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Cover illustration: *Sphagnum falcatulum*, Craigavon Park, 21 Feb 2018.  
Photo: Mike Wilcox (see article on p. 93).

## Field trip to Awhitu Regional Park's wetlands, 21 April 2018

P. (Tricia) A. Aspin

**Participants:** *Tricia Aspin (leader), Lisa Clapperton, Frances Duff, Philip Moll, Joshua Salter, Chevelle Sands, Sam Sutherland, Val Tomlinson, Alison Wesley, Elizabeth Walker, Ian Whitehouse, Maureen Young.* All photos taken on 21 April 2018 by Phillip Moll (PM), Joshua Salter (JS) and Chevelle Sands (CS).

Awhitu Regional Park is 116 ha and comprises areas of working farmland, pine plantations, regenerating bush slopes, wetlands, harbourside vegetation, salt meadows and many planted areas. The land was purchased by the Auckland Regional Authority in 1971 and plantings began soon after. The official opening was not until 1975. The Brook family took up the land in 1869 and son, Frank, had a particular interest in trees and planted many exotics as well as natives. It became a tradition to plant a kauri (*Agathis australis*) to mark a family event. The north-western section of the park has been leased by the Awhitu Golf Club since 1980. In all it is an area providing a wide diversity of plant communities in a controlled situation (Aspin 2008).

Time limited how much of the Park we could cover and so our aim was to explore the two main wetlands and also note some of the original Brook plantings in passing (see Appendix). Many of these original trees are still in existence.

We began by taking the walkway from the main carpark noting numerous kingfisher nesting-holes in the bank before looking at the salt marsh below. Since the removal of the floodgate the whole of the flat area becomes flooded with salt water on the highest tides, and many salt marsh species and mangroves (*Avicennia marina*) have established in what was once drained pastureland. The recent very high king tides saw the whole of this regenerating wetland inundated with salt water (Fig. 1). Species noted here along with mangroves were oioi (*Apodasmia similis*), *Machaerina juncea*, *Juncus kraussii*, *Plagianthus divaricatus*, *Selliera radicans*, *Samolus repens*, *Triglochin striata*, and along the base of the wooded slope a few *Lobelia anceps* with an occasional flower (Fig. 2).

We walked along the causeway fringed with planted flax (*Phormium tenax*), pohutukawa (*Metrosideros excelsa*) and cabbage trees (*Cordyline australis*). The original ngaio (*Myoporum laetum*) has succumbed to the salt water and only a small one remains. From here we could glimpse Kauritūtahi Island, formerly known as Brook's Island and botanised by Ewen Cameron 22 years ago while on a Cub Camp (Cameron 1996) (Fig. 3). Instead of

venturing along the beach we then negotiated the still-flooded track behind the shore dune to cross the first major wetland (Fig. 4). On the beach side was much *Machaerina juncea* and occasional *Ficinia nodosa* intertwined with *Muehlenbeckia complexa*. Noted were occasional bachelor's buttons (*Cotula coronopifolia*) and the exotic buck's horn plantain (*Plantago coronopus*). As gumboots were the order of the day we could venture through patches of *Juncus kraussii* into the main saltmarsh area and observe large areas colonised by glasswort (*Salicornia quinqueflora*). It was commented that the presence of this species indicates the limit of the highest tides (Fig. 5). *Samolus repens* and *Selliera radicans* are still present here but seem in less quantity than prior to so much flooding by salt water (P. Aspin pers. obs.) (Fig. 6). Further inland nearer the old fenceline, swathes of oioi appeared golden-hued in contrast (Fig. 7).

Staying within the reach of the wetland we took the track leading below the slope down from the homestead area. In from the beginning of the track and away from salt water influence was a patch of *Cyperus ustulatus* and along here we sheltered from a shower of rain while observing some of the Brook plantings. Of interest was the red stringybark eucalypt (*Eucalyptus macrorrhynca*). Mike Wilcox identified this species several years ago and said that it is an inland species seldom seen in New Zealand. Of note trackside was a large specimen of swamp cutty grass (*Gahnia xanthocarpa*) which provided some shelter from the last of the rain drops (Fig. 8). Several *Dianella latissima* were of interest with extra-long leaf blades (Fig. 9). On either side both tangle fern species, *Gleichenia dicarpa* and *D. microphylla*, were present. *Gleichenia dicarpa* was distinguished by the rounded, pouched segments and paired sporangia on the undersides of the pinnae, in contrast to the mostly silver-backed flat pinnae of *D. microphylla* which had a few yellow sporangia still present. Swamp millet (*Isachne globosa*), intermingled with *Centella uniflora*, was here also. Bracken fern (*Pteridium esculentum*), rasp fern (*Doodia australis*) and *Pteris tremula* were present on the slope side. Apart from the large kauri and natural regeneration (e.g. *Geniostoma ligustrifolium*, *Leucopogon fasciculatus* and *Myrsine australis*) most of the large trees along here, including kahikatea (*Dacrydium dacrydioides*) and rewarewa (*Knightia excelsa*), are part of the original Park plantings from the 1970s. Alison noted a mahoe sapling on the south side and identified it as the large-leaved mahoe (*Melicactus macrophylla*). There were three here, the largest being approximately 2 m tall. It could be assumed that they have been part of some



later plantings along with *Pittosporum eugeniioides*, *Coprosma lucida* and *C. robusta*, as *M. macrophylla* is previously unrecorded in the Awhitu District (cf. Aspin 2008).

We took the mown side track leading deep into the regenerating wetland and more ferns became notable. We observed *Blechnum minus* with many upright fertile fronds, *Cyathea dealbata*, *C. medullaris*, *Deparia petersenii*, *Dicksonia squarrosa*, *Diplazium australe*, *Histiopteris incisa*, *Hiya* (*Hypolepis*) *distans*<sup>1</sup>, *Hypolepis ambigua* and *Paesia scaberula*. Of special note was the abundance of *Hiya distans*. Although known in several Awhitu wetlands this regenerating area is proving to be a stronghold for the species (Fig. 10).

Returning along the track Chevelle noted a large dark brownish/black caterpillar with rows of spots along its body nestled among the mown grass. Subject of much interest we thought it could be that of the Convolvulus Hawk Moth (*Agrius convolvuli*), known to be in the Park, but it had no spur on the tail end (Fig. 11). Josh and I later identified it (from the internet) as the caterpillar of one of the armyworm (*Spodoptera*) species and the life-size illustration in "Which New Zealand Insect?" (Crowe 2005) confirms it as the exotic self-introduced tropical armyworm (*S. litura*). Armyworm is known to have been a pest in the Awhitu District in the past (P. Aspin pers. comm.).

By now it was time for lunch and we continued up the track to the campground area. On entering the homestead section we saw that one of the old original macrocarpa trees (*Cupressus macrocarpa*) had partially succumbed to the ravages of the recent severe storm in the Auckland Region. Fortunately the renowned giant one had weathered the winds and we gathered underneath for a group photo (Fig. 12). We lunched on the verandah of the historic Brook homestead (Fig. 13) and observed more original Brook plantings including the hedgerow of very tall Lawson's cypress (*Chamaecyparis lawsoniana*), an Italian cypress (*Cupressus sempervirens* 'Stricta'), a camellia (*Camellia japonica*) and a tall nikau (*Rhopalostylis sapida*). Contrary to what one would believe from information in the Awhitu Regional Park brochure, the Japanese cedars (*Crytomeria japonica*) were not part of the original Brook plantings but were put in during the layout of the 1970s (P. Aspin pers. obs.).

The second, more southern wetland is in marked contrast, with much less salt water influence, apart from the tidal creek, and has regenerated with the

more usual freshwater species. The inland fringes were extensively planted with kahikatea (*Dacrydium dacrydioides*) in the 1970s and the areas along the shoreline more recently with manuka (*Leptospermum scoparium*). After crossing the bridge (hoping to hear fernbirds among the *Plagianthus divaricartus* here) we took the track through the manuka and then went inland across towards the base of Lookout Hill. We noted the bright green of *Isolepis prolifera* in the drains on both sides of the walkway. As this wetland is impenetrable we explored along a drier finger of manuka which enabled us to observe the main species more closely. *Machaerina rubiginosa* and *Carex virgata* were noted and a large area of *M. articulata* was deeper in the wetland. Of concern was the large area of choking gypsywort (*Lycopus europaeus*) preventing the establishment of more desirable native species.

We left the track and headed uphill to the lookout which gave good views back to the wetland, Kauritutahi Island and across the Manukau Harbour to Auckland City (Fig. 14).

To head back we took the track down through "The Valley of the Settlers", an area planted out in 2004 to commemorate 150 years since the arrival of European settlers to the Awhitu District. Groves of kauri representing the small schools of the area were planted by descendants of the original families. At the base of the slope the lead-in valleys of the southern wetland were observed west of the metal track as we crossed the head of the wetland. Dense swathes of *Machaerina rubiginosa* and raupo (*Typha orientalis*) were dominant.

