninghamii	Pūnui	Gully tree fern					F(1)												
Cyathea dealbata	Ponga	Silver fern			F								M						
Cyathea medullaris	Mamaku	Black tree fern			F							F				F(1)			
Dicksonia squarrosa	Whekī	Whekī														F(3)			

Latin name	Māori name	Common name	S	C	V	P	B	S		C		V				P		B	W
									SS	WC	SC	WV	FV	HV	TV	SP			
Histiopteris incisa	Mātā	Water fern			F		F(p)					F		F		F			
Hymenophyllum rarum	Mauku	Filmy fern			F														
Hymenophyllum sanguinolentum	Mauku	Filmy fern			F														
Hypolepis ambigua			F	F	M														
Hypolepis rufobarbata		Sticky pig fern											F						F
Lastreopsis velutina		Velvet fern			F(1)														
Microsorum pustulatum ssp. pustulatum	Pāraharaha	Hound's tongue	F	M	M			F	F	F		F	M						F
Microsorum scandens	Mokimoki	Climbing hound's tongue							F				F						
Paesia scaberula	Mātātā	Lace fern, ring fern										F							F
Pellaea rotundifolia	Tarawera	New Zealand cliff brake, button fern		F(1)	F								F						F
Polystichum neozelandicum ssp. zerophyllum		Shield fern								M		F	M						
Polystichum occulatum								M		M		M	M			F			
Polystichum richardii			F	M	M														
Pteridium esculentum	Rārahu	Bracken	F	M	F		F					M							
Pteris macilenta	Titipo	Brake, sweet fern			F											F			
Pteris tremula	Turawera	Shaking brake		F	M			F				M	F						F
Pyrrosia eleagnifolia	Ota	Leatherleaf fern	M	A	M		F	M	F	A		F	M						
ORCHIDS																			
Bulbophyllum pygmaeum		Pygmy tree orchid			F										F				
Caladenia bartlettii		Mauve fingers			F														
Earina autumnalis	Raupeka	Autumn orchid			F										F				
Earina mucronata	Peka-a-waka	Bamboo orchid			F										F				
Microtis unifolia		Onion leaved orchid		F					F			M	M			F			
Pterostylis alobula		Greenhood			F								F						
Pterostylis australis		Greenhood										F							
Pterostylis montana		Greenhood										F							
Thelymitra longifolia	Maikuku	Common sun orchid		M	M				F(1)	M		M	M						
GRASSES																			
Austroderia fulvida	Toetoe	Toetoe										(p)	F			(p)			

Latin name	Māori name	Common name	S	C	V	P	B	S		C		V				P		B	W
									SS	WC	SC	WV	FV	HV	TV	SP			
Austroderia toetoe	Toetoe	Toetoe														(p)			(p)
Lachnagrostis littoralis ssp. littoralis		Coastal wind grass		F															
Lachnagrostis pilosa ssp. pilosa		Robust wind grass		F															
Microlaena stipoides		Slender rice grass	M	A	M	F	F												
Poa anceps		Broad-leaved poa	F	M	M			F											
Poa cita		Silver tussock	A	A	M				M	A									
Rytidosperma unarede		Bristle grass		F	F					F									
Trisetum antarcticum				M						F									
SEDGES																			
Carex breviculmis		Grassland sedge		F	F								F						
Carex dissita		Forest sedge													F				
Carex flagellifera		Trip me up, Glen Murray tussock	M	M	M		F	M	F			F	M			M			(p)
Carex geminata		Cutty grass	F	M	M							M				F			(p)
Carex litorosa		Sea sedge																(p)	
Carex raoulii		Coastal forest sedge	F	M	F								F						
Carex secta	Pukio	Niggerhead														F(2p)			(p)
Carex testacea		Speckled sedge, trip me up								F		(p)	M			(p)			
Carex virgata		Swamp sedge			F	F(2)										F			(p)
Cyperus ustulatus f. ustulatus	Toetoe upokotangata	Giant umbrella sedge	A	A	A				F			(p)				F			(p)
Eleocharis acuta		Sharp spike sedge			M											F			
Ficinia nodosa	Wiwi	Knobby club rush, ethel sedge	M	M	A				M	M		M	M			F			
Gahnia rigida		Gahnia																	(p)
Isolepis cernua var. cernua		Slender clubrush			M														
Isolepis inundata					F											F			
Isolepis prolifer					F														M
RUSHES & ALLIED SPECIES																			
Juncus australis	Wiwi	Leafless rush		M		A			F										F
Juncus distegus		Two storey rush		M		F													F
Juncus edgariae		Edgars rush			F	F							M						

Latin name	Māori name	Common name	S	C	V	P	B	S		C		V				P		B	W
									SS	WC	SC	WV	FV	HV	TV	SP			
Juncus pallidus		Giant rush, leafless rush		M	F		F												F
Juncus planifolius		Grass-leaved rush			F							F							
Juncus sarophorus		Fan flowered rush																	F
Luzula banksiana var. banksiana		Coastal woodrush	M	M	M					F		F							
Luzula picta var. picta					F					F			M						
MONOCOT HERBS OTHER THAN ORCHIDS, GRASSES, SEDGES																			
Arthropodium candidum	Rengarenga	New Zealand lily, bush lily			F														
Arthropodium cirratum	Rengarenga	Renga lily, Rock lily		M	A		F(p?)								A				
Dianella nigra	Tūrutu	New Zealand Blueberry		F	F								M						
Libertia grandiflora	Mīkoikoi	New Zealand iris			F(2)								F						
Phormium cookianum ssp. hookeri	Whaririki	Mountain flax		A	A		F(p?)	M		A									
Phormium tenax	Harakeke	Flax							M	F		(p)				(p)			(p)
Triglochin striata		Triglochin	F																
DAISY-LIKE HERBS (COMPOSITES)																			
Cotula australis		Common cotula, soldier's button	F	F	F	F													
Cotula coronopifolia		Bachelors button, yellow buttons	F	F	M	F											M		M
Craspedia uniflora var. maritima		Woolyhead	F	M	F(2)					M									
Euchiton audax				M	F														
Euchiton collinus		Cudweed			F														
Euchiton sphaericus							F												
Helichrysum filicaule		Creeping slender everlasting daisy				F													
Leptinella nana		Pygmy button daisy												F				(p)	
Leptinella tenella					F														
Pseudognaphalium luteoalbum												F							
Raoulia hookerii var. hookerii		Scabweed, scabweed mat daisy		M															
Senecio glomeratus ssp. glomeratus		Fireweed					F(1)												
Senecio hispidulus		Fireweed	F	M					M				F						
Senecio lautus var. lautus		Shore or variable groundsel	A	A	F			F	M	A						F			
Senecio minimus		Fireweed	F		F														

Latin name	Māori name	Common name	S	C	V	P	B	S		C		V				P		B	W
									SS	WC	SC	WV	FV	HV	TV	SP			
Senecio sterquilinus		Guano groundsel								M									
Sonchus kirkii	Pūhā, raurōroa	New Zealand sow thistle	F	F															
Vittadinia australis		White fuzzweed			F(2)														
DICOT HERBS OTHER THAN COMPOSITES																			
Acaena anserinifolia	Hutiwai	Bidibidi		F	F														
Aciphylla squarrosa var. squarrosa	Taramea	Speargrass, Spaniard	M	M	M			F		M		F(p)				F			
Apium prostratum ssp. prostratum var. filiforme		New Zealand celery	M																
Cardamine debilis agg.		NZ bitter cress		F	F								F						
Centella uniflora		Centella	F	F	F					M		F	M			F			
Colobanthus muelleri				M	F														
Dichondra repens		Mercury bay weed	M	M		F		M	M	M		M							F
Disphyma australe ssp. australe	Horokaka	Native ice plant	M	A				F		M									
Chenopodium triandrum		Pigweed	A	A	M			A		M		F							
Epilobium nummulariifolium		Creeping willowherb	A	A	A	M	A												M
Euphorbia glauca	Waiū-atua	Shore or sea spurge, sand milkweed						(p)											
Galium propinquum				F												F			
Geranium brevicaule										F									
Geranium microphyllum					M														
Geranium sessiliflorum var. arenarium		Short-flowered cranesbill		M															
Geranium solanderi		Solanders geranium		F															
Gonocarpus incanus					F(1)														
Haloragis erecta ssp. erecta	Toatoa	Fireweed, shrubby haloragis	M	F	F		F		F	M			M						
Hydrocotyle heteromeria		Waxweed, waxweed pennywort			M														F
Hydrocotyle moschata var. moschata		Hairy pennywort			M	F	F												
Lepidium olearaceum	Nau	Cook's scurvy grass		F				F											
Lilaeopsis novae-zelandiae			F														F		F
Linum monogynum var. monogynum	Rauhuia	NZ true flax, NZ linen flax	F	M				M	F	A						F			
Lobelia anceps	Punakura	New Zealand lobelia, shore lobelia	M		F		F	M											

