

Native plants of the Ōtuataua lava field, Ihumātao, South Auckland

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Geology (mainly from Hayward 2019)

Ōtuataua is one of a cluster of Auckland's small, monogenetic, basaltic volcanoes centred on the Ihumātao Peninsula in South Auckland. Its eruption, about 15,000 years ago, was initially phreatomagmatic, forming an encircling tuff ring and adjoining ash field, to the south of the vent. Later, dry-style eruptions built a scoria cone of about 60 m in height within the tuff ring. Lava flows spilled from the western edge of the cone and fanned out in a westerly direction. The Ōtuataua lava flows met the slightly older Puketapapakanga a Hape (Pukeiti) lava field to the north, the much older ash fields of Maungataketake to the south, and formed a rocky shoreline of the Manukau harbour to the west. The lava field covers about 50 ha.

History and context

The Ihumātao Peninsula and its volcanoes have a long history of human occupation. The Ōtuataua lava fields retain the largest and most intact pre-pakeha agricultural landscapes in contemporary Auckland. The landscape represents hundreds of years of Māori occupation prior to the arrival of Europeans to New Zealand (Hayward 2019). Complex and sophisticated gardening systems of this kind once covered some 8000 ha of lava field and volcanic ash deposits across the Auckland volcanic field (Gravis et al. 2017), but nearly all of this has been lost to the development of the city. Similar remnants exist on the lava fields of Maungarei (Mt. Wellington), Te Pane o Mataoho (Māngere), Matukutūruru (Wiri Mountain) and Matukutūreia (McLaughlins Mountain). Stone

heaps, low dry-stone walls and middens are the most prominent archaeological features of the Ōtuataua lava fields today.

The established garden systems at Ōtuataua were re-adapted for European crops and animal farming once these were introduced to the area prior to the mid-1840's. Cultivation of traditional crops, namely kumara (*Ipomoea batatas*), continued throughout this period (Mackintosh 2021). Traditional gardening practices ceased on the Ōtuataua lava fields in 1863, after Māori communities at Māngere, Ihumātao and Pūkaki were evicted from the land at the beginning of the Waikato War. After being confiscated by the Government in 1864, the lava fields at Ōtuataua were subdivided and sold to British immigrants (Mackintosh 2021). Dairying became the major land use from the late nineteenth century (Heritage NZ Ōtuataua Stonefields). Vestiges that remain from early Pakeha farmers include the large dry-stone walls (Fig. 1), hedgerows of barberry (*Berberis glaucophylla*) and a few specimen trees.

Quarrying has had a major effect on the Ōtuataua volcano. The cone was quarried away during the twentieth century, right up until the late 1990s. On the lava fields, quarries operated between 1950 and the 1970s (Hayward 2019). In 1999 the lava fields of Ōtuataua, the remnants of its cone and tuff ring (along with the partially-quarried cone) and the lava fields of neighbouring Puketapapakanga a Hape, were purchased by the Manukau City Council as the publicly accessible Ōtuataua Stonefields Historic Reserve. Since then, the volcano has enjoyed a



Fig. 1. Rock forest (right) and open lava field (foreground and left). Photo: 22 July 2017. The dry-stone wall is one of many at Ihumātao that were built by Pakeha farmers post-1864 (Mackintosh 2021). All photos by the author.



Fig. 2. *Pellaea falcata*. 3 Dec 2018.

degree of protection and management. Introduced plants, especially kikuyu (*Cenchrus clandestinus*), appear to be the most significant threat to the native flora at the current time. Cattle are grazed consistently on the south-western side of the lava field, with sporadic access given to the other areas. Hares (*Lepus europaeus*) and possums (*Trichosurus vulpecula*) are common mammalian herbivores in the area.

History of botanical study and collections

Ewen Cameron provided the first written botanical record of the Ōtuataua lava fields in 1991 (Cameron 1991). Cameron's paper described an area of rock forest and highlighted the presence of māwhai (*Sicyos australis*). In 2001, an Auckland Botanical Society field trip led by Mike Wilcox produced a good preliminary species list of both native and adventive plants (Preston Jones 2001). A second Auckland Botanical Society (ABS) field trip was undertaken on 20 November 2021 (27 attendees – see Acknowledgements). Most of the herbarium specimens collected from the Ōtuataua lava field are relatively recent. This is partially attributable to the use of the name 'Otuataua' which was not used for specimens prior to 1999. Instead, earlier collections use the locality 'Ihumatao', which incorporates the much larger surrounding area. The accompanying species lists (Appendix 1 (native vascular plants); Appendix 2 (adventive vascular plants); Appendix 3 (non-vascular plants)) incorporate all previous literature and herbarium records, as well as new records from the 2021 ABS field trip and my own

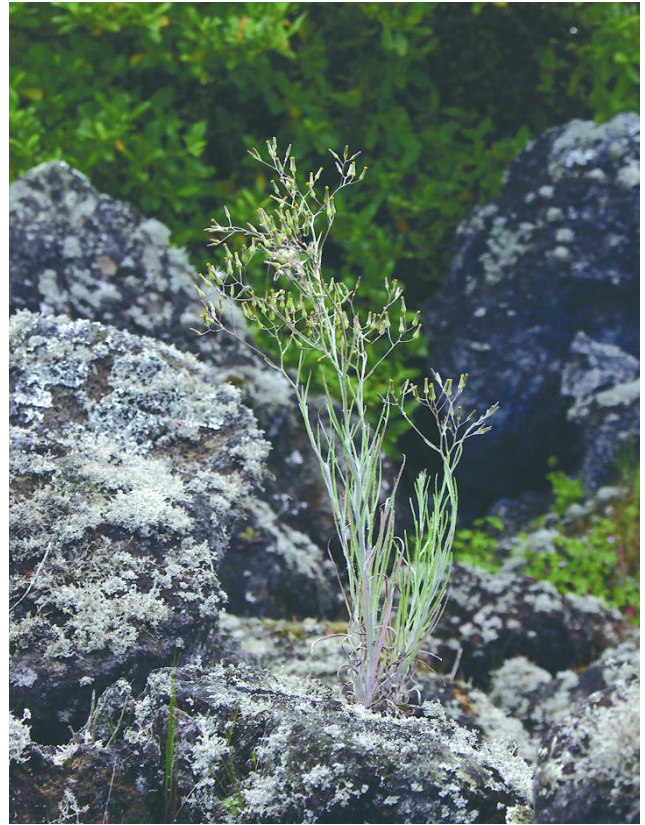


Fig. 3. *Senecio quadridentatus*. 3 Dec 2018.

observations made during numerous trips between 2016 and 2021. Herbarium specimens collected from 'Ihumatao', without further detail, have been omitted to avoid potential confusion.