We then crossed paddocks to enter the small foot track on the southern side of the lake formed by damming the natural waterway in the late 1980s. Wetland species noted included *Isachne globosa* and reedbeds of *Eleocharis sphacelata* (Fig. 15), and a large patch of *Deparia petersenii* was noted at the head of the lake (Fig. 16). Flax and cabbage trees were common plantings along the lake shore (Fig. 17). The track on the northern side is above the shoreline through a variety of trees with many ferns regenerating underneath. The small herb *Hydrocotyle elongata* was noted on the northern side (as well as the exotic *H. tripartita* on the mown section). Near the eastern end of the track *Coprosma crassifolia*, a small-leaved species with whitish undersides (Fig. 18), was of interest. This species, not known to occur naturally in the Awhitu District, was part of the lakeside plantings and has now naturalised in close proximity to the original specimens.

The road from the carpark crosses the dam and we looked at the fish ladder on the harbour side and then were fascinated by the 'tame' longfin eels at the small ramp on the SE edge of the lake (Fig. 19). We

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**Footnote 1:** The fern so familiar to us as *Hypolepis distans* has been renamed *Hiya distans*, because research has shown it to be closer to tropical species in the genus *Hiya*, than to other New Zealand species of *Hypolepis* (Perrie et al. 2018).





**Figs. 1-11:** **1.** Regenerating wetland featuring the salt-tolerant species *Apodasmia similis*, *Juncus kraussii* and mangroves. Photo: JS. **2.** *Lobelia anceps* in flower below the wooded slope on the edge of the wetland. Photo: PM. **3.** View out to Kauritutahi Island from the walkway. Photo: JS. **4.** The walkway across the wetland towards the homestead was still flooded from the recent high tides. Photo: PM. **5.** Dense beds of *Salicornia quinqueflora* and looking inland beyond the old fenceline. Photo: JS. **6.** *Juncus kraussii* and bright green *Selliera radicans* fronted by blue-green *Salicornia quinqueflora*. Photo: JS. **7.** The golden hues of *Apodasmia similis* are in contrast to the dull *Juncus kraussii* and mangroves begin to colonise the original farm drains now that high tides reach far inland. Photo: PM. **8.** *Gahnia xanthocarpa* provides a little shelter from the last of the rain. Photo: JS. **9.** Lisa shows the extraordinary length of a leaf blade of *Dianella latissima*. Photo: JS. **10.** The abundance of the fern, *Hiya distans*, is a strong feature at Awhitu Park. Photo: JS. **11.** The large caterpillar spotted by Chevelle was later identified as that of the tropical army worm. Caterpillar (approx. 5 cm long) posing on Val's sleeve. Photo: JS.





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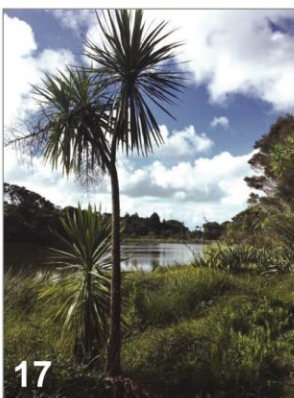
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**Figs. 12-19:** **12.** Our group under the large macrocarpa near Brook's Homestead. Photo: CS using Philip Moll's camera. **13.** Lunchtime in relative comfort on the verandah of Brook's Homestead. Photo: JS. **14.** Looking north-east, back across the second wetland and the Manukau Harbour to Auckland City, on the way up to the lookout. Photo: JS. **15.** Looking to the wooded north side of the lake across beds of *Elaecharis sphacelata* intertwined with *Isachne globosa*. Photo: JS. **16.** Tree ferns and *Deparia petersenii* at the head of the lake. Photo: JS. **17.** Looking eastwards down from the head of the lake. Photo: CS. **18.** Two domatia show on the whitish undersides of the small leaves of *Coprosma crassifolia*. Photo: JS. **19.** Longfin eels gather at the SE end of the lake. Note also the mats of the exotic bladderwort, *Utricularia gibba*. Photo: JS.

were unable to judge the length of the fins, but they were identified by the mouth extending past the eye, and the inner curve of the bent body forming wrinkles – features of the longfin (McDowall 2000). Notable here too, were tangled mats of *Utricularia gibba* accumulated near the water's edge. This exotic species had been recorded in a neighbouring farm dam in 2011 (AK 326702) where it was presumed to

have been introduced by waterfowl. A short walk back up to the carpark completed the day's circuit.

Birds noted were fantail, harrier hawk, pied oystercatcher, tui, waxeye, white-faced heron.

**Acknowledgments:** Thanks to Joshua Salter and Phillip Moll for supplying photographs.

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**Appendix: Vascular plants species list (native only):** Awhitu Regional Park (including adjoining beach and road frontages). See NZ Topo50 BB31 467939. Records from P.A. Aspin, July 2010, and a few from Shona Myers in 2003. List compiled from plants naturally occurring in the region (N), those planted by the Brook family (B) and by the ARC from 1973 onwards (A). Many planted species are now naturalised.

ABS = those added by Auckland Botanical Society, April 2018

◆ = only known in the Awhitu Ecological District from planted material

LYCOPODS and FERNS				DICOTYLEDONS	
<i>Adiantum cunninghamii</i>	N	<i>Lycopodium</i>	N	<i>Alectryon excelsus</i>	A
<i>Adiantum hispidulum</i>	N	<i>deuterodensum</i>		<i>Apium prostratum</i> var.	N
<i>Asplenium flaccidum</i>	N	<i>Lycopodium volubile</i>	N	<i>prostratum</i>	
<i>Asplenium oblongifolium</i>	N	<i>Microsorium pustulatum</i>	N	<i>Avicennia marina</i>	N
<i>Asplenium polyodon</i>	ABS	<i>Microsorium scandens</i>	N	<i>Beilschmiedia tarairi</i>	A
<i>Blechnum filliforme</i>	N	<i>Paesia scaberula</i>	N	<i>Beilschmiedia tawa</i>	A
<i>Blechnum novae-zelandiae</i> (incl. <i>B. minus</i> )	N	<i>Pneumatopteris pennigera</i>	N	<i>Brachyglottis repanda</i>	A
<i>Cyathea dealbata</i>	N	<i>Pteridium esculentum</i>	N	<i>Calystegia sepium</i> subsp.	N
<i>Cyathea medullaris</i>	N	<i>Pteris macilentata</i>	N	<i>roseata</i>	
<i>Deparia petersenii</i>	N	<i>Pteris tremula</i>	N	<i>Calystegia sepium</i> ×	N
<i>Dicksonia squarrosa</i>	N	<i>Pyrrosia elaeagnifolia</i>	N	<i>?C. tuguriorum</i>	
<i>Diplazium australe</i>	ABS	<i>Rumohra adiantiformis</i>	N	<i>Calystegia soldanella</i>	N
<i>Doodia australis</i>	N	<b>GYMNOSPERMS</b>		<i>Cardamine debilis</i>	N
<i>Gleichenia dicarpa</i>	N	<i>Agathis australis</i>	B, A	<i>Carpodetus serratus</i>	A
<i>Gleichenia microphylla</i>	ABS	<i>Dacrydium cupressinum</i>	B, A	<i>Centella uniflora</i>	N
<i>Histiopteris incisata</i>	N	<i>Dacrycarpus dacrydioides</i>	A	<i>Coprosma arborea</i>	ABS
<i>Hiya distans</i>	N	<i>Halocarpus kirkii</i> ◆	A	<i>Coprosma crassifolia</i> ◆	A
<i>Hypolepis ambigua</i>	ABS	<i>Libocedrus plumosa</i>	A	<i>Coprosma ?foetidissima</i> ◆	A
<i>Lastreopsis hispida</i>	N	<i>Phyllocladus</i>	B, A	<i>Coprosma lucida</i>	A
<i>Lycopodiella cernua</i>	N	<i>trichomanoides</i>		<i>Coprosma macrocarpa</i>	ABS
		<i>Podocarpus totara</i>	B, A	<i>Coprosma repens</i>	A
		<i>Prumnopitys ferrugineus</i>	A	<i>Coprosma rhamnoides</i>	N