Latin name	Māori name	Common name	S	C	V	P	B	S		C		V				P		B	W
									SS	WC	SC	WV	FV	HV	TV	SP			
Oxalis exilis		Creeping oxalis, yellow oxalis	A	A	F								M						
Parietaria debilis	Panapana	New Zealand pellitory	A	F	M			M			M								
Peperomia urvilleana		Peperomia		M															
Plantago raoulii				F(2)	F(2)														
Ranunculus acaulis		Sand or shore buttercup							F										
Ranunculus amphitrichus	Waoriki				F								F						
Ranunculus membranifolus					F								F						
Sarcocornia quinqueflora var. quinqueflora		Glasswort	M					F											
Scleranthus biflorus		Canberra grass		F(1)						F									
Stellaria parviflora		New Zealand chickweed			F								F						
Wahlenbergia gracilis		Harebell	M	F	F														
Wahlenbergia ramosa		Coastal harebell								M			F						
Wahlenbergia violacea		Violet harebell	F	M	M							M							

APPENDIX 2: Alphabetical order of contemporary names used in 2016 report

Name used in 2016 report	Original name used referenced material
Acianthus sinclairii	*Acianthus fornicatus*
Adiantum cunninghamii	*Adiantum affine*
Apium prostratum ssp. prostratum var. filiforme	*Apium australe*
Apodasmia similis	*Leptocarpus similis*
Asplenium appendiculatum ssp. appendiculatum	*Asplenium terrestre ssp. maritimum*
Asplenium oblongifolium	*Asplenium lucidum*
Asplenium polyodon	*Asplenium falcatum*
Astelia hastata	*Collospermum hastatum*
Austroderia toetoe	*Cortaderia toetoe*
Austroderia toetoe	*Toe toe*
Blechnum chambersii	*Lomaria lanceolata*
Blechnum discolor	*Lomaria discolor*
Blechnum filiforme	*Lomaria filiformis*
Blechnum fluviatile	*Lomaria fluvatilis*
Blechnum minus	*Lomaria capensis*
Blechnum parrisiae	*Doodia australis*
Blechnum penna-marina subsp. alpina	*Blechnum penna-marina*
Bolboschoenus caldwellii	*Scirpus caldwellii*
Blechnum zeelandicum	*Doodia squarrosa*
Brachyglottis kirkii var. kirkii	*Senecio kirkii*
Caladenia bartlettii	*Caladenia carnea agg.*
Caladenia alata	*Caladenia catenata*
Cardiomanes reniforme	*Trichomanes reniforme*
Carex banksiana	*Uncinia banksii*
Carex healyi	*Uncinia scabra*
Carex uncinata	*Uncinia uncinata*
Carmichaelia australis	*Carmichaelia arborea var.*
Centipeda elatinoides	*Centipeda orbicularis*
Chenopodium triandrum	*Rhagodia triandrum* *Einadia triandra*
Connorochloa tenuis	*Agropyron scabrum agg.*
Coprosma grandifolia	*Coprosma australis*
Coprosma repens	*Coprosma baueri*
Cyathea smithii	*Hemitelia smithii*
Deparia petersenii ssp. congrua	*Athrium japonicum*
Euchiton collinus	*Euchiton gymnocephalus* *Gnaphalium collinum*
Epilobium pedunculare	*Epilobium linnaeoides*
Euchiton japonicus	*Gnaphalium japonicum*
Ficinia nodosa	*Scirpus nodosus*
Freycinetia banksii	*Freycinetia baueriana spp. banksii*
Geniostoma ligustrifolium var. ligustrifolium	*Geniostoma rupestre var. ligustrifolium*
Histiopteris incisa	*Pteris incisa*

Hymenophyllum frankliniae	*Hymenophyllum ferriugineum*
Hymenophyllum revoltum	*Hymenophyllum tunbridgense*
Hypolepis ambigua	*Hypolepis tenuifolium*
Hypolepis rufobarbata	*Polypodium puctatum*
Isolepis cernua var. cernua	*Scirpus cernuus*
Isolepis inundata	*Scirpus inundatus*
Juncus edgariae	*Juncus gregiflorus*
Juncus kraussii var. australiensis	*Juncus maritimus var. australiensis*
Kunzea robusta	*Kunzea ericoides var. ericoides* *Leptospermum ericoides*
Lagenophora pumila	*Lagenophora forsteri*
Lastreopsis velutina	*Nephrodium velutinum*
Leptecophylla juniperina subsp. juniperina	*Cyathodes juniperina*
Leptinella dioica	*Cotula doica ssp. monoica*
Leptinella pusilla	*Cotula perpusilla*
Leptinella tenella	*Cotula membranacea*
Leucopogon fasciculatus	*Cyathodes fasciculata*
Lilaeopsis novae-zelandiae	*Lilaeopsis orbicularis*
Lobelia perpusilla	*Pratia perpusilla*
Loxogramme dictyopteris	*Anarthropteris lanceolata*
Melicytus crassifolius	*Hymenanthera crassifolia*
Melicytus obovatus	*Hymenanthera obovata*
Microsorum pustulatum ssp. pustulatum	*Phymatosorus diversifolius* *Phymatosorus pustulatus*
Microsorum scandens	*Phymatosorus scandens*
Myosotis brevis	*Myosotis pygmea var. minutiflora*
Notogrammitis billardierei	*Grammitis billardierei*
Notogrammitis heterophylla	*Ctenopteris heterophylla*
Olearia paniculata	*Olearia forsteri*
Olearia rani var. colorata	*Olearia cunninghamii*
Oxybasis glauca ssp. ambigua	*Chenopodium ambiguum*
Ozothamnus leptophylla	*Cassinia leptophylla*
Paesia scaberula	*Pteris scaberula*
Passiflora tetrandra	*Tetrapathea tetrandra*
Persicaria decipiens	*Polygonum decipens*
Poa billardierei	*Deyeuxia billardierei*
Poa cita	*Poa laevis*
Polyphlebium venosum	*Trichomanes venosum*
Polystichum neozelandicum ssp. zerophyllum	*Aspidium richardi*
Polystichum vestitum	*Aspidium vestitum*
Phlegmariurus varius	*Lycopodium varium*
Piper excelsum ssp. excelsum	*Macropiper excelsum var. excelsum*
Pseudognaphalium luteoalbum	*Gnaphalium luteoalbum*
Ranunculus amphitrichus	*Ranunculus rivularis*
Ranunculus membranifolus	*Ranunculus hirtus*
Raukaua anomalus	*Pseudopanax anomalus*
Raukaua edgerleyi	*Pseudopanax edgerleyi*

Rumohra adiantiformis	*Aspidium capense*
Schoenoplectus pungens	*Scirpus pungens*
Senecio wairauensis	*Erechtites prenanthoides*
Solanum nodiflorum	*Solanum americanum*
Sonchus kirkii	*Sonchus littoralis*
Sophora molloyi	*Sophora microphyllum var. (shrub)*
Spinifex sericeus	*Spinifex hirstutus*
Spergularia tasmanica	*Spergularia media*
Streblus banksii	*Paratrophis banksii*
Tetragonia implexicoma	*Tetragonia trigyna*
Thelymitra cyanea	*Thelymitra uniflora*
Typha orientalis	*Raupo*
Urtica perconfusa	*Urtica linearifolia*
Urtica sykesii	*Urtica incisa*
Veronica elliptica	*Hebe elliptica var. crassifolia*
Veronica parviflora	*Hebe parviflora* *Hebe arborea*
Veronica stricta var. macroura	*Hebe stricta var. macroura*
Veronica stricta var. stricta	*Hebe stricta var. stricta*
Veronica stricta var. stricta (atkinsonii)	*Hebe stricta var. atkinsonii*
Wahlenbergia violacea	*Wahlenbergia marginata*