Rock forest copses

In several areas of the Ōtuataua lava field, native trees form small pockets of rock forest (Fig. 1). These copses mostly grip to steep, sloping ground, or shallow rubbly valleys. The comparatively rugged topography of the Ōtuataua lava field appears to have been important for retaining forest into the contemporary time. Lava fields at Ambury Regional Park (Te Pane o Mataoho lava field) and Puketapapakanga a hape, which have similar histories but are flatter in contour, no longer support this kind of vegetation. Trees of the rock forest at Ōtuataua are titoki (*Alectryon excelsus*), *Coprosma macrocarpa*, karaka (*Corynocarpus laevigatus*), whau (*Entelea arborescens*), pigeonwood (*Hedycarya arborea*), māhoe (*Melicytus ramiflorus*), ngaio (*Myoporum laetum*) and pūriri (*Vitex lucens*). Where the canopy is expansive enough to provide a good level of shade, *Coprosma macrocarpa*, kawakawa (*Piper excelsum*) and some hangehange (*Geniostoma ligustrifolium*) form a good sub-canopy. The bouldery ground of the rock forest copses have a good diversity of small native plants. Ferns are represented by jointed fern (*Arthopteris tenella*), necklace fern (*Asplenium flabellifolium*), hanging spleenwort (*Asplenium flaccidum*), shining spleenwort (*Asplenium oblongifolium*), kowaowao (*Microsorium pustulatum*), tarawera (*Pellaea*

rotundifolia), shaking brake (*Pteris tremula*) and leather-leaf fern (*Pyrrhosia elaeagnifolia*). Other plants include *Peperomia urvilleana*, kahakaha (*Astelia hastata*) and meadow rice grass (*Microlaena stipoides*). Kōwharawhara (*Astelia solandri*) was present in these rock forests until at least October 2017 but appears to be absent now.

Open lava field

Most of the Ōtuataua lava field is unshaded by trees. Much of this open, exposed and rubbly landscape is swathed in exotic grassland, with increasing amounts of kikuyu (pers. obs. since 2016). Despite the abundance of exotic plants, indigenous species are still plentiful. All of the trees which form the rock forest copses are also found as scattered, wind-battered individuals on the open lava field. Other trees present in this habitat are a few pōhutukawa (*Metrosideros excelsa*), *Coprosma macrocarpa* x *C. propinqua*, taupata (*Coprosma repens*) and karo (*Pittosporum crassifolium*).

Ferns are particularly diverse and abundant on the open lava fields at Ōtuataua. The most common species are rosy maidenhair (*Adiantum hispidulum*), jointed fern, necklace fern, shining spleenwort, woolly cloak fern (*Cheilanthes distans*), rasp fern (*Doodia australis*), sickle fern (*Pellaea falcata*) (Fig. 2), tarawera, bracken (*Pteridium esculentum*), shaking brake and leather-leaf fern. Ferns in lower quantity include sickle spleenwort (*Asplenium polyodon*), rock fern (*Cheilanthes sieberi*), *Doodia squarrosa* and prickly shield fern (*Polystichum neozealandicum*). On the open lava fields, ferns typically grow amongst loose basalt rubble or in crevices between broken slabs of lava. Some species, notably *Cheilanthes*, occur unprotected, atop boulders.

Erect herbs, notably Australian fireweed (*Senecio bipinnatisectus*), Esler's fireweed (*Senecio esleri*), *Senecio hispidulus*, pahokoraka (*Senecio quadridentatus*) (Fig. 3) and dark nightshade (*Solanum opacum*), are seasonally prominent, especially in rubbly areas, such as old stone heaps. Smaller native herbs of open situations include *Crassula colligata*, *Crassula sieberiana*, Thompson's oxalis (*Oxalis thompsoniae*), Jersey cudweed (*Pseudognaphalium luteoalbum*) and two orchids: the onion orchid (*Microtis unifolia*) and slender sun orchid (*Thelymitra pauciflora*). Both coastal astelia (*Astelia banksii*) and kahakaha (Fig. 4) occur on the open lava field, mostly nearer the coast.

Vines are a feature of the lava fields, with white bindweed (*Calystegia tuguriorum*) (Fig. 5) and pōhuehue (*Muehlenbeckia complexa*) being especially prominent, sprawling over boulders and fences, and growing through bracken. A vigorous bindweed which appears to be a hybrid between

white bindweed and shore bindweed (*Calystegia soldanella*) is locally common in overgrown grassland. A vine of particular note is māwhai (Fig. 6), which typically grows alongside the rock forest copses. The Ōtuataua lava fields appear to host the only remaining natural population of this rare cucurbit in Auckland.

Along the south-western side of the lava field, cattle grazing is more intense and consistent. Consequently, there is much less kikuyu. Also, the ground is less rubbly in this area, with slab flows dominating the topography. In the shallow soils which top these lava flows, red bidibid (*Acaena novaezealandiae*), Mercury Bay weed (*Dichondra repens*), pātōtara (*Leucopogon fraseri*) (Fig. 7), creeping oxalis (*Oxalis exilis*) and *Juncus usitatus* are all present. Meadow rice grass is common in the grazed pasture.