<i>Coprosma robusta</i>	N, A	<i>Olearia furfuracea</i>	N	<i>Dianella latissima</i>	ABS
<i>Coprosma tenuicaulis</i>	N	<i>Olearia traversiorum</i> ◆	A	<i>Dianella nigra</i>	N
<i>Coprosma</i> sp. x 2	A	<i>Oxalis exilis</i>	N	<i>Dichelachne crinata</i>	N
<i>Corokia cotoneaster</i>	A	<i>Parsonsia heterophylla</i>	N	<i>Eleocharis acuta</i>	N
<i>Corynocarpus laevigatus</i>	A	<i>Persicaria decipiens</i>	N	<i>Eleocharis sphacelata</i>	N
<i>Cotula coronopifolia</i>	N	<i>Piper exelsum</i>	N	<i>Ficinia nodosa</i>	N
<i>Dichondra repens</i>	N	<i>Pittosporum crassifolium</i>	A	<i>Gahnia lacera</i>	N
<i>Dodonaea viscosa</i>	A	<i>Pittosporum eugenioides</i>	A	<i>Gahnia xanthocarpa</i>	ABS
<i>Dysoxylum spectabile</i>	A	<i>Pittosporum ralphii</i> ◆	A	<i>Gastrodia sesamoides</i>	N
<i>Entelea arborescens</i>	A	<i>Pittosporum tenuifolium</i>	A	<i>Isachne globosa</i>	N
<i>Epilobium pallidiflorum</i>	N	<i>Plagianthus divaricatus</i>	N	<i>Isolepis prolifera</i>	N
<i>Geniostoma ligustrifolium</i>	N	<i>Planchonella costata</i>	A	<i>Isolepis reticularis</i>	ABS
<i>Gonocarpus incanus</i>	N	<i>Pomaderris amoena</i>	N	<i>Juncus australis</i>	N
<i>Gonocarpus micranthus</i>	ABS	<i>Pseudopanax arboreus</i>	A	<i>Juncus edgariae</i>	N
<i>Griselinia littoralis</i>	A	<i>Pseudopanax crassifolius</i>	A	<i>Juncus kraussii</i>	N
<i>Haloragis erecta</i>	N	<i>Pseudopanax lessonii</i>	A	<i>Juncus pallidus</i>	N
<i>Hebe macrocarpa</i>	N	<i>Salicornia quinqueflora</i>	N	<i>Juncus planifolius</i>	N
<i>Hebe stricta</i>	A	<i>Samolus repens</i>	ABS	<i>Lachnagrostis billardierei</i>	N
<i>Hebe</i> sp.	A	<i>Schefflera digitata</i>	A	<i>Lepidosperma australe</i>	N
<i>Hedycarya arborea</i>	A	<i>Selliera radicans</i>	N	<i>Lepidosperma laterale</i>	N
<i>Hoheria populnea</i>	A	<i>Spergularia marina</i>	N	<i>Libertia grandiflora</i>	N
<i>Hydrocotyle dissecta</i>	N	<i>Solanum americanum</i>	N	<i>Machaerina articulata</i>	N
<i>Hydrocotyle elongata</i>	ABS	<i>Sophora chathamica</i>	B	<i>Machaerina juncea</i>	N
<i>Knightia excelsa</i>	B, A	<i>Suaeda novae-zelandiae</i>	N	<i>Machaerina rubiginosa</i>	N
<i>Kunzea robusta</i>	N, A	<i>Syzygium maire</i>	N?	<i>Machaerina teretifolia</i>	N
<i>Laurelia novae-zelandiae</i>	A	<i>Tetragonia tetragonioides</i>	N	<i>Machaerina tenax</i>	N
<i>Leptecophylla juniperina</i>	N	<i>Toronia toru</i>	A	<i>Microlaena stipoides</i>	N
<i>Leptospermum scoparium</i>	N, A	<i>Vitex lucens</i>	A	<i>Microtis unifolia</i>	N
<i>Leucopogon fasciculatus</i>	N	<i>Wahlenbergia violacea</i>	N	<i>Morelotia affinis</i>	N
<i>Leucopogon fraseri</i>	N			<i>Oplismenus hirtellus</i>	N
<i>Lilaeopsis novae-zelandiae</i>	N			<i>Phormium cookianum</i>	A
<i>Litsea calcaris</i>	A	<b>MONOCOTYLEDONS</b>		<i>Phormium tenax</i>	N, A
<i>Lobelia anceps</i>	N	<i>Acianthus sinclairii</i>	N	<i>Poa anceps</i>	N
<i>Melicope temata</i>	A	<i>Apodasmia similis</i>	N	<i>Potomageton cheesemanii</i>	N
<i>Melicytus macrophyllus</i> ◆	ABS	<i>Astelia banksii</i>	N	<i>Pterostylis albula</i>	N
<i>Melicytus ramiflorus</i>	A	<i>Austrostipa stipoides</i>	N	<i>Rhopalostylis sapida</i>	A
<i>Metrosideros excelsa</i>	N, A	<i>Bolboschoenus medianus</i>	N	<i>Rytidosperma biannulare</i>	N
<i>Muehlenbeckia australis</i>	N	<i>Carex banksiana</i>	N	<i>Rytidosperma unarede</i>	N
<i>Muehlenbeckia complexa</i>	N	<i>Carex dissita</i>	N	<i>Schoenus tendo</i>	N
<i>Myoporum laetum</i>	A	<i>Carex lessoniana</i>	N	<i>Tetragonia capillaris</i>	N
<i>Myriophyllum propinquum</i>	ABS	<i>Carex lambertiana</i>	N	<i>Thelymitra longifolia</i>	N
<i>Myrsine australis</i>	N	<i>Carex secta</i>	N	<i>Thelymitra pauciflora</i>	N
<i>Myrsine salicina</i>	A	<i>Carex solandri</i>	N	<i>Triglochin striata</i>	N
<i>Nertera depressa</i>	N	<i>Carex uncinata</i>	N	<i>Typha orientalis</i>	N
<i>Olearia albida</i>	A	<i>Carex virgata</i>	N		
		<i>Cordyline australis</i>	N, A		
		<i>Cyperus ustulatus</i>	N		

# Botany of Craigavon Park, Blockhouse Bay, Auckland

Mike Wilcox

## Introduction

Craigavon Park is an Auckland Council reserve in the Whau Local Board area (Fig. 1). It covers 11.8 ha and was gifted as a park to Auckland in 1929 by Mrs W.H. (Caughey) Smith to commemorate the visit by Lord Craigavon, the Prime Minister of Northern Ireland. William Henry Smith originally acquired the land from 1897 to 1905 (Blockhouse Bay Historical Society 2018). Landscape architect Fred Tschopp designed the park in 1929–1932 (Adam 2002). The park is a very popular off-leash dog-walking area and features a children's playground, a fitness trail, and a network of wide paths and bush tracks. It is in the Avondale Stream catchment of the Whau River.

There are five main types of vegetation here: open grass and verges; kanuka/gumland; old pine and black wattle woods; wetland, including stream margins; and cultivated native and exotic trees.

## Combined visit by the Auckland Botanical Society and the Auckland branch of the NZ Entomological Society, 15 September 2018

Those attending were *John Adam, Stephanie Angove-Emery, Paul Bell-Butler, Frances Duff, Alan Flynn, Luke Flynn, Molly Flynn, Beth Gibbs, Bill Goldstone, Ben Goodwin, Leslie Haines, Peter Hutton, Sandra Jones, Dongmei Li, Huimin Lin, Anna Mairs, Dylan Mairs, Richard Mairs, Nicholas Martin, Alistair MacArthur, Sharon Osman, Juliet Richmond, Joshua Salter, Stephen Thorpe, Liz Walker, Alison Wesley, Mike Wilcox, Dave Wilson, Maureen Young.*

Botanical highlights from the visit were the discovery of several ferns not previously recorded there, namely *Adiantum raddianum*, *Diplazium australe*, *Lastreopsis glabella* and *Pteris cretica* on creek banks; the abundance on the grassy margins of pink romulea (*Romulea rosea*) in full flower; the presence of two well-grown saplings of tawa (*Beilschmiedia tawa*) in regenerating bush; and numerous large-leaved mahoe (*Melicytus macrophyllus*) including one in flower.

## Lichens

The bark of old pine trees provides a significant habitat for lichens, common species being *Chrysothrix candelaris*, *Lepraria finkii*, *Parmotrema reticulatum*, *Ramalina celastri* and *Usnea pusilla*. The only terrestrial lichen recorded here is *Cladonia darwinii* (Fig. 2).