APPENDIX 3: Alphabetical order of original names used in earlier reports

Original name used referenced material	Name used in 2016 report
Acianthus fornicatus	*Acianthus sinclairii*
Adiantum affine	*Adiantum cunninghamii*
Agropyron scabrum agg.	*Connorochloa tenuis*
Anarthropteris lanceolata	*Loxogramme dictyopteris*
Apium australe	*Apium prostratum ssp. prostratum var. filiforme*
Aspidium capense	*Rumohra adiantiformis*
Aspidium richardi	*Polystichum neozelandicum ssp. zerophyllum*
Aspidium vestitum	*Polystichum vestitum*
Asplenium falcatum	*Asplenium polyodon*
Athrium japonicum	*Deparia petersenii ssp. congrua*
Asplenium lucidum	*Asplenium oblongifolium*
Asplenium terrestre ssp. maritimum	*Asplenium appendiculatum ssp. appendiculatum*
Blechnum penna-marina	*Blechnum penna-marina subsp. alpina*
Caladenia carnea agg.	*Caladenia bartlettii*
Caladenia catenata	*Caladenia alata*
Carmichaelia arborea var.	*Carmichaelia australis*
Cassinia leptophylla	*Ozothamnus leptophylla*
Centipeda orbicularis	*Centipeda elatinoides*
Chenopodium ambiguum	*Oxybasis glauca ssp. ambigua*
Collospermum hastatum	*Astelia hastata*
Coprosma australis	*Coprosma grandifolia*
Coprosma baueri	*Coprosma repens*
Cortaderia toetoe	*Austroderia toetoe*
Cotula doica ssp. monoica	*Leptinella dioica*
Cotula perpusilla	*Leptinella pusilla*
Cotula membranacea	*Leptinella tenella*
Ctenopteris heterophylla	*Notogrammitis heterophylla*
Cyathodes fasciculata	*Leucopogon fasciculatus*
Cyathodes juniperina	*Leptecophylla juniperina subsp. juniperina*
Deyeuxia billardierei	*Poa billardierei*
Doodia australis	*Blechnum parrisiae*
Doodia squarrosa	*Blechnum zeelandicum*
Einadia triandra	*Chenopodium triandrum*
Epilobium linnaeoides	*Epilobium pedunculare*
Erechtites prenanthoides	*Senecio wairauensis*
Euchiton gymnocephalus	*Euchiton collinus*
Freycinetia baueriana spp. banksii	*Freycinetia banksii*
Geniostoma rupestre var. ligustrifolium	*Geniostoma ligustrifolium var. ligustrifolium*
Gnaphalium collinum	*Euchiton collinus*
Gnaphalium japonicum	*Euchiton japonicus*
Gnaphalium luteoalbum	*Pseudognaphalium luteoalbum*

Grammitis billardierei	*Notogrammitis billardierei*
Hebe arborea	*Veronica parviflora*
Hebe elliptica var. crassifolia	*Veronica elliptica*
Hebe parviflora	*Veronica parviflora*
Hebe stricta var. atkinsonii	*Veronica stricta var. stricta (atkinsonii)*
Hebe stricta var. stricta	*Veronica stricta var. stricta*
Hebe stricta var. macroura	*Veronica stricta var. macroura*
Hemitelia smithii	*Cyathea smithii*
Hymenanthera crassifolia	*Melicytus crassifolius*
Hymenanthera obovata	*Melicytus obovatus*
Hymenophyllum ferriugineum	*Hymenophyllum frankliniae*
Hymenophyllum tunbridgense	*Hymenophyllum revoltum*
Hypolepis tenuifolium	*Hypolepis ambigua*
Juncus gregiflorus	*Juncus edgariae*
Juncus maritimus var. australiensis	*Juncus kraussii var. australiensis*
Kunzea ericoides var. ericoides	*Kunzea robusta*
Lagenophora forsteri	*Lagenophora pumila*
Leptocarpus similis	*Apodasmia similis*
Leptospermum ericoides	*Kunzea robusta*
Lilaeopsis orbicularis	*Lilaeopsis novae-zelandiae*
Lomaria capensis	*Blechnum minus*
Lomaria discolor	*Blechnum discolor*
Lomaria filiformis	*Blechnum filiforme*
Lomaria fluvatilis	*Blechnum fluviatile*
Lomaria lanceolata	*Blechnum chambersii*
Lycopodium varium	*Phlegmariurus varius*
Macropiper excelsum var. excelsum	*Piper excelsum ssp. excelsum*
Myosotis pygmea var. minutiflora	*Myosotis brevis*
Nephrodium velutinum	*Lastreopsis velutina*
Olearia cunninghamii	*Olearia rani var. colorata*
Olearia forsteri	*Olearia paniculata*
Paratrophis banksii	*Streblus banksii*
Phymatosorus diversifolius	*Microsorum pustulatum ssp. pustulatum*
Phymatosorus pustulatus	*Microsorum pustulatum ssp. pustulatum*
Phymatosorus scandens	*Microsorum scandens*
Poa laevis	*Poa cita*
Polygonum decipens	*Persicaria decipiens*
Polypodium puctatum	*Hypolepis rufobarbata*
Pratia perpusilla	*Lobelia perpusilla*
Pseudopanax anomalus	*Raukaua anomalus*
Pseudopanax edgerleyi	*Raukaua edgerleyi*
Pteris incisa	*Histiopteris incisa*
Pteris scaberula	*Paesia scaberula*
Ranunculus hirtus	*Ranunculus membranifolus*

Ranunculus rivularis	*Ranunculus amphitrichus*
Raupo	*Typha orientalis*
Rhagodia triandrum	*Chenopodium triandrum*
Scirpus caldwellii	*Bolboschoenus caldwellii*
Scirpus cernuus	*Isolepis cernua var. cernua*
Scirpus inundatus	*Isolepis inundata*
Scirpus nodosus	*Ficinia nodosa*
Scirpus pungens	*Schoenoplectus pungens*
Senecio kirkii	*Brachyglottis kirkii var. kirkii*
Solanum americanum	*Solanum nodiflorum*
Sonchus littoralis	*Sonchus kirkii*
Sophora microphyllum var. (shrub)	*Sophora molloyi*
Spinifex hirstutus	*Spinifex sericeus*
Spergularia media	*Spergularia tasmanica*
Tetragonia trigyna	*Tetragonia implexicoma*
Tetrapathea tetrandra	*Passiflora tetrandra*
Thelymitra uniflora	*Thelymitra cyanea*
Toe toe	*Austroderia toetoe*
Trichomanes reniforme	*Cardiomanes reniforme*
Trichomanes venosum	*Polyphlebium venosum*
Uncinia banksii	*Carex banksiana*
Uncinia scabra	*Carex healyi*
Uncinia uncinata	*Carex uncinata*
Urtica incisa	*Urtica sykesii*
Urtica linearifolia	*Urtica perconfusa*
Wahlenbergia marginata	*Wahlenbergia violacea*

APPENDIX 4: Mana Island Comparative Botanical Assessment

MANA ISLAND COMPARATIVE BOTANICAL ASSESSMENT

Site: 1 - Motuhara Bush; 2 - Whitireia Park; 3 - Karehana Scenic Reserve; 4 - Taupo mire; 5 - Porirua Scenic Reserve;6 - Pipinui Point;7 - Smith's Gulley; 8 - Pukerua Bay - Wairaka Point; 9 - Little Brother Island; 10 - Kapiti Island

Key: P = Planted; X = Naturally Occurring			Site	3 - 10km Away					11 - 20km			20-30km	
Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
GYMNOSPERM TREES													
Dacrycarpus dacrydioides	Kahikatea	White Pine	P			X	X	X					
Dacrydium cupressium	Rimu	Red pine	P			X		X					
Podocarpus totara	Tōtara	Tōtara		X		X		X					
Prumnopitys ferruginea	Miro	Brown pine	P			X		X					X
Prumnopitys taxifolia	Matai	Black pine	P	X		X		X					X
MONOCOT TREES													
Cordyline australis	Tī kōuka	Cabbage tree	X	X	X	X	X	X	X	X	X		X
Rhopalostylis sapida	Nīkau	Nīkau	P	X				X					X
DICOT TREES/SHRUBS													
Alectryon excelsus var. excelsus	Tītoki	Tītoki	X	X	X	X		X			X		X
Aristotelia serrata	Makomako	Wineberry		X		X		X					X
Beilschmedia tawa	Tawa	Tawa	P	X	X	X		X					X
Brachyglottis repanda	Rangiora	Tree daisy	X	X		X	X	X	X	X			X
Brachyglottis kirkii var. kirkii	Kohurangi	Kirk's daisy											X
Carmichaelia arborea		South Island or swamp broom	X						X				X
Carmichaelia australis	Tainoka, taunoka	Common broom			X	X	X	X					
Carpodetus serratus	Putaputaweta	Marbleleaf				X		X					X
Coprosma areolata		Thin-leaved coprosma	X	X			X	X	X				X
Coprosma colensoi													X
Coprosma crassifolia					X			X					
Coprosma foetidissima	Hūpiro	Stinkwood, shit shrub						X					X