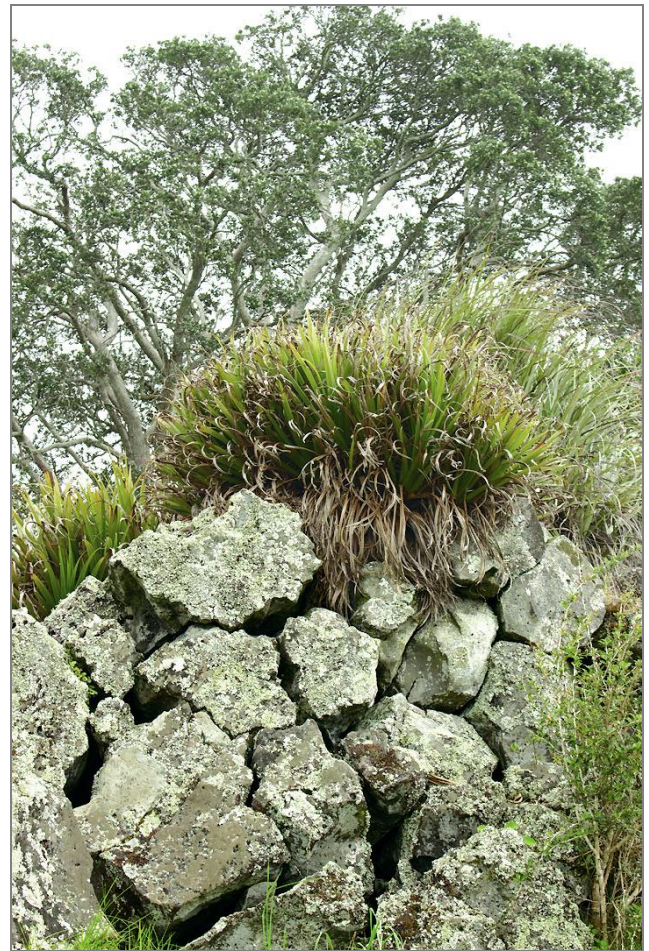


Fig. 4. *Astelia hastata*. 25 Dec 2020.

Quarry sites

To the northwest of the cone, the landscape has been locally damaged by quarrying. The quarry sites are especially harsh and xeric. However, *Crassula colligata*, *Epilobium cinereum*, *Euchiton sphaericus*, turnip-rooted geranium (*Geranium retrorsum*), Thompson's oxalis and Jersey cudweed all find the habitat suitable. One of the quarry pits has been

partially refilled with quarry spoil of large boulders. Trees, especially *Coprosma macrocarpa*, mahoe and ngaio, are beginning to establish themselves amongst the unstable blocks (Fig. 8); and many ferns can be found growing in the deep crevices below.

Near the coast, a semi-permanent wetland has formed in a depression left on the floor of one quarry pit. Nahui (*Alternanthera nahu*), common water milfoil (*Myriophyllum propinquum*), *Eleocharis acuta*, slender clubrush (*Isolepis cernua*), duckweed (*Lemna minor*) and watermeal (*Wolffia australiana*) are species to be found here. In the past, azolla (*Azolla rubra*) has been abundant in this wetland, though in early 2019 it vanished inexplicably and has not returned since. Cattle are occasionally given access to this wetland, which results in significant damage to native plant communities.

Coastal fringe

Much of the rocky shoreline of the Ōtuataua lava field was destroyed by the construction of the Manukau Sewage Purification Works oxidation ponds, which began in the late 1950s. Further modification came when the oxidation ponds were decommissioned and the infrastructure removed in the late 1990s–early 2000s. A series of small artificial beaches now form the northern coastline of the Ōtuataua Stonefields Historic Reserve. Behind these beaches there is a strip of boggy, reclaimed land. Mostly, this area is dominated by the invasive drooping sedge (*Carex divisa*), but there are also wetlands planted with kukuraho (*Bolboschoenus fluviatilis*), *Carex secta*, kuawa (*Schoenoplectus tabernaemontani*) and cabbage trees (*Cordyline australis*). Wild native plants are uncommon along reformed areas of the coastline, though there is some shore bindweed (*Calystegia soldanella*), kōkihi

(*Tetragonia tetragonoides*) and needle grass (*Austrostipa stipoides*) on the beaches; and *Hypolepis dicksonioides* is a noteworthy occurrence in the wetland areas.

The situation is better further west, where the stretches of the natural basalt shoreline persist. A good range of native shoreline plants may be found here. Plants of the salt-sprayed boulders, and the crevices between them, are numerous: bachelors buttons (*Cotula corinoprifolia*), toatoa (*Haloragis erecta*), shore lobelia (*Lobelia anceps*), sea primrose (*Samolus repens*), glasswort (*Sarcocornia quinqueflora*), remuremu (*Selliera radicans*), oioi (*Apodasmia similis*), trip-me-up (*Carex flagellifera*), knobby club rush (*Ficinia nodosa*), slender club rush (*Isolepis cernua*), sea rush (*Juncus kraussii*), swamp twig rush (*Machaerina juncea*), flax (*Phormium tenax*) and arrow grass (*Triglochin striata*). There are scattered small trees of taupata, and the odd shrub of saltmarsh ribbonwood (*Plagianthus divaricatus*), as well as vines of shore bindweed and pōhuehue. Mangrove (*Avicennia marina*) forms a dense fringe along most of the coastline and in one area there is a small colony of purua grass (*Bolboschoenus medianus*).

Adventive plants

Though this article is primarily focused on indigenous plants, some additions to the 2001 preliminary species list (Preston Jones 2001), were made during the November 2021 field trip. On the lava fields themselves the following were recorded: tarweed (*Bellardia viscosa*), ivy-leaved toadflax (*Cymbalaria muralis*), doves-foot geranium (*Geranium molle*), acrid lettuce (*Lactuca virosa*), hairy birdsfoot trefoil (*Lotus suaveolens*), hairy buttercup (*Ranunculus sardous*), catchfly (*Silene gallica*), gravel groundsel



Fig. 5. *Calystegia tuguriorum*. 25 Dec 2020.



Fig. 6. *Sicyos australis*. 13 May 2017.

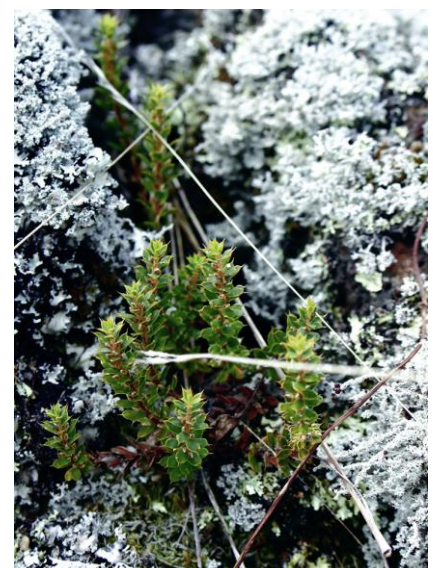


Fig. 7. *Leucopogon fraseri*. 13 May 2019.