## Bryophytes

The liverwort *Heteroscyphus coalitus* is particularly conspicuous after rain (Fig. 3). It grows in colonies in shade, its main habitats being the base of old Monterey pine trees (*Pinus radiata*), and at the base of old or dead silver fern trunks (*Cyathea dealbata*). *Chiloscyphus semiteres* also grows at the base of old pine trees, on cabbage tree trunks, and on logs, and with it the moss *Rhaphidorrhynchium amoenum*. *Hypnum cupressiforme* and *Wijkia extenuata* are other mosses found here in on exposed tree roots. Trunks of mahoe (*Melicytus ramiflorus*) and titoki (*Alectryon excelsus*) trees in semi-shade commonly

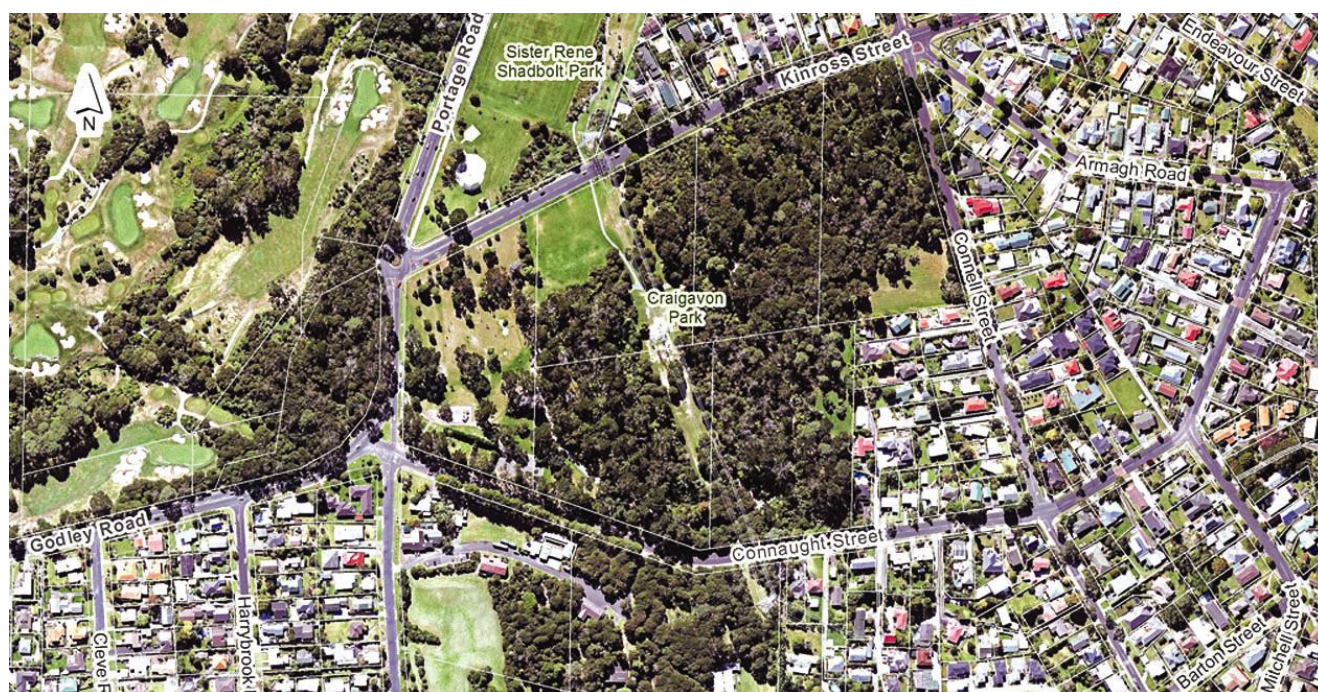


Fig. 1. Map of Craigavon Park.





**Fig. 2.** *Cladonia darwinii*, 19 Sep 2018. All photos taken in Craigavon Park by the author.



**Fig. 3.** *Heteroscyphus coalitus*, 14 Feb 2018.



**Fig. 4.** *Lycopodium deuterodensum*, 14 Feb 2018.

have a green mat-like coating of the liverwort *Metzgeria furcata*. The liverwort *Frullania solanderiana* forms green mats on the bark of kanuka (*Kunzea robusta*) and mahoe. Pipe cleaner moss (*Ptychomnion aciculare*) and milk moss (*Leucobryum javense*) are conspicuous terrestrial mosses of the kanuka/gumland community, the latter also occurring at the base of large old pine trees. *Thuidiopsis furfurosa* is another terrestrial moss found here in rather open scrub, and with it, the exotic thalloid liverwort *Lunularia cruciata*. The introduced European feather moss *Pseudoscleropodium purum* has been found on the ground in pine forest, *Eurhynchium praelongum* occurs commonly amongst grass, sometimes with *Breutelia pendula*, while a colony of sphagnum moss (*Sphagnum falcatulum*) occurs on the eastern forest edge (see cover illustration). A fine patch of *Lopidium concinnum* occurs on an old culvert pipe in deep shade.

### Ferns & Lycophytes

By far the commonest fern is silver tree fern (*Cyathea dealbata*) which occurs scattered and in groves in the understorey of the pine/wattle woods and in kanuka forest and regenerating mixed bush (following felling of pines). Mamaku (*C. medullaris*) is uncommon with a preference for damper sites and is represented mostly as naked stems following die-off of the crowns after felling of pine trees. *Dicksonia squarrosa* is also uncommon here. *Deparia petersenii* is a prominent fern of the stormwater creek banks, where also grow much less commonly gully fern (*Pneumatopteris pennigera*), kiokio (*Parablechnum novae-zelandiae*), *Adiantum raddianum*, *Diplazium australe* and *Austroblechnum membranaceum*.

The gumland (beneath kanuka, pines and wattle) vegetation of the north-eastern section of the park has extensive colonies of the club-moss *Lycopodium deuterodensum* (Fig. 4), and occasional *Gleichenia microphylla* and *Lindsaea linearis*. Epiphytic ferns are not at all prominent, but *Asplenium flaccidum*, *A. oblongifolium*, *A. polyodon* and *Microsorium pustulatum* are often seen as very low epiphytes or on the ground, and *Tmesipteris lanceolata* has been observed on silver fern trunks. The filmy fern *Hymenophyllum flabellatum* has been found in shade at the base of an old Monterey pine. This is the only filmy fern that regularly occurs in modified open bush habitats in the Manukau Harbour forest fringes at Hillsborough and Lynfield (Wilcox & Kowhai 2015; Wilcox & Warden 2017a, 2017b), where it is a small plant with short, crowded pinnae. *Selaginella kraussiana* is present in damp areas beside the tracks.

### Gymnosperms

Monterey pine and maritime pine (*Pinus pinaster*) are dominant trees of the park. They were planted in the early days on what was mostly then gumland scrub



on phosphate-deficient clay soil. The maritime pines are clearly the better adapted to this site, with numerous large healthy trees of noble appearance and with very attractive bark. The Monterey pines (Fig. 5) have struggled, and though attaining a large size, are mostly very branchy, and several had to be felled in 2005 because they had become moribund and hazardous (Auckland City Council 2005). Both species bear huge numbers of cones, but very few wildings have appeared. *Pinus radiata* sheds pollen in late July–early August, while *P. pinaster* sheds its pollen in mid–late September.

Of the native conifers, kahikatea (*Dacrycarpus dacrydioides*) stands out for its good growth, excellent health and elegant straight trunks. These have been mostly planted. Rimu (*Dacrydium cupressinum*) is occasionally seen as vigorous tall saplings in kanuka forest, while totara (*Podocarpus laetus* and *P. totara*) are widespread. Kauri (*Agathis australis*) is represented by a few smallish specimens planted on the margins, and tanekaha (*Phyllocladus trichomanoides*) is a rarity in kanuka/gumland forest. One approx. 5 m tall juvenile specimen of matai (*Prumnopitys taxifolia*) was recorded beside the path alongside the main stream.

There are two cultivated specimens of African yellowwood (*Afrocarpus falcatus*) growing near the carpark and playground, one of which is a very impressive spreading female tree.

### Monocots

The only monocot trees in the park are cabbage tree (*Cordyline australis*), nikau palm (*Rhopalostylis sapida*), and phoenix palm (*Phoenix canariensis*). Cabbage trees are common in the planted native bush areas, including the swamps by the creeks, and are regenerating in the pine forests. Nikau seedlings occur occasionally, and there are a few big specimens, probably planted. Phoenix palm has been recorded just as young seedlings.



Fig. 5. Pines, 15 Sep 2018.

Grasses are well represented, with the native *Microlaena stipoides* being particularly abundant, and a feature species of the park. The only other native grasses recorded are *Oplismenus hirtellus* in gumland/kanuka forest and near creeks, *Deyeuxia quadriseta*, *Rytidosperma unarede* in kanuka/gumland//pine forest, and toetoe (*Austroderia fulvida*) – planted beside a wetland. Prominent exotic grasses are narrow-leaved carpet grass (*Axonopus fissifolius*) which is the dominant summer species in the mown grass areas, and the very tall Vasey grass (*Paspalum urvillei*) found abundantly on bush and wetland margins. Common spring grasses are sweet vernal (*Anthoxanthum odoratum*), shivery grass (*Briza minor*), Yorkshire fog (*Holcus lanatus*) and annual poa (*Poa annua*).