Coprosma grandifolia	Kanono	Kanono		X		X		X					X
Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Coprosma lucida	Karamū	Shining karamū	X	X		X		X	X				X
Coprosma propinqua var. propinqua	Mingimingi	Mingimingi	X		X	X	X	X	X	X	X		X
Coprosma repens	Taupata	Mirror leaf	X	X	X		X	X			X	X	X
Coprosma rhamnoides		Coprosma rhamnoides	X	X	X	X	X	X	X	X			X
Coprosma robusta	Karamū	Karamū	X		X		X	X		X			X
Coprosma rotundifolia						X		X					X
Coprosma tenuicaulis	Hukihuki	Swamp coprosma					X						X
Coriaria arborea var. arborea	Tutu	Tree tutu					X						X
Corynocarpus laevigatus	Karaka	Karaka	X	X	X	X		X		X	X		X
Discaria toumatou	Tūmatakuru	Matagouri, Wild Irishman											X
Dodonaea viscosa	Akeake	Akeake	P										
Dysoxylum spectabile	Kohekohe	Kohekohe	X	X	X	X		X			X		X
Elaeocarpus dentatus	Hīnau	Hīnau	P	X	X	X		X					X
Entelea arborescens	Whau	Cork tree	P	X									
Fuchsia excorticata	Kōtukutuku	Tree fuchsia				X	X	X					X
Geniostoma ligustrifolium var. ligustrifolium	Hangehange	New Zealand privet		X	X	X	X	X	X				X
Griselinia littoralis	Kāpuka	Broadleaf						X					X
Griselinia lucida	Puka	Broadleaf	X	X		X		X	X		X		X
Hedycarya arborea	Porokaiwhiri	Pigeonwood	P	X	X	X		X					X
Ileostylus micranthus	Pirita	Green mistletoe											X
Knightia excelsa	Rewarewa	New Zealand honeysuckle	P	X		X	X	X			X		X
Korthalsella salicornioides		Dwarf mistletoe											X
Kunzea robusta	Kānuka	White tea tree	X	X	X	X	X	X	X				X
Laurelia novae-zealandiae	Pukatea	Pukatea	P			X		X					X
Leptecophylla juniperina subsp. juniperina	Mingimingi	Prickly mingimingi	X			X			X	X			
Leptospermum scoparium	Mānuka	Tea tree	X	X	X	X	X	X	X		X		X
Leucopogon fasciculatus	Mingimingi	Tall mingimingi		X		X		X	X	X			X
Leucopogon fraseri	Pātōtara	Dwarf mingimingi	X		X		X		X	X			X

Lophomyrtus bullata	Ramarama	New Zealand myrtle			X	X	X	X					X
Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Lophomyrtus obcordata	Rōhutu	New Zealand myrtle				X			X				
Melicope simplex	Poataniwha							X					
Melicope ternata	Wharangi	Wharangi	X	X	*X*	X		X					X
Melicytus crassifolius		Thick-leaved mahoe			X	X			X				X
Melicytus obovatus			X									X	X
Melicytus ramiflorus	Māhoe	Whiteywood	X	X	X		X	X	X	X	X		X
Metrosideros robusta	Rātā	Northern rātā	X	X	X			X					X
Mida salicifolia	Maire taike	Willow-leaved maire						X					X
Muehlenbeckia astonii		Wigiwig	*X*										
Myoporum laetum	Ngaio	Ngaio	X	X	X	X	X	X	X	X	X	X	X
Myrsine australis	Matipo	Red mapou	X	X	X	X		X	X				X
Myrsine salicina	Toro	Toro						X					X
Nestegis cunninghamii	Maire rau nui	Maire rau nui						X					X
Nestegis lanceolata	Maire rauriki	White Maire		X		X		X					X
Nestegis montana	Maire kōtae or rōroro	Narrow-leaved maire											X
Olearia paniculata	Akiraho	Golden akeake	X	X		X		X	X	X	X		X
Olearia rani var. colorata	Heketara	Tree daisy		X		X	X	X					X
Olearia solandri		Coastal tree daisy	X		X	X	X	X	X	X	X		X
Ozothamnus leptophylla	Tauhinu	Cottonwood	X		X	X	X	X	X	X	X		X
Pennantia corymbosa	Kaikōmako	Kaikōmako	X	X	X	X	X	X	X	X			X
Pimelea aff. aridula (Pipinui point)									X				
Pimelea urvilleana ssp. urvilleana									X	X			X
Pimelea prostrata ssp. prostrata	Wharengāngara	Strathmore weed	X	X			X						X
Piper excelsum ssp. excelsum	Kawakawa	Pepper tree	X	X	X	X	X	X	X	X	X		X
Pittosporum cornifolium	Wharewhareatua	Perching pittosporum						X					X
Pittosporum crassifolium	Karo	Karo	P	X	X	X	X	X					X
Pittosporum eugenioides	Tarata	Lemonwood	P	X		X		X					X
Pittosporum tenuifolium	Kōhūhū	Black matipo	P	X	X	X	X	X					X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Plagianthus divaricatus	Mākaka	Saltmarsh ribbonwood	X								X		
Pomaderris phylicifolia	Tauhinu							X					
Pseudopanax arboreus	Whauwhaupaku	Five finger	P	X		X	X	X			X		X
Pseudopanax crassifolius	Horoeka	Lancewood	P	X		X							X
Pseudopanax lessonii (nat)	Houpara	Coastal five-finger					X						X
Pseudowintera axillaris	Horopito	Lowland horopito						X					X
Pseudowintera colorata	Horopito	Mountain horopito											X
Raukaua anomalus													X
Raukaua edgerleyi	Raukawa							X					X
Rhabdothamnus solandri	Taurepo	New Zealand gloxinia								X			
Schefflera digitata	Patē	Seven finger				X		X					X
Solanum aviculare var. aviculare	Poroporo	Poroporo	X					X			X		X
Solanum laciniatum	Poroporo	Poroporo	X	X		X	X	X		X			X
Sophora chathamica	Kōwhai	Coastal Kōwhai	P										
Sophora microphylla	Kōwhai	Kōwhai	P	X		X		X					
Sophora molloyi	Kōwhai	Cook Strait or Molloy's kōwhai	P										X
Streblus banksii	Turepo	Large leaved milk tree	X	X	X						X		X
Streblus heterophyllus	Turepo	Small leaved milk tree		X			X						
Syzygium maire	Maire tawake	Swamp maire											X
Urtica ferox	Ongaonga	Tree nettle					X	X	X		X		X
Veronica elliptica	Kōkōmuka	Shore hebe, shore koromiko										X	X
Veronica parviflora	Kōkōmuka tāranga, Koromiko			X							X		X
Veronica stricta var. stricta (atkinsonii)	Koromiko	Koromiko	P	X			X	X					X
Veronica stricta var. macroura	Koromiko		X						X	X			X
Veronica stricta var. stricta	Koromiko								X				X
Weinmannia racemosa	Kāmahi	Kāmahi					X						X
MONOCOT LIANES													
Freycinetia banksii	Kiekie	Kiekie	X	X		X		X					X
Ripogonum scandens	Kareao	Supplejack		X		X	X	X					X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
DICOT LIANES													
Calystegia sepium ssp. roseata	Rauparaha	Pink bindweed	X				X						
Calystegia soldanella	Panahi	Shore bindweed	X								X		X
Calystegia turguriorum	Pōwhiwhi	Climbing convolvulus	X		X		X						X
Clematis foetida						X							
Clematis forsteri	Puataua	Small white clematis	X	X	X	X	X	X	X		X		X
Clematis paniculata	Puawānanga	White clematis				X	X	X		X			X
Metrosideros colensoi	Rātā			X									
Metrosideros diffusa	Rātā	White rātā		X	X	X	X	X	X				X
Metrosideros fulgens	Akatawhiwhi	Scarlet rātā		X		X		X					X
Metrosideros perforata	Akatorotoro	Small white rātā	X	X	X	X	X	X	X	X			X
Muehlenbeckia australis	Pōhuehue	Large leaved muehlenbeckia	X	X	X	X	X	X		X			X
Muehlenbeckia complexa	Pōhuehue	Wire vine	X	X	X	X	X	X	X		X	X	X
Parsonsia heterophylla	Akakiore	New Zealand Jasmine	X	X	X	X	X	X	X		X		X
Passiflora tetandra	Kohia	Passion vine		X		X	X	X					X
Rubus australis	Taraheke	Swamp lawyer					X						X
Rubus cissoides	Tātarāmoa	Bush lawyer				X	X	X					X
Rubus schmidelioides var. schmidelioides	Taramoa	White leaved lawyer			X	X	X						
Tetragonia implexicoma	Kōkihi	NZ spinach	X				X	X	X	X	X		X
Tetragonia tetragonoides	Kōkihi	NZ spinach											X
CLUBMOSSES & QUILLWORTS													
Lycopodium volubile	Waewaekoukou	Climbing clubmoss											X
Phlegmariurus varius		Clubmoss											X
FERN & FERN ALLIES													
Adiantum cunninghamii	Puhinui	Common maiden hair	X	X		X	X		X	X			X
Adiantum diaphanum		Tuberous or small maidenhair	X		X	X	X		X	X			
Adiantum fulvum		Maidenhair				X							X
Adiantum viridescens		Maidenhair		X		X							
Anogramma leptophylla		Jersey fern, annual fern	X			X							