Fig. 8. Quarry spoil with regenerating rock forest. 25 Dec 2020.

(*Senecio skirrhodon*), field madder (*Sherardia arvensis*), small French tare (*Vicia disperma*), vetch (*Vicia sativa*), oatgrass (*Arrhenatherum elatus*), shivery grass (*Briza minor*), toadrush (*Juncus bufonius*), tall fescue (*Lolium arundinaceum*), rough-stalked meadow grass (*Poa trivialis*) and vulpia hair grass (*Vulpia bromoides*). Wild adventive plants seen on the adjoining reclaimed land of the coastal fringe were swamp sheoak (*Casuarina glauca*), gypsywort (*Lycopus europaeus*), celery-leaved buttercup (*Ranunculus sceleratus*) and purple-backed duckweed (*Landoltia punctata*). Pickerel weed (*Pontederia cordata*) and an iris (probably *I. pseudacorus*) growing aside it, are probably plantings. See Appendix 2 for an updated list of adventive plants recorded between 2001 and 2021.

Acknowledgements

Anthony Wright, Brian Ireland and Rhiannon Prime all assisted with fieldwork between 2016 and 2021.

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Dhahara Ranatunga assisted with herbarium records. Ewen Cameron checked over the draft species lists. Jessica Beever thoughtfully recommended the inclusion of mosses, and provided a taxonomically-updated list.

Members of the Auckland Botanical Society who attended the 20 November 2021 field trip were: Ben Goodwin (leader), Ewen Cameron (assist-leader), Jenny Andrew, Graham Beck, Rosie Beck, Jessica Beever, Michael Bowden, Maureen Burke, Steve Cook, Bev Davidson, Geoff Davidson, Neil Davies, Fiona Drummond, Alex Fox, Leslie Haines, Peter Mooseberger, Colleen Pilcher, Helen Preston Jones, Juliet Richmond, Ian Smith, Lydia Smith, Sam Sutherland, Liz Walker, Kay Wallace, Alison Wesley, Mike Wilcox and Maureen Young.

Appendix 1. Annotated list of native vascular plants recorded from the Ōtuataua lava field

All species seen by the author between early 2016 and November 2021, unless otherwise noted. Excludes plants of adjoining reclaimed land, along coastal fringe.

Pteridophytes

<i>Adiantum cunninghamii</i>	Cunningham's maidenhair	Not seen between 2016-2021. Recorded by Preston Jones (2001).
<i>Adiantum hispidulum</i>	rosy maidenhair	Locally common, open lava field. Also noted by Preston Jones (2001).
<i>Arthropteris tenella</i>	jointed fern	Sparse, rock forest and open lava field. Also noted by Cameron (1991) and Preston Jones (2001). AK353105 <i>EK Cameron 1991</i> .
<i>Asplenium flabellifolium</i>	necklace fern	Occasional, rock forest and open lava field. Also noted by Preston Jones (2001).
<i>Asplenium flaccidum</i>	hanging spleenwort	Few in rock forest. Also noted by Cameron (1991) and Preston Jones (2001).
<i>Asplenium oblongifolium</i>	shining spleenwort	Occasional in rock forest; few on open lava field and in quarry spoil. Also noted by Preston Jones (2001).
<i>Asplenium polyodon</i>	sickle spleenwort	Rare, open lava field. Also noted by Preston Jones (2001).
<i>Azolla filliculoides</i>	azolla	Abundant, quarry floor wetland (2017); not seen since 2018.
<i>Cheilanthes distans</i>	woolly cloak fern	Common, open lava field and quarry sites. Also noted by Preston Jones (2001). AK238763 <i>EK Cameron 1991</i> .
<i>Cheilanthes sieberi</i>	rock fern	Sparse, open lava field.
<i>Doodia australis</i>	rasp fern	Frequent to locally common, open lava field and quarry spoil. Also noted by Preston Jones (2001).
<i>Doodia squarrosa</i>		Rare, open lava field.
<i>Microsorium pustulatum</i>	kowaowao	Occasional, rock forest. Also noted by Cameron (1991) and Preston Jones (2001).
<i>Pellaea falcata</i>	sickle fern	Locally common, open lava field and quarry spoil. AK330788 <i>P.J. de Lange et al. 2012</i> .
<i>Pellaea rotundifolia</i>	tarawera	Common, rock forest, open lava field and quarry spoil. Also noted by Preston Jones (2001).
<i>Polystichum neozelandicum</i>	prickly shield fern	Rare, open lava field.
<i>Pteridium esculentum</i>	bracken	Common, open lava field. Also noted by Preston Jones (2001).
<i>Pteris tremula</i>	shaking brake	Frequent, rock forest, open lava field and quarry spoil. Also noted by Cameron (1991) and Preston-Jones (2001).
<i>Pyrrosia elaeagnifolia</i>	leather-leaf fern	Frequent, rock forest and open lava field. Also noted by Cameron (1991) and Preston Jones (2001).

Dicotyledons

<i>Alternanthera denticulata</i>	lesser joyweed	Known from one collection in 2016. AK380910 <i>CD Kilgour 2016</i> .
<i>Alternanthera nahui</i>	nahui	Sparse, quarry floor wetland.
<i>Acaena novae-zelandiae</i>	red bidibid	Rare, open lava field.
<i>Alectryon excelsus</i>	tītoki	Common, rock forest and open lava field. Also noted by Cameron (1991) and Preston Jones (2001).
<i>Avicennia marina</i>	mangrove	Abundant, coast.
<i>Calystegia soldanella</i>	shore bindweed	Locally common, coast.
<i>Calystegia tuguriorum</i> x <i>C. soldanella</i>		Locally common, open lava field, near coast.
<i>Calystegia tuguriorum</i>	white bindweed	Common, open lava field. Also noted by Preston Jones (2001).