Sedges are very conspicuous in the park, particularly in the kanuka/pine gumlands and along the creeks. Sword sedge (*Lepidosperma laterale*) is a standout species here, being very common in the pine and kanuka forest (Fig. 6). Other gumland-type sedges present are *Gahnia setifolia*, *G. xanthocarpa*, *Schoenus tendo* and *Tetraria capillaris*. The introduced yellow sedge (*Carex demissa*) grows in a thriving colony on the eastern margin of the park; *Carex lessoniana*, *C. secta* and *C. virgata* are abundant along the central creek; and *C. lambertiana* and *C. ochrosaccus* occur in regenerating forest and *C. dissita* by creeks. The weedy *Cyperus eragrostis* occurs abundantly on the damp margins of roads and tracks. Damp patches on the park margins have an assemblage of soft sedges, mainly *Isolepis distigmatosa*, *I. levynsiana* and *I. sepulcralis*.

Rushes are not particularly common in the park, the introduced soft rush (*Juncus effusus*) being the only tall leafless species occurring in the central wetland. A wood rush, *Luzula multiflora* (flowering in late August / early September), occurs in the open grassy area at the entrance at the corner of Kinross and Connell Streets, and near the children's playground.



Fig. 6. *Lepidosperma laterale*, 8 Feb 2018.





**Fig. 7.** *Sparaxis bulbifera*, 17 Sep 2018.



**Fig. 8.** *Melicytus macrophyllus*, 14 Feb 2018.



**Fig. 9.** Some kanuka (*Kunzea robusta*) forest has lush undergrowth, 4 Feb 2018.

Of the remaining miscellaneous monocots, arum lily (*Zantedeschia aethiopica*), montbretia (*Crococsmia ×crococsmiiflora*) and wandering Jew (*Tradescantia fluminensis*) are weeds of damp shaded places, flax (*Phormium tenax*) is common (probably planted) along the central stream, blue iris (*Aristea ecklonii*) is a weed of forest margins, and the native *Dianella latissima* and *D. nigra* are widespread in the kanuka/pine gumland vegetation. Near the entrance on the corner of Kinross and Connell Streets and by the children's playground the spring bulb *Sparaxis bulbifera* is found in impressive drifts (Fig. 7), and with it, *Gladiolus undulatus*, while *Romulea rosea* is another abundant wildflower in early spring (flowering spectacularly during the ABS visit).

#### **Dicot trees, shrubs and woody climbers**

The park has a range of dicot trees, planted as early pioneers, as amenity specimens, as restoration of former open sites and following removal of pines, or naturally occurring. Firstly, black wattle (*Acacia mearnsii*) was planted early on in mixture with the pines, and the trees have reached a large size. Many have been felled in recent years.

Secondly, there are numerous exotic trees in the amenity areas (playground, carpark, grassed fringes). Several Australian trees feature here, notably willow myrtle (*Agonis flexuosa*), silver dollar gum (*Eucalyptus cinerea*), brush box (*Lophostemon confertus*), giant honey myrtle (*Melaleuca armillaris*), brush cherry (*Syzygium australe*), lilly pilly (*S. smithii*) – of the Myrtaceae; silky oak (*Grevillea robusta*) of the Proteaceae; and river she-oak (*Casuarina cunninghamiana*) and swamp she-oak (*C. glauca*) of the Casuarinaceae. Other exotic amenity trees are London plane (*Platanus ×acerifolia*), claret ash (*Fraxinus angustifolia* var. *oxycarpa* 'Raywood'), box elder (*Acer negundo*), European beech (*Fagus*



**Fig. 10.** Kanuka forest where undergrowth has been destroyed by trampling, 19 Sep 2018.



*sylvatica*), tulip tree (*Liriodendron tulipifera*), Yunnan poplar (*Populus yunnanensis*), and corkscrew willow (*Salix matsudana* 'Tortuosa'). The best performers are brush box and Yunnan poplar.

Native trees too have been planted for amenity, the commonest being pohutukawa (*Metrosideros excelsa*), together with a specimen of narrow-leaved maire (*Nestegis montana*) and several puriri (*Vitex lucens*) and titoki (*Alectryon excelsus*).

Thirdly, the trees planted for ecological restoration are, with some exceptions, typical species native to Auckland. Abundantly represented are karo (*Pittosporum crassifolium*), lemonwood (*P. eugenioides*), kohuhu (*P. tenuifolium*), houpara (*Pseudopanax lessonii*), pohutukawa, karamu (*Coprosma robusta*), lacebark (*Hoheria populnea*), kowhai (*Sophora chathamica*) and wharangi (*Melicope ternata*). Non-local natives noted are *Griselinia littoralis*, *Olearia albida*, *Olearia paniculata*, *Sophora tetraptera* and *Streblus banksii*, and there is also an Australian shrub, *Leptospermum polygalifolium*, in the mixture. Koromiko (*Veronica stricta*) has commonly been planted on the margins. Within these maturing planted forests can be found self-established native shrubs, notably kawakawa (*Piper excelsum*), pigeonwood (*Hedycarya arborea*), mahoe (*Melicytus ramiflorus*), broad-leaved mahoe (*M. macrophyllus*) (Fig. 8), *M. micranthus*, hangehange (*Geniostoma ligustrifolium*), and coastal karamu (*Coprosma macrocarpa*). Naturally occurring silver fern is widely present in these planted forests, the trunks providing a foothold for the epiphytic establishment of pohutukawa, mingimingi (*Leucopogon fasciculatus*) and five-finger (*Pseudopanax arboreus*). Wet areas adjoining the main creek have successful (though still young) plantings of pukatea (*Laurelia novae-zelandiae*) and



Fig. 11. *Acacia longissima*, 14 Feb 2018.

swamp maire (*Syzygium maire*). Kohekohe (*Dysoxylum spectabile*) has regenerated profusely from presumably planted parent trees, forming an impressive mini-forest on the eastern boundary. And fourthly, the native trees natural to the area, the prime tall species being kanuka (*Kunzea robusta*). It occurs in pure groves (Fig. 9), some of which have been badly trampled (Fig. 10), and as a sub-canopy in the pine/wattle forest. Understorey associates are mapou, hangehange (*Geniostoma ligustrifolia*), pigeonwood, mahoe, mingimingi (*Leucopogon fasciculatus*) – in flower August and September (see Gardner 2013 for observations on its sexual dimorphism), shining karamu (*Coprosma lucida*) and *Coprosma rhamnoides*, this last being extraordinarily abundant. Kumerahou (*Pomaderris kumeraho*) is widely present on bush margins and was in flower during the September 2018 visit. Small saplings of *Coprosma arborea* occur in some of the better stands of kanuka, and putaputaweta (*Carpodetus serratus*) has been noted (though may have been planted). The only native lianas present are *Metrosideros perforata* clothing the naked trunk of a dead silver tree fern, and straggly examples of *Clematis paniculata* and *Parsonsia heterophylla*.

Mention also needs to be made of some exotic shrubs that have colonised the area, some of which are weeds. Four Australian plants – sweet hakea (*Hakea drupacea*), prickly hakea (*Hakea sericea*), long-leaved wattle (*Acacia longissima*) (Wilcox 2011) (Fig. 11), and native willow (*Callistachys lanceolatus*) – have been recorded as naturalised plants in the park, and there is sparse presence of moth plant (*Araujia hortorum*), *Elaeagnus × reflexa*, *Fatsia japonica*, Japanese spindle berry (*Euonymus japonica*), *Cotoneaster glaucophyllus* and gorse (*Ulex europaea*). The Australian *Leptospermum polygalifolium* is represented by a stout, multi-trunked specimen (probably planted) laden with seed, and with a second tree close by growing on an old pine stump. Black wattle has not regenerated much, but a fire would see it come up thickly. Woolly nightshade (*Solanum mauritianum*) appears to be confined to a few corners on the south-eastern side, where some seedlings have sprung up, and Jerusalem cherry (*Solanum pseudocapsicum*) is occasional in shaded undergrowth.

#### Herbaceous dicots

Only four native dicot herbs are at all common here. These are *Centella uniflora* in most forest areas, *Hydrocotyle moschata* beside paths, *Dichondra repens*, and *Persicaria decipiens* in wetland. Others recorded are *Callitriche muelleri*, *Calystegia sepium* subsp. *roseata*, *Geranium homeanum*, *G. retrorsum*, *Gonocarpus incanus*, *Oxalis exilis*, the fireweeds *Senecio bipinnatisectus* and *S. esleri*, and *Veronica plebeia*.



**Fig. 12.** *Hypericum mutilum*, 2 Feb 2018. Flowers are c. 4 mm in diameter.

Exotic dicot herbs are abundant in the open grassed areas, on the bush edges, and in the wetland. There is a rather long list of these, mostly of commonplace species, though there are some that are noteworthy. Selfheal (*Prunella vulgaris*) is particularly abundant, being found in grassland, on the bush edges, and beside every track and road. Another in this category is parsley dropwort (*Oenanthe pimpinelloides*) much in evidence on the bush edges and on the fringe of wetland. Chamomile (*Chamaemelon nobile*) is local here, forming a few patches within grassland. Dwarf St John's wort (*Hypericum mutilum*) is not well-known in Auckland, but there is a thriving colony not far from the main parking area (Fig. 12). Perhaps Craigavon's most famous plant is the Australian composite *Solenogyne gunnii*, a pilose flat weed reported from there by Rhys Gardner (1993, 1995). For a complete species list see the Appendix.