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Arthropteris tenella		Jointed fern		X	X	X			X				X
Asplenium appendiculatum ssp. appendiculatum		Ground spleenwort	X										X
Asplenium appendiculatum ssp. maritimum		Coastal spleenwort	X		X				X	X	X		
Asplenium bulbiferum	Pikopiko	Hen & chickens	P	X		X	X			X			X
Asplenium flabellifolium		Butterfly fern, necklace fern	X		X		X		X	X			X
Asplenium flaccidum	Makawe o Raukatauri	Hanging spleenwort	X		X	X	X		X			X	X
Asplenium gracillimum		Hen and chicken fern	X		X	X							X
Asplenium hookerianum var. hookerianum		Spleenwort	X	X	X	X	X		X	X			X
Asplenium oblongifolium	Huruhuruwhenua	Shining spleenwort	X	X	X	X	X		X	X	X	X	X
Asplenium obtusatum		Shore spleenwort								X			X
Asplenium polyodon	Petako	Sickle spleenwort	X	X	X	X	X						X
Azolla rubra		Pacific azolla, red azolla	X										X
Blechnum blechnoides		Shore hard fern							X				
Blechnum chambersii	Nini	Lance fern	X	X	X	X	X		X	X			X
Blechnum discolor	Petipeti	Crown fern				X							X
Blechnum filiforme	Pānako	Thread fern	X	X	X	X	X		X				X
Blechnum fluviatile	Kiwikiwi	Creek fern							X	X			X
Blechnum membranaceum			X			X							
Blechnum minus	Kiokio	Swamp kiokio	X			X	X		X	X			X
Blechnum nigrum		Black hard fern											X
Blechnum novae-zelandiae	Kiokio	Palm leaf fern	X	X	X	X							
Blechnum parrisiae		Rasp fern											X
Blechnum penna-marina subsp. alpina		Alpine hard fern	X						X				X
Blechnum procerum						X							
Botrychium australe	Pātōtara	Parsley fern											X
Botrychium biforme		Fine-leaved parsley fern											X
Cardiomanes reniforme	Raurenga	Kidney fern											X
Cheilanthes distans		Woolly cloak or rock fern									X		X
Cheilanthes sieberi ssp. sieberi		Rock fern							X		X		X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Cyathea cunninghamii	Pūnui	Gully tree fern		X		X							X
Cyathea dealbata	Ponga	Silver fern	X	X	X	X	X						X
Cyathea medullaris	Mamaku	Black tree fern	X	X	X	X	X		X	X			X
Cyathea smithii	Kātote	Soft tree fern											X
Deparia petersenii ssp. congrua													X
Dicksonia fibrosa	Whekī-ponga	Golden tree fern											X
Dicksonia squarrosa	Whekī	Whekī	X	X						X			X
Histiopteris incisa	Mātā	Water fern	X	X	X		X						X
Hymenophyllum atrovirens		Filmy fern											X
Hymenophyllum bivalve	Mauku	Filmy fern											X
Hymenophyllum demissum	Piripiri	Drooping filmy fern		X		X							X
Hymenophyllum dilatatum	Matua mauku	Filmy fern					X						X
Hymenophyllum flabellatum	Mauku	Filmy fern											X
Hymenophyllum frankliniae		Rusty filmy fern											X
Hymenophyllum lyallii		Filmy fern											X
Hymenophyllum multifidum	Mauku	Much-divided filmy fern											X
Hymenophyllum rarum	Mauku	Filmy fern	X										X
Hymenophyllum revoltum	Mauku	Filmy fern											X
Hymenophyllum sanguinolentum	Mauku	Filmy fern	X										X
Hymenophyllum scabrum		Rough filmy fern											X
Hypolepis ambigua			X		X				X	X			X
Hypolepis millefolium	Huarau	Thousand leaved fern											X
Hypolepis rufobarbata		Sticky pig fern	X						X				X
Lastreopsis glabella		Smooth shield fern		X	X	X	X						X
Lastreopsis hispida	Tuakura	Hairy fern				X							X
Lastreopsis microsora ssp. pentangularis						X							X
Lastreopsis velutina		Velvet fern	X	X	X	X							X
Leptolepia novae-zelandiae		Lace fern											X
Leptopteris hymenophylloides	Heruheru	Single crape fern											X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Lindsaea trichomanoides													X
Loxogramme dictyopteris		Lancefern		X		X							X
Microsorum pustulatum ssp. pustulatum	Pāraharaha	Hound's tongue	X	X	X	X			X	X	X		X
Microsorum scandens	Mokimoki	Climbing hound's tongue	X	X	X	X	X						X
Notogrammitis billardierei	Paretao	Common strap fern											X
Notogrammitis heterophylla		Comb fern											X
Ophioglossum coriaceum		Adders tongue											X
Paesia scaberula	Mātātā	Lace fern, ring fern	X		X	X	X			X			X
Pellaea rotundifolia	Tarawera	NZ cliff brake, button fern	X	X	X	X	X		X		X		X
Pneumatopteris pennigera	Pākauroharoha	Gully fern, feather fern		X		X	X		X	X			X
Polyphlebium endlicherianum						X							
Polyphlebium venosum		Veined bristle fern											X
Polystichum neozelandicum ssp. zerophyllum			X	X	X	X			X	X			X
Polystichum occulatum			X	X		X			X	X			
Polystichum silvaticum				X									X
Polystichum vestitum					X		X						X
Pteridium esculentum	Rārahu	Bracken	X	X	X	X	X		X	X	X		X
Pteris macilenta	Turawera	Shaking brake	X	X	X	X	X						X
Pteris tremula	Turawera	Shaking brake	X	X	X	X			X	X			X
Pyrrosia eleagnifolia	Ota	Leatherleaf fern	X	X	X	X	X		X	X	X		X
Rumohra adiantiformis	Karuwai	Leathery shield fern		X	X	X							X
ORCHIDS													
Acianthus sinclairii		Heart-leaved orchid, pixie cap				X	X			X			X
Bulbophyllum pygmaeum		Pygmy tree orchid	X							X			X
Caladenia alata		Mauve fingers					X						X
Caladenia bartlettii		Mauve fingers	X										
Chiloglottis cornuta		Bird orchid, ant orchid											X
Corybas macranthus		Spider orchid				X							
Corybas trilobus		Spider orchid											X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Dendrobium cunninghamii	Winika, pekapeka	Christmas orchid											X
Drymoanthus adversus		Drymoanthus			X								X
Earina autumnalis	Raupeka	Autumn orchid	X										X
Earina mucronata	Peka-a-waka	Bamboo orchid	X										X
Gastrodia cunninghamii	Perei	Black orchid											X
Microtis unifolia		Onion leaved orchid	X		X		X		X				X
Orthocerus novae-zeelandiae		Horned orchid					X						
Prasophyllum colensoi		Leek orchid											X
Pterostylis alobula		Greenhood	X			X	X						X
Pterostylis australis		Greenhood	X										X
Pterostylis banksii	Tutukiwi	Greenhood				X							X
Pterostylis graminea		Grass-leaved greenhood					X						X
Pterostylis montana		Greenhood	X				X						
Thelymitra longifolia	Maikuku	Common sun orchid	X		X	X	X		X	X			X
Thelymitra cyanea		Swamp or striped sun orchid											X
Thelymitra pauciflora	*Thelymitra cyanea*	Sun orchid					X						
GRASSES													
Austroderia fulvida	Toetoe	Toetoe	P							X			
Austroderia toetoe	Toetoe	Toetoe	P			X	X		X	X			X
Connorochloa tenuis		Prostrate blue grass										X	X
Dichelachne crinita		Long-hair plume grass					X						X
Echinopogon ovatus		Hedgehog grass			X		X						X
Festuca multinodis		Creeping fescue							X	X			
Hierochloe redolens	Karetu	Holy grass											X
Lachnagrostis filiformis		New Zealand wind grass											X
Lachnagrostis littoralis ssp. littoralis	*Lachnagrostis filiformis*	Coastal wind grass	X						X	X			
Lachnagrostis pilosa ssp. pilosa		Robust wind grass	X						X	X			
Microlaena avenacea		Bush rice grass		X		X							X
Microlaena stipoides		Slender rice grass	X	X	X	X			X	X			X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Poa anceps		Broad-leaved poa	X	X		X	X		X	X			X
Poa billardierei													X
Poa cita		Silver tussock	X				X		X	X	X	X	X
Poa imbecilla		Weak poa											X
Puccinellia stricta		Salt grass											X
Puccinellia walkeri		Walkers Saltgrass										X	
Rytidosperma clavatum		Bristle grass											X
Rytidosperma gracile		Dainty bristle grass											X
Rytidosperma petrosum		Cook Strait bristle grass											X
Rytidosperma unarede		Bristle grass	X										X
Spinifex sericeus	Kōwhangatara	Spinifex											X
Trisetum antarcticum			X										X
SEDGES													
Bolboschoenus caldwellii	Purua grass	Caldwell's clubrush											X
Carex banksiana		Fine-leaved bastard grass		X									X
Carex breviculmis		Grassland sedge	X		X		X						
Carex comans		Sedge											X
Carex cyanea		Bastard grass, hook grass							X				
Carex dissita		Forest sedge	X	X	X		X						X
Carex flagellifera		Trip me up, Glen Murray tussock	X	X	X	X	X		X	X	X		X
Carex forsteri		Forster's sedge		X					X				X
Carex geminata		Cutty grass	X	X			X		X		X		
Carex healyi		Harsh-leaved bastard grass				X							X
Carex imbecilla		Delicate bastard grass				X							
Carex lessoniana		Cutty grass			X		X		X				X
Carex Māorica	Makura	Māori sedge					X						
Carex pumila		Sand sedge											X
Carex raoulii		Coastal forest sedge	X										
Carex 'raotest'					X		X						X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Carex secta	Pukio	Niggerhead	P				X			X	X		X
Carex solandri		Forest sedge, solanders sedge		X		X	X						
Carex spinirostris		Coastal Sedge, Petrel Scrub Sedge											X
Carex testacea		Speckled sedge, trip me up	X	X									X
Carex uncinata	Matau a Māui	Hooked sedge		X		X	X		X	X			X
Carex virgata		Swamp sedge	X		X	X	X		X				X
Cyperus ustulatus f. ustulatus	Toetoe upokotangata	Giant umbrella sedge	X		X		X		X	X	X		X
Eleocharis acuta		Sharp spike sedge	X		X		X						X
Eleocharis gracilis		Slender spike sedge											X
Ficinia nodosa	Wiwi	Knobby club rush, ethel sedge	X				X		X		X		X
Gahnia pauciflora		Cutting sedge		X		X							X
Gahnia setifolia	Mapere	Giant Gahnia, Razor Sedge											X
Gahnia rigida		Gahnia	P										
Isolepis cernua var. cernua		Slender clubrush	X						X				X
Isolepis inundata			X										X
Isolepis prolifer			X		X		X		X	X			
Isolepis reticularis							X						
Lepidosperma australe		Square stemmed sedge											X
Machaerina rubiginosa		Baumea					X						
Machaerina tenax							X						
Schoenoplectus pungens		Three square											X
Schoenus maschalinus		Dwarf bog rush					X		X				
RUSHES & ALLIED SPECIES													
Apodasmia similis	Oioi	Jointed wire rush								X	X		X
Juncus australis	Wiwi	Leafless rush	X						X				X
Juncus caespiticius		Grass-leaved rush			X								X
Juncus distegus		Two storey rush	*X*		*X*								
Juncus edgariae		Edgars rush	X		X				X				X
Juncus kraussii var. australiensis		Sea rush											X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Juncus pallidus		Giant rush, leafless rush	X		X					X	X		X
Juncus planifolius		Grass-leaved rush	X		X				X				X
Juncus sarophorus		Fan flowered rush	X										X
Luzula banksiana var. banksiana		Coastal woodrush	X						X	X		X	X
Luzula banksiana var. migrata		Woodrush									X		
Luzula picta var. picta			X		X								
MONOCOT HERBS OTHER THAN ORCHIDS, GRASSES, SEDGES													
Arthropodium candidum	Rengarenga	New Zealand lily, bush lily	X	X					X				X
Arthropodium cirratum	Rengarenga	Renga lily, Rock lily	X										X
Astelia fragrans	Kakaha	Bush flax, bush lily				X			X				X
Astelia hastata	Kahakaha	Kahakaha								X			X
Astelia solandri	Kōwharawhara	Perching astelia				X							X
Dianella nigra	Tūrutu	New Zealand Blueberry	X	X		X							X
Lemna minor	Kārearea	Common duck weed					X		X				
Libertia grandiflora	Mīkoikoi	New Zealand iris	X	X		X							X
Libertia ixioides	Mīkoikoi	New Zealand iris											X
Phormium cookianum ssp. hookeri	Whaririki	Mountain flax	X			X			X	X	X		X
Phormium tenax	Harakeke	Flax	X	X			X						X
Potamogeton cheesemanii		Red pond weed											X
Ruppia megacarpa		Horses mane weed, lakeweed											X
Typha orientalis	Raupō	Bullrush					X						X
Triglochin striata		Triglochin	X										X
DAISY-LIKE HERBS (COMPOSITES)													
Centipeda elatinoides		Sneezeweed, snuff weed											X
Cotula australis		Common cotula, soldier's button	X				X						X
Cotula coronopifolia		Bachelors button, yellow buttons	X				X						X
Craspedia uniflora var. maritima		Woolyhead	X						X	X			
Euchiton audax			X		X		X		X		X		X
Euchiton collinus		Cudweed	X		X		X		X				X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Euchiton involucratus					X		X						X
Euchiton japonicus													X
Euchiton sphaericus			X	X									
Helichrysum filicaule		Creeping slender everlasting daisy	X										X
Lagenophora pumila	Papataniwhaniwha								X				X
Leptinella dioica		Shore cotula											X
Leptinella dispersa ssp. dispersa									X				
Leptinella pusilla													X
Leptinella tenella			X										X
Microseris scapigera									X	X		X	
Pseudognaphalium luteoalbum			X						X		X	X	X
Raoulia sp.			X										
Raoulia hookeri var. hookeri		Scabweed mat daisy							X	X			
Senecio glomeratus ssp. glomeratus		Fireweed	X		X		X						X
Senecio hispidulus		Fireweed	X		X		X		X				X
Senecio lautus var. lautus		Shore or variable groundsel	X						X		X		X
Senecio minimus		Fireweed	X			X							x
Senecio quadridentatus		Cotton or white fireweed					X						x
Senecio rufiglandulosus										X			x
Senecio sterquilinus		Guano groundsel	X									X	
Senecio wairauensis		Mountain fireweed											X
Sonchus kirkii	Pūhā, raurōroa	New Zealand sow thistle	X							X			X
Sonchus novae-zelandiae												X	
Taraxacum magellanicum		NZ dandelion, native dandelion											X
Vittadinia australis		White fuzzweed	X						X		X		X
DICOT HERBS OTHER THAN COMPOSITES													
Acaena anserinifolia	Hutiwai	Bidibidi	X				X		X	X			X
Acaena novae-zelandiae		Red Bidibid							X				
Aciphylla squarrosa var. squarrosa		Spaniard, speargrass	X						X	X			