<i>Coprosma macrocarpa</i>		Common, rock forest, open lava field and quarry spoil. Also noted by Cameron (1991) and Preston Jones (2001). AK278980 <i>EK Cameron 1991</i> .
<i>Coprosma robusta</i>	karamu	Rare, one on margin of rock forest. Also noted by Preston Jones (2001).
<i>Coprosma repens</i>	taupata	Occasional, open lava field and margin of rock forest. Frequent along coast. Also noted by Preston Jones (2001).
<i>Coprosma macrocarpa</i> × <i>C. propinqua</i> (= <i>Coprosma</i> × <i>cunninghamii</i>)		Rare, one on open lava field. AK362761 <i>J Salter & F Duff 2016</i> .
<i>Corynocarpus laevegatus</i>	karaka	Common, forest and open lava field. Also noted by Cameron (1991) and Preston Jones (2001). AK159002 <i>RO Gardner 1999</i> .
<i>Cotula coronopifolia</i>	bachelor's button	Seasonally common, quarry floor wetland and coast.
<i>Crassula colligata</i>		Seasonally common, open lava field and quarry sites.
<i>Crassula sieberiana</i>		Occasional, open lava field and quarry sites. AK288941 <i>EK Cameron 2004</i> .
<i>Dichondra repens</i>	Mercury Bay weed	Occasional, open lava field. Also noted by Preston-Jones (2001). AK206355 <i>EK Cameron 1992</i> .
<i>Dodonaea viscosa</i>	akeake	Not seen between 2016–2021. Noted by Cameron (1991) and Preston Jones (2001).
<i>Entelea arborescens</i>	whau	Common, rock forest, open lava field and quarry spoil. Also noted by Cameron (1991) and Preston Jones (2001).
<i>Epilobium cinereum</i>		Locally common, quarry sites. Also noted by Preston Jones (2001). AK238765 <i>EK Cameron 1999</i> .
<i>Euchiton sphaericus</i>		Sparse, quarry sites.
<i>Geniostoma ligustrifolium</i>	hangehange	Sparse, rock forest and open lava field, in crevices. Also noted by Preston Jones (2001).
<i>Geranium retrorsum</i>	turnip-rooted geranium	Rare, quarry site.
<i>Haloragis erecta</i>	toatoa	Locally common, coast. Also noted by Preston Jones (2001).
<i>Hedycarya arborea</i>	pigeonwood	Frequent, rock forest and open lava field. Also noted by Preston Jones (2001).
<i>Leucopogon fraseri</i>	pātōtara	Locally common, open lava field.
<i>Lobelia anceps</i>	shore lobelia	Rare, coast.
<i>Melicytus ramiflorus</i>	māhoe	Frequent, rock forest, open lava field and quarry spoil. Also noted by Preston Jones (2001).
<i>Metrosideros excelsa</i>	pōhutukawa	Few on open lava field. Also noted by Preston Jones (2001).
<i>Muehlenbeckia complexa</i>	pōhuehue	Abundant, open lava field, quarry spoil and coast. Also noted by Preston Jones (2001).
<i>Myoporum laetum</i>	ngaio	Occasional, rock forest, open lava field, quarry spoil. Also noted by Preston-Jones (2001).
<i>Myriophyllum propinquum</i>	common water milfoil	Frequent, quarry floor wetland.
<i>Olearia paniculata</i>	akiraho	Not seen between 2016–2021. Recorded as planted tree by Preston-Jones (2001).
<i>Oxalis exilis</i>	creeping oxalis	Sparse, open lava field. Also noted by Preston-Jones (2001).
<i>Oxalis thompsoniae</i>	Thompsons oxalis	Occasional, open lava field and quarry sites.
<i>Peperomia urvilleana</i>		Occasional to locally common, rock forest and open lava field, in crevices. Also noted by Cameron (1991) and Preston-Jones (2001).
<i>Piper excelsum</i>	kawakawa	Occasional, rock forest and quarry spoil. Also noted by Cameron (1991) and Preston-Jones (2001).
<i>Pittosporum crassifolium</i>	karo	Few, open lava field. Also noted by Preston-Jones (2001).
<i>Plagianthus divaricatus</i>	saltmarsh ribbonwood	Sparse, coast.
<i>Pseudognaphalium luteoalbum</i>	Jersey cudweed	Occasional, open lava field; locally common, quarry sites. Also noted by Preston-Jones (2001).
<i>Samolus repens</i>	sea primrose	Common, coast.

<i>Sarcocornia quinqueflora</i>	glasswort	Common, coast.
<i>Selliera radicans</i>	remuremu	Rare, coast.
<i>Senecio bipinnatisectus</i>	Australian fireweed	Locally common, open lava field.
<i>Senecio esleri</i>	Esler's fireweed	Occasional, open lava field.
<i>Senecio hispidulus</i>		Occasional, open lava field. Also noted by Preston-Jones (2001).
<i>Senecio quadridentatus</i>	pahokoraka	Locally common, open lava field. Also noted by Preston-Jones (2001). AK238767 <i>EK Cameron 1999</i> ; AK292922 <i>MD Wilcox 2004</i> .
<i>Sicyos australis</i>	māwhai	Sparse – locally common, open lava field. Also noted by Cameron (1991) and Preston-Jones (2001). AK278981 <i>EK Cameron 1991</i> ; AK205942 <i>EK Cameron 1992</i> ; AK256411 <i>EK Cameron 2002</i> ; AK280043 <i>C Delmiglio 2002</i> ; AK301872 <i>EK Cameron 2008</i> .
<i>Solanum americanum</i>	small-flowered nightshade	Not seen between 2016–2021. Was recorded by Preston-Jones (2001), possibly in error for <i>S. opacum</i> , which was not recognised in New Zealand at that time.
<i>Solanum opacum</i>	dark nightshade	Occasional, open lava field
<i>Vitex lucens</i>	pūriri	Few, rock forest and open lava field. Also noted by Cameron (1991) and Preston-Jones (2001).