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## Feature plants

1. *Lepidosperma laterale*: very common in the kanuka forest and pine/wattle woodlands.
2. *Microlaena stipoides*: abundant on forest margins and in shaded places.
3. *Coprosma rhamnoides*: very common in kanuka forest and pine/wattle woodland.
4. *Kunzea robusta*: the only common, large native tree.
5. *Pinus radiata*: the signature large tree, commonly with *Pinus pinaster*.
6. *Acacia mearnsii*: many large old trees have been felled, though there are numerous ones still there. There are wildings, but these are not abundant, and unlikely to result in a resurgence of black wattle. Long-leaved wattle (*Acacia longissima*) was seen during the Sept 2018 visit.
7. *Lophostemon confertus*: worthy of mention as it is among the healthiest and handsomest of the various amenity trees that have been planted.
8. *Melicytus macrophyllus*: unusually, this tree, which is more at home in kauri and upland forest forests in Auckland, is coming away in some numbers in parts of the pine woodlands, and seemingly natural. *Melicytus micranthus* is also present, along with the common *Melicytus ramiflorus*.
9. *Centella uniflora*: the commonest native herb.
10. *Hypericum mutilum*: one large colony on a shady roadside. A little-known plant in Auckland.
11. *Solenogyne gunnii*: an Australian flat weed related to *Lagenophora*. Not seen in the present survey.
12. *Hakea drupacea*: a famous Blockhouse Bay plant recorded from Craigavon Park but not in recent years.

## Acknowledgements

Thanks to Stephen Thorpe, Ben Goodwin and Maureen Young for their contributions to the species list, and to John Adam for the information about Fred Tschopp. Joshua Salter thanks Jessica Beever for confirmation of the ID of *Sphagnum falciculatum*.

## Appendix: List of plants in Craigavon Park, Blockhouse Bay.

List compiled over numerous visits by the author from Dec 1999 to Oct 2018; and ABS visit on 15 Sep 2018.

\* = naturalised, cult. = planted

### Fungi

<i>Corynelia tropica</i>	on leaves of a totara tree
<i>Gymnopilus spectabilis</i>	on old cut stumps in pine/wattle forest

### Lichens

<i>Chrysothrix</i> sp.	on bark of pine trees
<i>Cladonia darwinii</i>	on ground beside a track
<i>Cladonia floverkeana</i>	on bark of old log
<i>Dirinaria picta</i>	on bark of <i>Cupressus sempervirens</i>
<i>Lepraria finkii</i>	on bark of pine trees and <i>Myrsine australis</i> , and on <i>Cyathea dealbata</i>
<i>Parmotrema reticulatum</i>	on bark of pine trees and on old pine stumps in open
<i>Ramalina celastri</i>	on bark of dead twigs of pine trees
<i>Strigula schizospora</i>	on titoki leaves
<i>Usnea pusilla</i>	on bark of dead twigs of pine trees
<i>Usnea rubicunda</i>	on dead twigs of <i>Leucopogon fasciculatus</i> and <i>Pittosporum tenuifolium</i>

### Algae

<i>Cephaleuros lagerheimii</i>	on leaves of <i>Meliccytus ramiflorus</i>
<i>Spirogyra</i> sp.	in the main pond near the pylon clearing

### Mosses

<i>Breutelia pendula</i>	damp ground in open grassy area
<i>Calliergonella cuspidata</i> *	in damp grassy area, eastern side
<i>Campylopus clavatus</i>	on ground in kanuka forest
<i>Campylopus introflexus</i>	on old stump in open
<i>Eurhynchium praelongum</i> *	in grass areas, common
<i>Fissidens taxifolius</i> *	on soil
<i>Hypnum cupressiforme</i>	on raised root of pine tree
<i>Leucobryum javense</i>	on ground in kanuka gumland and at the base of old pine trees
<i>Lopidium concinnum</i>	on old culvert pipe by stream
<i>Pseudoscleropodium purum</i> *	on ground in pine forest, and in open grassy margins
<i>Ptychomnion aciculare</i>	on ground in kanuka gumland
<i>Rhaphidorrhynchium amoenum</i>	at base of old pine trees
<i>Rhizogonium distichum</i>	on exposed tree roots
<i>Rosulabryum subtomentosum</i>	on stone pillar, entrance on corner of Connell and Kinross Streets
<i>Sphagnum falcatulum</i>	damp ground on eastern forest edge
<i>Syntrichia antarctica</i>	on stone pillar, entrance on corner of Connell and Kinross Streets
<i>Thuidiopsis furfurosa</i>	on ground in open scrub
<i>Thuidiopsis sparsa</i>	on ground in forest on track edge
<i>Wijkia extenuata</i>	on exposed tree roots

### Liverworts & hornworts

<i>Bazzania adnexa</i>	eastern kanuka/gumland, growing on exposed tree roots
<i>Chiloscyphus semiteres</i>	on bases of old pine trees, on cabbage tree trunks and old pine logs
<i>Frullania solanderiana</i>	on bark of kanuka and mahoe trees
<i>Heteroscyphus coalitus</i>	common at base of large pine trees
<i>Lobatiriccardia alterniloba</i>	on exposed roots of a pine tree in shaded forest, near a small stream
<i>Lunularia cruciata</i> *	on ground in open scrubby area
<i>Megaceros</i> sp.	vertical section of stream bank, in bush
<i>Metzgeria furcata</i>	on bark of mahoe and titoki trees
<i>Neolepidozia patentissima</i>	on rotting pine stump
<i>Symphyogyna hymenophyllum</i>	on bank in shaded forest
<i>Trichocolea mollissima</i> ,	on an old log



## Lycophytes

*Lycopodium deuterodensum*  
*Phlegmariurus varius*  
*Selaginella kraussiana* \*

## Ferns

*Adiantum raddianum* \*  
*Asplenium flaccidum*  
*Asplenium oblongifolium*  
*Asplenium polyodon*  
*Austroblechnum membranaceum*  
*Cyathea dealbata*  
*Cyathea medullaris*  
*Deparia petersenii*  
*Dicksonia squarrosa*  
*Diplazium australe*  
*Doodia australis*  
*Gleichenia microphylla*  
*Hymenophyllum flabellatum*  
*Icarus filiformis*  
*Lastreopsis glabella*  
*Lindsaea linearis*  
*Microsorium pustulatum*  
*Nephrolepis cordifolia* \*  
*Paesia scaberula*  
*Parablechnum novae-zelandiae*  
*Pneumatopteris pennigera*  
*Pteridium esculentum*  
*Pteris cretica* \*  
*Pteris tremula*  
*Pyrrosia elaeagnifolia*  
*Tmesipteris lanceolata*

## Gymnosperms

*Agathis australis* (cult.)  
*Afrocarpus falcatus* \* (cult.)  
*Cryptomeria japonica* \* (cult.)  
*Cupressus sempervirens* \* (cult.)  
*Dacrycarpus dacrydioides*  
*Dacrydium cupressinum*  
*Ginkgo biloba* \* (cult.)  
*Phyllocladus trichomanoides*  
*Pinus pinaster* \* (cult.)  
*Pinus radiata* \* (cult.)  
*Podocarpus laetus* (cult.)  
*Podocarpus totara* (cult. and natural)  
*Prumnopitys taxifolia* (cult.)

## Monocots – grasses

*Agrostis stolonifera* \*  
*Anthoxanthum odoratum* \*  
*Austroderia fulvida* (cult.)