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Apium prostratum ssp. prostratum var. filiforme		New Zealand celery	X	X					X			X	X
Atriplex buchananii		Buchanan's orache										X	
Cardamine debilis agg.		NZ bitter cress	X	X	X		X						X
Centella uniflora			X		X	X	X		X				X
Chenopodium allanii													X
Colobanthus muelleri		Centella	X						X				X
Crassula moshata		Shore stonecrop									X	X	
Crassula sieberiana		Sundew					X		X	X			X
Daucus glochidiatus		native carrot, New Zealand carrot											X
Dichondra brevifolia agg.		Dichondra							X				X
Dichondra repens		Mercury bay weed	X		X	X			X	X	X		X
Disphyma australe ssp. australe	Horokaka	Native ice plant	X						X	X	X	X	X
Drosera auriculata													
Einadia triandra		Pigweed	X								X	X	
Epilobium alsinoides		Willowherb											X
Epilobium bilardiereanum		Willowherb											X
Epilobium chionanthum		Marsh willowherb											X
Epilobium cinereum		Willowherb											X
Epilobium insulare		Willowherb							X				
Epilobium nerteroides													X
Epilobium nummulariifolium		Creeping willowherb	X						X	X			X
Epilobium pallidiflorum		Swamp willowherb					X						X
Epilobium pedunculare		Long-stalked willowherb											X
Epilobium pubens		Willowherb											X
Epilobium rotundifolium		Round-leaved willowherb							X				X
Euphorbia glauca	Waiū-atua	Shore or sea spurge, sand milkweed	X										
Euphrasia cuneata		North Island eyebright											X
Galium propinquum			X		X		X						X
Galium trilobum		Native bedstraw					X						X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Geranium breivcaule			X										
Geranium microphyllum			X				X						X
Geranium sessiliflorum var. arenarium		Short-flowered cranesbill	X						X				
Geranium solanderi		Solanders geranium	X		X								
Gonocarpus aggregatus									X				
Gonocarpus incanus			X										
Gonocarpus montanus							X						
Haloragis erecta ssp. erecta	Toatoa	Fireweed, shrubby haloragis	X	X			X		X	X			X
Hydrocotyle heteromeria		Waxweed, waxweed pennywort	X		X	X	X						X
Hydrocotyle moschata var. moschata		Hairy pennywort	X	X	X	X	X		X	X	X		X
Hydrocotyle novae-zelandiae var. novae-zelandiae					X								X
Lepidium olearaceum	Nau	Cook's scurvy grass	X									X	X
Lepidium tenuicaule		Shore cress											X
Leptostigma setulosum									X				
Lilaeopsis novae-zelandiae			X										X
Limosella lineata		Mudwort											X
Linum monogynum var. monogynum	Rauhuia	NZ true flax, NZ linen flax	X						X	X	X	X	X
Lobelia anceps	Punakura	NZ lobelia, shore lobelia	X		X				X	X			X
Lobelia angulata		Pratia							X				
Lobelia perpusilla													X
Myosotis brevis													X
Myriophyllum propinquum		Common water milfoil											X
Nertera depressa	*Myriophyllum propinquum*	Bead plant, fruiting duckweed							X				X
Oxalis exilis		Creeping oxalis, yellow oxalis	X		X	X			X	X			X
Oxalis magellanica		White oxalis							X				
Oxybasis glauca ssp. ambigua													X
Parietaria debilis	Panapana	New Zealand pellitory	X		X								X
Pelargonium inodorum	Kopata						X				X		X
Peperomia urvilleana		Peperomia	X								X		X