Monocotyledons

<i>Apodasmia similis</i>	oioi	Rare, coast.
<i>Astelia banksii</i>	coastal astelia	Locally common, open lava field.
<i>Astelia hastata</i>	kahakaha	Sparse, rock forest and open lava field. Also noted by Preston-Jones (2001).
<i>Astelia solandri</i>	kōwharawhara	Rare, rock forest (2016 & 2017); not seen since 2017. Also noted by Preston-Jones (2001).
<i>Austrostipa stipoides</i>	needlegrass	Not seen between 2016–2021, but seen recently (28 Mar 2022), locally common on rocky coastline, SW corner of lava field.
<i>Bolboschoenus medianus</i>	purua grass	One colony, coast.
<i>Carex flagellifera</i>	trip-me-up	Locally common, coast.
<i>Carex solandri</i>		Locally common, rocky scrub on coast.
<i>Cordyline australis</i>	cabbage tree	Rare, planted trees on margin of rock forest.
<i>Cyperus ustulatus</i>	umbrella sedge	Occasional, coast.
<i>Eleocharis acuta</i>		Common, quarry floor wetland.
<i>Ficinia nodosa</i>	knobby club rush	Sparse, coast.
<i>Isolepis cernua</i>	slender clubrush	Locally common, coast; occasional, quarry floor wetland.
<i>Juncus australis</i>	hollow rush	Rare, coast.
<i>Juncus kraussii</i>	sea rush	Occasional, coast.
<i>Juncus usitatus</i>		Rare, open lava field.
<i>Juncus pallidus</i>	giant rush	Rare, coast.
<i>Lemna minor</i>	duckweed	Rare, quarry floor wetland
<i>Machaerina juncea</i>	swamp twig rush	Rare, coast.
<i>Microlaena stipoides</i>	meadow rice grass	Common, open lava field and rocky scrub on coast. Also noted by Preston-Jones (2001).
<i>Microtis unifolia</i>	onion orchid	Sparse, open lava field and quarry spoil.

<i>Oplismenus hirtellus</i>	basket grass	Not seen between 2016–2021. Noted by Cameron (1991).
<i>Phormium tenax</i>	flax	Occasional, wild plants on coast. Some planted, on margin of rock forest. Also noted by Preston-Jones (2001).
<i>Thelymitra pauciflora</i>	slender sun orchid	Rare, open lava field and quarry spoil. `Thelymitra` sp.' noted by Preston-Jones (2001).
<i>Triglochin striata</i>	arrow grass	Sparse, coast.
<i>Wolffia australiana</i>	watermeal	Common, quarry floor wetland.

Appendix 2. Adventive vascular plants recorded from the Ōtuataua lava field 2001 – 2021

(pl) = cultivated # = seen only on adjoining reclaimed land, along coastal fringe.

Pteridophytes

Nephrolepis cordifolia ladder-fern AK238768 EK Cameron (1999)

Gymnosperms

Araucaria heterophylla (pl) Norfolk Island pine

Chamaecyparis lawsoniana (pl) Lawson cypress

Cupressus macrocarpa (pl) macrocarpa

Pinus radiata (pl) Monterey pine

Dicotyledons

Achillea millefolium yarrow

Amaranthus hybridus amaranth

Amaranthus lividus purple amaranth

Lysimachis arvensis scarlet pimpernel

Andredera cordifolia mignonette

Araujia sericifera moth vine

Arctotheca calendula Cape weed

Bellardia viscosa tarweed

Berberis glaucophylla barberry

Bidens frondosa # beggar's ticks

Buddleja davidii buddleia

Calystegia sepium x *C. silvatica* AK380915 CD Kilgour (2016)

Callitriche stagnalis callitriche

Carduus pycnocephalus slender-winged thistle

Dicots cont:

Casuarina glauca # swamp she-oak

Centaureum erythraea centaury

Chenopodium murale nettle-leaved fathen

Cirsium vulgare Scotch thistle

Conium maculatum hemlock

Convolvulus arvensis field bindweed AK380911 CD Kilgour (2016)

Coronopus didymus twincrest

Crassula decumbens Cape crassula

Crataegus monogyna hawthorne

Crepis capillaris smooth hawksbeard

Cuscuta epithymum dodder

Cymbalaria muralis ivy-leaved toadflax

Datura stramonium Jimson weed AK380913 CD Kilgour (2016)

Daucus carota wild carrot

Echium plantagineum Patterson's curse

Erigeron sumatrensis fleabane

Erodium cicutarium storksbill

Erythrina xsykesii (pl) coral tree

Euphorbia characias Wulfen spurge

Euphorbia depauperata AK248198 GS Stone (1999)

Euphorbia peplus petty spurge

Euonymus japonicus (pl) Japanese spindle-tree

Dicots cont:

<i>Ficus macrophylla</i> (pl & wild)	Moreton Bay fig	AK246802 <i>EK Cameron</i> (2000)
<i>Foeniculum vulgare</i>	fennel	
<i>Fumaria muralis</i>	scrambling fumitory	
<i>Galium aparine</i>	cleavers	
<i>Galium divaricatum</i>	slender bedstraw	
<i>Gamochaeta simplicicaule</i>	tall cudweed	
<i>Geranium dissectum</i>	cut-leaf cranesbill	
<i>Geranium molle</i>	doves-foot geranium	
<i>Geranium purpureum</i>	small herb robert	
<i>Gomphocarpus fruticosus</i>	swanplant	AK380917 <i>CD Kilgour</i> (2016)
<i>Helminthotheca echioides</i>	oxtongue	
<i>Hypochaeris radicata</i>	catsear	
<i>Lactuca virosa</i>	acrid lettuce	
<i>Leontodon saxatilis</i>	hawkbit	
<i>Linaria pelisseriana</i>	Pelisser's toadflax	
<i>Ligustrum lucidum</i>	shining privet	
<i>Ligustrum sinense</i>	Chinese privet	
<i>Linaria purpurea</i>	linaria	
<i>Linum bienne</i>	pale flax	
<i>Lotus pedunculatus</i>	lotus	
<i>Lotus suaveolens</i>	hairy birdsfoot trefoil	
<i>Lycium ferocissimum</i>	box thorn	
<i>Lycopus europaeus</i> #	gypsywort	
<i>Malva sylvestris</i>	large-flowered mallow	
<i>Medicago arabica</i>	spotted medick	
<i>Mentha pulegium</i>	pennyroyal	
<i>Mercurialis annua</i>	annual mercury	Observed 2004, Mike Wilcox
<i>Modiola caroliniana</i>	creeping mallow	
<i>Nasturtium officinale</i>	watercress	
<i>Nicandra physalodes</i>	apple of Peru	AK380912 <i>CD Kilgour</i> (2016)
<i>Olea europaea</i> (pl)	olive	
<i>Orobancha minor</i>	broomrape	
<i>Oxalis corniculata</i>	horned oxalis	