*Axonopus fissifolius* \*  
*Briza minor* \*  
*Cenchrus clandestinus* \*  
*Cortaderia selloana* \*  
*Cynodon dactylon* \*  
*Danthonia decumbens* \*  
*Deyeuxia quadriseta* (R.O.Gardner, 1982, AK 171998; S.Astridge, 1975, AK 216382)  
*Digitaria sanguinalis* \*  
*Echinochloa crus-galli* \*  
*Ehrharta erecta* \*  
*Eleusine indica* \*  
*Eragrostis brownii* \*  
*Glyceria declinata* \*  
*Holcus lanatus* \*  
*Microlaena stipoides*  
*Oplismenus hirtellus* subsp. *imbecillis*  
*Panicum dichotomiflorum* \*  
*Paspalum dilatatum* \*  
*Paspalum orbiculare* (A.Esler & S.Astridge, 1975, CHR 276364)  
*Paspalum urvillei* \*  
*Poa annua* \*  
*Poa trivialis* \*  
*Rytidosperma biannulare* \*  
*Rytidosperma racemosum* \*  
*Rytidosperma unarede*  
*Setaria pumila* \*  
*Sporobolus africanus* \*  
*Vulpia bromoides* \*

## Monocots – restiads, rushes and sedges

*Apodasmia similis* (cult.)  
*Carex demissa* \*  
*Carex dissita*  
*Carex divulsa* \*  
*Carex flagelliformis*  
*Carex lambertiana*  
*Carex lessoniana*  
*Carex ochrosaccus*  
*Carex secta*  
*Carex uncinata*  
*Carex virgata*  
*Cyperus brevifolius* \*  
(Connaught St verge)  
*Cyperus congestus* \*  
*Cyperus eragrostis* \*  
*Cyperus ustulatus*  
*Gahnia setifolia*  
*Gahnia xanthocarpa*

*Isolepis inundata*  
*Isolepis levynsiana* \*  
*Isolepis distigmata*  
*Isolepis sepulcralis* \*  
*Juncus articulatus* \*  
*Juncus dichotomus* \*  
*Juncus effusus* \*  
*Juncus planifolius*  
*Juncus prismatocarpus*  
*Juncus tenuis* \*  
*Lepidosperma australe*  
*Lepidosperma laterale*  
*Luzula multiflora* \*  
*Machaerina juncea*  
*Schoenus apogon*  
*Schoenus maschalinus*  
*Schoenus tendo*  
*Tetraria capillaris*

## Monocots - other

*Agapanthus orientalis* \*  
*Allium triquetrum* \*  
*Alstroemeria* sp. \*  
*Archontophoenix cunninghamiana* \*  
*Aristea ecklonii* \*  
*Arthropodium bifurcatum* (cult.)  
*Asparagus scandens* \*  
*Cordyline australis*  
*Crococsmia × crocosmiiflora* \*  
*Dianella latissima*  
*Dianella nigra*  
*Freesia refracta* \*  
*Gladiolus undulatus* \*  
*Hyacinthoides non-scripta* \* (cult.)  
*Phoenix canariensis* \* (seedlings)  
*Phormium cookianum* (dwarf cultivar) (cult.)  
*Phormium tenax*  
*Rhopalostylis sapida*  
*Romulea rosea* \*  
*Sparaxis bulbifera* \*  
*Sparaxis tricolor* \*  
*Tradescantia fluminensis* \*  
*Zantedeschia aethiopica* \*

## Dicot trees, shrubs and woody climbers

*Acacia longissima* \* (M.D.Wilcox, 9 Mar 2018, AK 371028)  
*Acacia mearmsii* \* (cult. & wildings)  
*Acer negundo* \* (cult.)  
*Aesculus hippocastanum* \* (cult.)

*Agonis flexuosa* \* (cult.)  
*Alectryon excelsus* subsp. *grandis* (cult.)  
*Alectryon excelsus* subsp. *excelsus*  
*Araujia hortorum* \*  
*Beilschmiedia tarairi* (cult. and natural)  
*Beilschmiedia tawa*  
*Callistachys lanceolata* \* (E.K.Cameron: 3 Nov 1996, AK 229810; 2 May 1998, AK 235586; 16 Nov 1998, AK 237588)  
*Camellia sasanqua* \* (cult.)  
*Carmichaelia australis* (cult.)  
*Carpodetus serratus*  
*Casuarina cunninghamiana* \* (cult.)  
*Casuarina glauca* \* (cult.)  
*Chrysanthemoides monilifera* \*  
*Clematis montana* \* (cult.)  
*Clematis paniculata*  
*Coprosma arborea*  
*Coprosma* × *cunninghamii*  
*Coprosma grandifolia*  
*Coprosma lucida*  
*Coprosma macrocarpa*  
*Coprosma repens* (cult.)  
*Coprosma rhamnoides*  
*Coprosma robusta*  
*Corokia* × *cheesemanii* (cult.)  
*Corynocarpus laevigatus*  
*Cotoneaster glaucophyllus* \*  
*Dodonaea viscosa* (cult.)  
*Dysoxylum spectabile*  
*Elaeagnus* × *reflexa* \*  
*Eucalyptus cinerea* \* (cult.)  
*Euonymus japonica* \*  
*Euryops pectinatus* \* (cult., eastern margin)  
*Fagus sylvatica* \* (cult.)  
*Fatsia japonica* \*  
*Fraxinus angustifolia* var. *oxycarpa* \* (cult.)  
*Geniostoma ligustrifolia*  
*Grevillea robusta* \*  
*Griselinia littoralis* (cult.)  
*Hakea drupacea* \* (A.E.Esler, Oct 1973, AK 364775; E.K.Cameron, Feb 1986, AK 275898)  
*Hakea sericea* \*  
*Hedera helix* \*  
*Hedycarya arborea*  
*Hoheria populnea* (cult.)  
*Ipomoea cairica*  
*Ipomoea indica* \* (margin)  
*Nightia excelsa*  
*Kunzea robusta*

*Laurelia novae-zelandiae* (cult.)  
*Leptospermum polygalifolium* \* (cult.)  
*Leptospermum scoparium* (cult.)  
*Leucopogon fasciculatus*  
*Ligustrum sinense* \*  
*Liriodendron tulipifera* \* (cult.)  
*Lophostemon confertus* \* (cult.)  
*Melaleuca armillaris* \* (cult.)  
*Melicope ternata*  
*Melicytus macrophyllus*  
*Melicytus micranthus*  
*Melicytus ramiflorus*  
*Metrosideros collina* \* (cult.)  
*Metrosideros excelsa* (cult. and wild)  
*Metrosideros kermadecensis* (cult.)  
*Metrosideros perforata*  
*Metrosideros robusta* (cult.)  
*Myrsine australis*  
*Nestegis cunninghamii* (cult.)  
*Nestegis lanceolatus* (cult.)  
*Nestegis montana* (cult.)  
*Olearia albida* (cult.)  
*Olearia paniculata* (cult.)  
*Parsonsia heterophylla*  
*Piper excelsum*  
*Pittosporum eugeniooides*  
*Pittosporum crassifolium*  
*Pittosporum tenuifolium*  
*Platanus* × *acerifolia* \* (cult.)  
*Plectranthus barbatus* var. *grandis* \*  
*Pomaderris kumeraho*  
*Populus yunnanensis* \* (cult.)  
*Pseudopanax arboreus*  
*Pseudopanax crassifolius*  
*Pseudopanax crassifolius* × *P. lessonii* 'Cyril Watson' (cult.)  
*Pseudopanax lessonii*  
*Salix matsudana* 'Tortuosa' \* (cult.)  
*Schefflera digitata*  
*Solanum laciniatum*  
*Solanum mauritanium* \*  
*Solanum pseudocapsicum* \*  
*Sophora chathamica* (cult.)  
*Sophora tetraptera* (cult.)  
*Streblus banksii* (cult.)  
*Syzygium australe* \* (cult.)  
*Syzygium maire* (cult.)  
*Syzygium paniculatum* \*  
*Syzygium smithii* \* (cult.)  
*Trachelospermum jasminoides* \* (cult.)  
*Ulex europaeus* \*

*Veronica stricta* (cult.)  
*Vitex lucens* (cult.)

## Dicot herbs

*Amaranthus lividus* \*  
*Apium nodiflorum* \*  
*Bellis perennis* \*  
*Bidens frondosa* \*  
*Callitriche muelleri*  
*Callitriche stagnalis* \*  
*Calystegia sepium*  
*Cardamine flexuosa* \*  
*Cardamine hirsuta* \*  
*Centaurium erythraea* \*  
*Centella uniflora*  
*Cerastium glomeratum* \*  
*Chamaemelum nobile* \*  
*Cirsium vulgare* \*  
*Crepis capillaris* \*  
*Cymbalaria muralis* \*  
*Daucus carota* \*  
*Dichondra repens*  
*Epilobium ciliatum* \*  
*Erigeron karvinskianus* \*  
*Erigeron sumatrensis* \*  
*Euphorbia peplus* \*  
*Fumaria muralis* \*  
*Galium aparine* \*  
*Galium divaricatum* \*  
*Gamochaeta coarctata* \*  
*Geranium homeanum*  
*Geranium molle* \*  
*Geranium retrorsum*  
*Geranium purpureum* \*  
*Geranium robertianum* \*  
*Gonocarpus incanus*  
*Helminthotheca echioides* \*  
*Hydrocotyle moschata*  
*Hydrocotyle tripartita* \*  
*Hypericum mutilum* \*  
*Hypochaeris radicata* \*  
*Jacobaea vulgaris* \*  
*Lapsana communis* \*  
*Leontodon saxatilis* \*  
*Lepidium didymum* \*  
*Leucanthemum vulgare* \*  
*Lotus angustissimus* \*  
*Lotus pedunculatus* \*  
*Lysimachia arvensis* \*  
*Lythrum hyssopifolia* \*  
*Mentha pulegium* \*  
*Modiola caroliniana* \*