Latin name	Māori name	Common name	Mana Island	1	2	3	4	5	6	7	8	9	10
Persicaria decipiens													X
Plantago raoulii			X						X				X
Potentilla anserinoides		Silverweed											X
Ranunculus acaulis		Sand or shore buttercup	X										X
Ranunculus amphitrichus	Waoriki		X										X
Ranunculus macropus		Swamp buttercup					X						
Ranunculus membranifolus			X			X	X						X
Ranunculus reflexus	Maru	Hairy buttercup			X								
Rumex flexuosus	Runa	Māori dock, NZ dock											X
Samolus repens var. repens		Sea primrose, shore pimpernel							X	X			X
Sarcocornia quinqueflora var. quinqueflora		Glasswort	X								X	X	X
Scandia geniculata		Scandia											X
Scleranthus biflorus		Canberra grass	X						X				X
Selliera radicans	Remuremu	Selliera											X
Solanum nodiflorum		Small flowered nightshade			X								X
Spergularia tasmanica		New Zealand sea spurrey, native sea spurrey											X
Stellaria decipiens var. decipiens				X	X	X							
Stellaria parviflora		New Zealand chickweed	X			X	X					X	X
Suaeda novae-zelandiae		Sea blite										X	
Urtica sykesii	Ongaonga	Scrub nettle											X
Urtica perconfusa		Swamp nettle					X						
Viola cunninghamii		Mountain or white violet											X
Viola filicaulis		Forest violet								X			
Wahlenbergia ramosa		Coastal harebell	X										
Wahlenbergia violacea		Violet harebell	X										X

APPENDIX 5. Waikoko Wetland Workings (explanation J. Christensen) by L. Clapcott

FRIENDS OF MANA ISLAND
MANA ISLAND FLORAL DIVERSITY PROJECT

Waikoko Wetland Site Visit - 9 April 2016

Present:

Linda Kerkmeester – FOMI project manager
Jason Christensen – DOC ranger during and post wetland construction
Matt Ward – botanical advisor
Jeff Hall – current DOC ranger (present for some of visit)
Lisa Clapcott – project contractor

The site visit was undertaken to record more detailed information from Jason Christensen, former ranger, on the original design and intended hydrology of the wetland and the changes implemented and observed as the constructed wetland settled over time.

It has been difficult to consider any current floral diversity actions for the wetland due to the long term changes and seasonal fluctuations in hydrology. In general, the wetland is drier than was anticipated, due to siltation, maintenance changes and other unknown factors, possibly maturity of vegetation throughout catchment and climate cycles/changes.

The visit travelled from top to bottom ponds through the four small catchments of the wetland system. The following notes attempt to summarise the information gleaned from Jason, along with recording thoughts and discussion around weed control and floral improvement for the wetland (Figure 44).

House Valley Pond

- Never dried out historically
- Becoming drier and vegetated as years pass
- Discovered the cause at base of pond - dam wall blown out, either by one or several flood events
- Could be repaired with rocks and then silt from 'Jason's' pond, which has been deposited from this catchment (effectively moving the silt back up the catchment). Will need to be monitored as it could occur again
- Jason noted the black nutrient input from shag and starlings roost.
- Site of large karaka, possibly culturally significant for iwi.

Aston's/Kaikōmako Reservoir

- Original function was to hold water to manage flow further down the system.
- Completely dry at present with signs of increasing siltation and vegetation. Jeff has noted there is only water in the pond in winter.
- Unlikely the flow is ever reaching the concrete overflow at the east end of the pond but cannot be sure as we don't know enough about the year round water levels now.
- Also another small overflow area on the true left side of pond.
- Healthy and truncating *Carex secta* indicate there is still a good level or moisture at the site of captured underground spring water.
- Potential volunteer task – check pond levels and photograph each volunteer trip (trip leader more likely to be appropriate for continuity).
- Noted that we should check the NIWA rainfall records to inform the questions we have regarding changes over time.

Jason's Pond

- Receives flow from House, Aston's and Kaikōmako Valleys
- In recent years the pond has been silting up badly and dries out completely in summer (main cause now known as the house Valley pond blow out).
- Teal use it when wet and several of us have seen pairs with ducklings each spring on the pond
- Repairing the dam with the silt from this pond should improve water levels here but in the short term it may still be wise to focus on edge plants which can withstand variable water levels. *Cotula coronopifolia* (bachelor's button) is doing well here and will retreat back to the edge when water levels rise
- The main current/flow (when flowing) runs out of Jason's pond past the top house through to the wetland complex. Rare *Gahnia rigida* is also along this flow route

Pond below 'Bypass'

- This part of system is meant to be as natural as possible, but extra wingwalls, weir gates and pipes were requested additions by designers and consultants post construction once the system had been observed for a time. In theory this seemed sensible but in practice, water wasn't held effectively anyway.
- Most of the *Gahnia rigida* was pulled out by takahe or Pūkeko so it could be assumed if more were planted with large guards, this could continue to be a good site for more *Gahnia rigida*.