Dicots cont:

<i>Oxalis chnoodes</i>	downy wood-sorrel	AK330790 <i>PJ de Lange et al</i> (2012)
<i>Persea americana</i> (pl)	avocado	AK301873 <i>EK Cameron</i> (1998)
<i>Physalis peruviana</i>	Cape gooseberry	
<i>Phytolacca octandra</i>	inkweed	
<i>Plantago lanceolata</i>	narrow-leaved plantain	
<i>Plantago major</i>	broad-leaved plantain	
<i>Polycarpon tetraphyllum</i>	allseed	
<i>Polygonum arenastrum</i>	small-leaved wireweed	
<i>Polygonum aviculare</i>	wireweed	
<i>Pontederia cordata</i> # (pl)?	pickerel weed	AK383601 <i>EK Cameron</i> (2021)
<i>Populus x canadensis</i> (pl)	hybrid poplar	
<i>Portulaca oleracea</i>	purselane	
<i>Prunella vulgaris</i>	selfheal	
<i>Prunus persica</i> (pl)	peach	
<i>Ranunculus muricatus</i>	buttercup	
<i>Ranunculus sardous</i>	hairy buttercup	
<i>Ranunculus sceleratus</i> #	celery-leaved buttercup	
<i>Ranunculus repens</i>	creeping buttercup	
<i>Rosa canina</i>	dog rose	
<i>Rubus fruticosus</i>	blackberry	
<i>Rumex acetosella</i>	sorrel	
<i>Rumex obtusifolius</i>	broad-leaved dock	
<i>Sedum spurium</i>	Caucasian stonecrop	AK285562 <i>PA Maddison</i> (2004), AK289220 <i>EK Cameron</i> (2004)
<i>Senecio skirrhodon</i>	gravel groundsel	
<i>Sherardia arvensis</i>	field madder	
<i>Silene gallica</i>	catchfly	
<i>Silybum marianum</i>	variegated thistle	AK258822 <i>EK Cameron</i> (2002)
<i>Sisymbrium officinale</i>	hedge mustard	
<i>Solanum laxum</i>	potato-vine	AK238759 <i>EK Cameron</i> (1999)
<i>Solanum linnaeanum</i>	apple of Sodom	
<i>Solanum mauritianum</i>	tobacco weed	

Dicots cont:

<i>Solanum nigrum</i>	black nightshade	
<i>Sonchus oleraceus</i>	puha	
<i>Spergula arvensis</i>	spurrey	
<i>Spergularia rubra</i>	sand spurrey	
<i>Stachys arvensis</i>	staggerweed	
<i>Stellaria media</i>	chickweed	
<i>Taraxacum officinale</i>	dandelion	
<i>Tecomaria capensis</i> (pl)	Cape honeysuckle	
<i>Tolpis barbata</i>	umbrella milkwort	AK238761 <i>EK Cameron</i> (1999)
<i>Torilis arvensis</i>	hedge parsley	AK207024 <i>EK Cameron</i> (1992)
<i>Trifolium campestre</i>	hop trefoil	AK288942 <i>EK Cameron</i> (2004)
<i>Trifolium dubium</i>	suckling clover	
<i>Trifolium fragiferum</i>	strawberry clover	AK349046 <i>EK Cameron</i> (2014)
<i>Trifolium repens</i>	white clover	
<i>Trifolium subterranean</i>	subterranean clover	
<i>Ulex europaeus</i>	gorse	
<i>Verbascum blattaria</i>	moth mullein	AK207022 <i>EK Cameron</i> (1992)
<i>Verbascum thapsus</i>	woolly mullein	AK207023 <i>EK Cameron</i> (1992)
<i>Verbena bonariensis</i>	tall verbena	
<i>Veronica anagallis-aquatica</i>	water speedwell	AK206357 <i>EK Cameron</i> (1992)
<i>Veronica persica</i>	Persian speedwell	
<i>Vicia disperma</i>	small French tare	
<i>Vicia sativa</i>	vetch	
<i>Vicia tetrasperma</i>	smooth vetch	
<i>Vinca major</i>	periwinkle	
<i>Xanthium spinosum</i>	Bathurst burr	AK206356 <i>EK Cameron</i> (1999)

Monocotyledons

<i>Aira caryophyllea</i>	silvery hair grass
<i>Allium triquetrum</i>	onionweed
<i>Anthoxanthum odoratum</i>	sweet vernal

Monocots cont:

<i>Arrhenatherum elatius</i>	oatgrass	
<i>Arum italicum</i>	Italian arum	
<i>Asparagus asparagoides</i>	smilax	
<i>Briza minor</i>	shivery grass	
<i>Bromus lithobius</i>	Chilean brome	
<i>Carex divisa</i>	drooping sedge	
<i>Carex divulsa</i>	grey sedge	AK238760 <i>EK Cameron</i> (1999)
<i>Cenchrus clandestinus</i>	kikuyu	
<i>Cortaderia selloana</i>	pampas	
<i>Cynodon dactylon</i>	Indian doab	
<i>Cyperus eragrostis</i>	tall flatsedge	
<i>Dactylis glomerata</i>	cocksfoot	
<i>Eleusine indica</i>	crowsfoot	
<i>Holcus lanatus</i>	Yorkshire fog	
<i>Iris ?pseudacorus</i> # (pl)?	yellow flag iris	
<i>Juncus bufonius</i>	toad rush	
<i>Landoltia punctata</i> #	purple-backed duckweed	
<i>Lolium arundinaceum</i>	tall fescue	
<i>Lolium multiflorum</i>	Italian ryegrass	
<i>Lolium perenne</i>	perennial ryegrass	
<i>Paspalum dilatatum</i>	paspalum	
<i>Phalaris aquatica</i>	bulbous canary-grass	AK283810 <i>EK Cameron</i> (2003)
<i>Phalaris minor</i>	lesser canary grass	
<i>Phoenix canariensis</i>	phoenix palm	
<i>Poa trivialis</i>	rough-stalked meadow grass	
<i>Rytidosperma racemosum</i>	danthonia	
<i>Setaria gracilis</i>	knot root bristle grass	
<i>Sporobolus africanus</i>	ratstail	
<i>Vulpia bromoides</i>	vulpia hair grass	
<i>Zantedeschia aethiopica</i>	calla lilly	

Appendix 3. Non-vascular plants recorded from the Ōtuataua lava field 1999 – 2021.