Overflow routes to sewerage pipe zone

- This part of system travels on the eastern edge of system to the area by the generator shed where all catchment flow meets before the sea outlet
- This area had been considered for an access point for a central wetland walk - to access the wetland more and direct public away from buildings and associated infrastructure. Access could potentially be from the old '250,000 plants' sign area via the original stock route from the wharf
- *Plagianthus divaricatus* (saltmarsh ribbonwood) is doing well along this route

RETURNING UPHILL TO FOLLOW WETA VALLEY AND SOUTH VALLEY FLOWS

Lower Weta Valley Pond

- Taps installed here run to southern wetland area (by plant nursery and takahe pens) to top up from a 'permanent' open water pond. No longer permanently wet. More signs of siltation and increased vegetation
- As with Jason's pond, this is the only other part of wetland seen closely by public
- Some culverts/overflows require clearing here. Easily blocked up with sticks and vegetation
- Some large wetland trees such as Pukatea planted here
- Silt cakes could be manually moved back to edges in late summer and eventually planted on (appropriate edge profiles need to be considered)
- Flows into an area intended as ephemeral

Ephemeral zone

- The start of this zone and Upper Overflow receive quite heavy silt loading. Manual removal of silt may be the only way to keep this functioning as per intention. Or is it acceptable to allow it to become more terrestrial over time?
- This area was meant to dry up first but system seems to have changed and it now seems to have water in it before some of the others
- Some open areas of grass good for teal. Weed control not really efficient at this height as the water will control much of it during winter anyway
- Edge plantings doing well despite some seasonal encroachment of *Calystegia silvatica* (Bindweed).
- This is another area where silt cakes could be moved to the edge (or islands) for future plantings (consider increased weed risk with higher exposed soil)

Spillway

- Not as much silt in this part of the system.

- The overflow pipe at the south east of the area takes half of the catchment water. This flows into another overflow, the drain running by the generator shed and sewerage ponds
- The lower outlet has been carved out lower over time and could easily be raised to improve the water level in this area

Flood plain

- Intended as flood plain for Weta Valley (two ponds here)
- Plagianthus divaricatus, Cyperus ustulatus, and Austroderia species are doing very well here. Good fern-bird habitat
- Only zone where Juncus species are a little more numerous
- Between Flood plain and Lower Overflow, the culvert (by southern track) is silted up half way. Weta Valley catchment has fine silty soil which moves easily through both natural and man-made parts of the catchment. A large drain was put in as a simple silt trap and it was filled in only two years. This was manually cleared for two years following. This will not sustain water flow long term without management.

Lower Overflow

- Re-iterated that we need to re-visit these levels in winter to be better informed
- The exit outlet running to the sea travels through a culvert just north of the Lockwood. This outlet (if open) takes the combined flow from the catchments. Note, the Lockwood is sitting on one of the lowest points on the island and has had flood water through the piles at times

Wetland Lookout

- No longer able to view much of the wetland system - becoming less relevant to the signage
- Some removal and/or trimming of common tree and shrub species would improve the educational experience here
- Noted that hybrid *Pseudopanax* should be controlled around this area. Main seed source probably from tree directly adjacent to bottom track to wetland lookout
- Suggestion that hide could be moved to a more accessible site

General comments

- It was agreed that small projects in targeted area would result in meaningful outcomes. If effort is spread too widely, there may not be any effective long term improvement and will be difficult for project managers and staff to implement, especially if many volunteers are new to the island and tasks in the wetland
- When discussing improvement to wetland vegetation, it is important to distinguish edge health with floral diversity.
- Calystegia silvatica (Bindweed) has been on the site before the wetland construction. It dies back in winter and we don't actually know whether it is increasing its range now the wetland has settled (even though it is suspected). Choosing a drier, less sensitive area with exotic species as ground cover would be a good way to trial control. Ideally, pulling off vines, allowing to recover a few weeks and following up with herbicide spray and paste control off native plants could be worth trialling. There are tensions with timing for this work, however, as the best time to do it would be late summer when wetland at its driest. The bindweed is dying off at this point and herbicide control is more likely to only create resistance to the toxin. February may be an option.
- Risks using volunteers for weed control were noted. Tasks should be chosen which pose almost no risk to native flora and fauna. A cautionary approach would be best (E.g. we are not sure where Teal are nesting. Plant ID skills and close supervision are required).
- Old wetland photographs collated and digitised could be useful for project files to illustrate changes over time. There is a brief un-edited film available for viewing if required (J. Christensen, *pers. comm.*, 2016).

APPENDIX 6. Wetland plant species for a restored wetland on Mana Island (Miskelly, 1999)

Wetland plant species that may be suitable for a restored wetland on Mana Island
(Miskelly, 1999)
Note that water chemistry will dictate the mix of species that could be planted. For example, raupo and *Carex Māorica* require high pH and high fertility, while *Drosera, Utricularia* and *Lycopodium* require low pH and low fertility. Some species grow readily in more than one habitat, so th e di visions below are not clear-cut. All are species appropriate for the ecological district.

	BASIC SPECIES (to give community structure)	THREATENED SPECIES
Brackish water	*Juncus maritimus* *Leptocarpus similis* *Bolboschoenus caldwellii* *Schoenoplectus pungens* shore ribbonwood	*Leptinella dioica* ssp. *monoica* *Mimulus repens* *Schoenus nitens* *Carex litorosa* *Baumea juncea*
Freshwater, constant water level (permanently wet?)	*Typha orientalis* *Phormium tenax* *Carex secta* *Coprosma tenuicaulis* *Coprosma propinqua* *Leptospermum scoparium* (wetland ecotype) *Gahnia xanthocarpa* *Austroderia toetoe* *Carex Māorica*	*Ranunculus macropus* *Epilobium pallidiflorum* *Epilobium chionanthum* *Drosera binata* *Polygonum salicifolium* *Hypolepis distans* *Myriophyllum robustum* *Carex diandra* *Galium trilobum* *Hydrocotyle pterocarpa*
Freshwater, fluctuating water level	*Lilaeopsis novae-zelandiae* *Ranunculus limosella* *L. ruthiana* *Limosella lineata* *Myriophyllum propinquum*	*Glossostigma dimorphum* *Potamogeton pectinatus* *Mazus novae-zelandiae* *Lepilaena bilocularis* *Elatine gratioloides* *Myriophyllum votschii* *Sebaea ovata*
Wet edge	*Olearia solandri* *Coprosma rigida*	*Leptinella tenella* *Rorippa palustris* *Rumex flexuosa* *Callitriche muelleri* swamp nettle *Gleichenia microphylla* *Gahnia rigida* *Carex dipsacea* *Gratiola sexdentata* *Mentha cunninghamii* *Carex sinclairii* *Deparia petersenii* *Ophioglossum coriaceum* swamp maire *Gunnera prorepens*

APPENDIX 7. Correspondence from Phil Marsh re: Takahe & Open grassland - May 9th 2016

Hi Matt,

Thanks heaps for sending this reminder through- much appreciated. In summary, takahē are extremely vulnerable to being closed out of previously suitable habitat by revegetation programmes. We're beginning to see the results of island restoration projects closing takahē out on a gradual basis. This is not something that will happen quickly on an island the size of Mana but sites such as Kapiti and Tiritiri Matangi are good examples of islands that have become less suitable for takahē over time. If Mana Island were to be left with no vegetation management then in 10 years the capacity for breeding pairs may be down to 7 pairs, in 20 years this may be down to 5 pairs etc.

We would be extremely supportive of FOMI supporters maintaining the vegetation at a level that is not detrimental to takahē. Obviously this is very difficult to measure but maybe could be done with some aerial photographs? A few years ago I utilised some aerial photographs comparing Kapiti Island in 1987 vs 2013. This showed a marked increase in ground cover vegetation on site and showed why it was likely that less takahē were surviving on Kapiti then compared to the 1990's (though there are naturally other factors such as translocations on/off to consider here).

I wonder if a mark in the sand could be placed on current vegetation levels and some assurance that no further grassland be allowed to disappear from what is currently there? We know that currently Mana has the ability to hold 10+ breeding pairs of takahē (I would say 11 pairs would be the most but this may be unrealistic with current resources available for them). If this could be maintained then the takahē management team would be extremely comfortable with the fact that future population levels would not be impacted upon. If Mana Island were to be left with no vegetation management then in 10 years the capacity for breeding pairs may be down to 7 pairs, in 20 years this may be down to 5 pairs. Currently Mana Island holds the biggest number of breeding pairs out of any secure site in New Zealand (excluding the Burwood takahē centre) so it is an extremely important site to the takahē management team and we have been thankful for its existence.

These views come from an entirely biased takahe view, however Mana Island stakeholders such as FOMI need to decide where they see the future of Mana being most suited. If that is Mana Island becoming completely forest covered then takahē will not be suited to that environment as takahē and forest do not mix. However if the current levels of vegetation could be maintained at 2016 levels or very similar then there is no reason that 10+ breeding pairs of takahē will not still be present in 20 years time.

I hope that helps you in your future direction. Please let me know if you require any further thoughts. I am occasionally up in Wellington for takahē work so would be more than happy to come and give a presentation on takahē recovery to FOMI if it was useful?

Cheers,
Phil

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