Lichens				
<i>Cladonia confusa</i>	AK240016	DB Rogan (1999)	<i>Campylopus introflexus</i>	Bot Soc field trip, Nov 2021
<i>Cladonia ramulosa</i>	AK240018	DB Rogan (1999)	<i>Ceratodon purpureus</i>	AK300378 JE Beever (2004)
<i>Lecanora campestris</i>	AK239635	DB Rogan (1999)	<i>Fissidens curvatus</i>	AK300385 JE Beever (2004)
<i>Neofuscelia loxodella</i>	AK240017	DB Rogan (1999)	<i>Funaria hygrometrica</i>	AK300380 JE Beever (2004)
<i>Placopsis</i> sp.	AK240019	DB Rogan (1999)	<i>Gertrudiella torquata</i>	AK289735 JE Beever (2005)
<i>Pseudocyphellaria neglecta</i>	AK240014	DB Rogan (1999)	<i>Grimmia pulvinata</i>	AK300374 JE Beever (2004)
<i>Ramalina celastri</i> var. <i>celastri</i>	AK240015	DB Rogan (1999)	<i>Hypnum cupressiforme</i>	AK300386 JE Beever (2004)
			<i>Hypopterygium rotulatum</i>	AK239422 EK Cameron (1999)
			<i>Philonotis tenuis</i>	AK300388 JE Beever (2004)
			<i>Ptychomitrium australe</i>	AK300389 JE Beever (2004)
			<i>Rosulabryum campylothecium</i>	AK300387 JE Beever (2004)
			<i>Rosulabryum subtomentosum</i>	AK300381 JE Beever (2004)
			<i>Syntrichia antarctica</i>	AK300359 JE Beever (2004)
			<i>Syntrichia papillosa</i>	AK300360 JE Beever (2004)
			<i>Thuidiopsis sparsa</i>	AK300379 JE Beever (2004)
			<i>Tortella flavovirens</i>	AK300362 JE Beever (2004)
			<i>Tortula muralis</i>	AK300367 JE Beever (2004)
			<i>Triquetrella papillata</i>	AK300368 JE Beever (2004)
			<i>Weissia</i> "Miranda"	AK332728 JE Beever (2004)
			<i>Weissia controversa</i>	AK332725 JE Beever (2004)
Liverworts				
<i>Chiloscyphus semiteres</i>	AK239423	EK Cameron (1999)		
<i>Metzgeria furcata</i>	AK304298	PJ de Lange et al. (2009)		
Mosses (supplied by Jessica Beever, 2021)				
<i>Barbula calycina</i>	AK289734	JE Beever (2005)		
<i>Barbula convoluta</i>	AK289733	JE Beever (2005)		
<i>Barbula unguiculata</i>	AK300357	JE Beever (2006)		
<i>Bryum argenteum</i>	AK300383	JE Beever (2004)		
<i>Bryum clavatum</i>	AK300377	JE Beever (2004)		
<i>Bryum dichotomum</i>	AK300382	JE Beever (2004)		
<i>Campylopus clavatus</i>	AK300384	JE Beever (2004)		

Christmas pot-luck picnic and field trip to Point Wells, Whangateau, 4 December 2021

Maureen Young and Ewen Cameron

Participants: *Jessica Beever, Duncan Benzie, Steve Cook, Ewen Cameron, Bev & Geoff Davidson, Frances Duff, Leslie Haines, Mei Nee Lee, John Millett, Philip Moll, Helen Preston Jones, Juliet Richmond, Joshua Salter, Lydia & Ian Smith, John Staniland, Claire Stevens, Cheryl Taylor, Alison Wesley, Maureen Young (leader).*

Fortuitously, our Christmas function had been planned for the day after Aucklanders were allowed

out of COVID-19 gaol, and Auckland had just moved to the new traffic light system (red) which allows up to 100 vaccinated people to gather, keeping 1-m physically apart. So, we headed north to the pleasant village of Point Wells, located on a tongue of peat land in the Whangateau Harbour. After meeting at the local hall and setting it up for our meal, we set off on our pre-luncheon walk which took us on a loop, partly through village streets and partly around the harbour's edge (Fig. 1).

Figs. 1–7: **1.** Bot Soccers (some with Covid face masks) looking at the saltmarsh species along the Point Wells foreshore. Photo, looking north: Cheryl Taylor. All photos taken on the day of the field trip, unless otherwise stated. **2.** *Sphagnum falcatulum*, along with several other interesting mosses, occurred in a street-side ditch at Point Wells. Photo: Joshua Salter. **3.** *Selliera* (*Goodenia radicans*) with the split corollas – a common feature of the family, Goodeniaceae. Photo: Philip Moll. **4.** Patches of different saltmarsh species: needle tussock at back (pale-coloured); sea rush (erect and dark green); samolus (with white flowers); selliera (bright green and no flowers evident); marsh ribbonwood (shrub, front right); and rank kikuyu in foreground. Photo: Joshua Salter. **5.** Flowering saltmarsh celery (*Apium* "white denticles") showing the white denticles on the tips of the leaflet segments, hence its informal name. Photo: Joshua Salter. **6.** Young fruit of the marsh ribbonwood, on the edge of the saltmarsh. Photo: Joshua Salter. **7.** The attractive but weedy wild gladiolus and knobby clubrush. Photo: Joshua Salter.