<i>Myosotis discolor</i> *	<i>Portulaca oleracea</i> *	<i>Solanum nigrum</i> *
<i>Myosotis laxa</i> *	<i>Potentilla indica</i> *	<i>Solenogyne gunnii</i> *
<i>Myosotis sylvatica</i> *	<i>Prunella vulgaris</i> *	<i>Soliva sessilis</i> *
<i>Oenanthe pimpinelloides</i> *	<i>Ranunculus muricatus</i> *	<i>Sonchus asper</i> *
<i>Oxalis exilis</i>	<i>Ranunculus parviflorus</i> *	<i>Sonchus oleraceus</i> *
<i>Oxalis incarnata</i> *	<i>Ranunculus repens</i> *	<i>Stachys sylvatica</i> *
<i>Oxalis pes-caprae</i> *	<i>Ranunculus sardous</i> *	<i>Taraxacum officinale</i> *
<i>Oxalis purpurea</i> *	<i>Rumex obtusifolius</i> *	<i>Trifolium repens</i> *
<i>Persicaria decipiens</i>	<i>Senecio bipinnatisectus</i>	<i>Veronica arvensis</i> *
<i>Phytolacca octandra</i> *	<i>Senecio esleri</i>	<i>Veronica persica</i> *
<i>Plantago lanceolata</i> *	<i>Sherardia arvensis</i> *	<i>Veronica plebeia</i>
<i>Plantago major</i> *	<i>Sison amomum</i> *	<i>Veronica serpyllifolia</i> *
<i>Polycarpon tetraphyllum</i> *	<i>Solanum lycopersicum</i> *	<i>Viola odorata</i> *

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## Mt Eden/Maungawhau urban rock-forests revisited

Ewen K. Cameron

On the 19 July 2014 Auckland Botanical Society (ABS) repeated its Mt Eden / Maungawhau urban rock-forest field trip of 17 July 1999 (Cameron 1999a), only this time we started with a record number (?) of 66 people (see Appendix 1) at Government House and finished with 36 people at Almorah Road (compared with 38 and finishing with 22 in 1999). Although it was a cold winter's day the rain held off until the end of the trip.

### The day's programme (19 July 2014):

10 am–noon: Government House grounds, via the Savannah Street entrance;  
 Noon–1 pm: Eden Gardens for lunch;  
 1.15 pm: Withiel Thomas Reserve off Withiel Drive (with talks from others);  
 Walk from Withiel Thomas to Almorah Road forest and finish there by 4 pm.

### **Introduction**

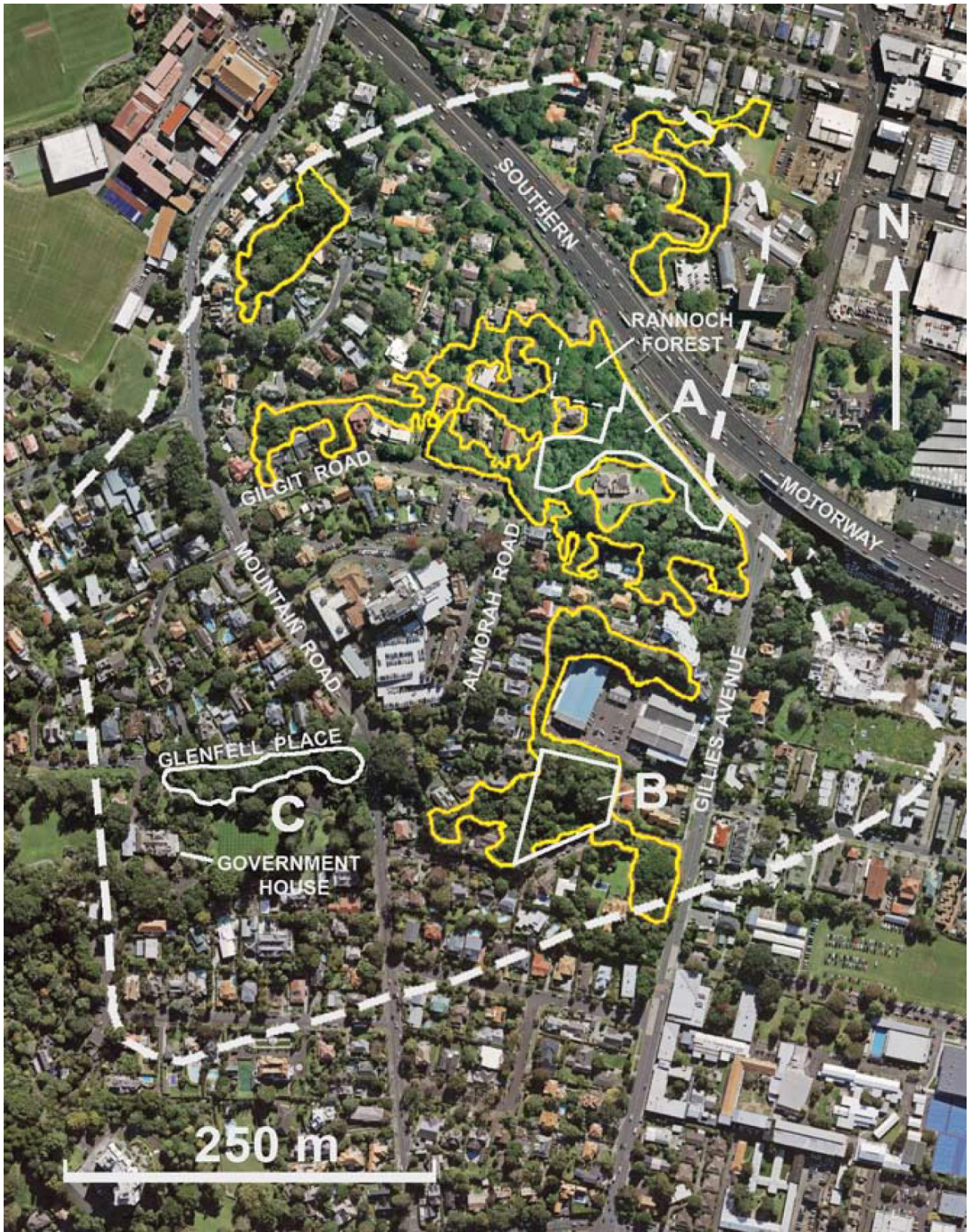
For a background on these Mt Eden rock-forest areas of urban Auckland see Kirk (1871), Millener (1965), Cranwell (1981), Esler (1991: 193), Smale and Gardner (1999), Cameron (1999a), Esler (2004: 48–49), Bush (2006), Wilcox (2012), and a very full and readable account by Wilkins (2016). In the 19<sup>th</sup> century it was estimated to cover less than 50 ha (Smale & Gardner 1999) and today is only 3 ha (see Fig. 1). The forest is a mix of public and private land (1.7 vs 1.3 ha). There are also scattered rock-forest trees and shrubs in adjacent properties. It all has a certain level of protection under a Special Ecological

Area (SEA) (Fig. 1) designation in the Unitary Plan, allowing only light tree-trimming; most other activities require a permit.

The remaining Mt Eden rock-forests lie on the north-eastern lower slopes of Mt Eden/Maungawhau on basaltic lava now estimated to be 28,000 years old (Hayward et al. 2011). Today the forests are centred around three small areas: Almorah Road (block A) (ex Goodfellow property), Government House grounds (block C) and Withiel Thomas Reserve (block B) (Fig. 1). Two of these face south and one faces north (Almorah) – this might explain the greater abundance of puriri (*Vitex lucens*) in the warmer Almorah forest. The best known, and the only one easily accessible to the public, is Withiel Thomas Reserve which was actually planted by Prof Thomas (see below); the other two appear to be genuine forest remnants. Lucy Cranwell (1981: 13) pointed out that one can also get a good view over the low rock wall into the Almorah rock-forest from Almorah Road.

Auckland Council recently classified its indigenous ecosystems (Singers et al. 2017) into the Department of Conservation's national ecosystem classification. The rock-forests fitted into their Puriri forest variant of WF7.2, which occurs on basaltic volcanoes in three main North Island areas: Pukekohe-Auckland, Whangarei and Kerikeri-Kaikōhe. It has a threat status of Critically Endangered.





**Fig. 1.** Location of the three main Mt Eden rock-forests in 'public' ownership (outlined in white): A = Almorah (ex Goodfellow), B = Withiel Thomas, C = Government House (not open to the general public). The broken white line marks the approximate original extent of this forest type (based on Smale & Gardner 1999, fig. 1). All 3.0 ha of the remaining fragmented Mt Eden rock-forest, as protected under the Council's Special Ecological Area (SEA), are delineated in yellow. Aerial photo (2017) and SEA boundary from Auckland Council GeoMaps (<https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html>), adapted by Joshua Salter.







## What is a rock-forest?

Lava fields with blocks of basalt rock would have been a feature of early Auckland. On Mt Eden, and a few other areas, there developed a special type of forest where broadleaf trees dominated without pohutukawa (*Metrosideros excelsa*) or conifers. I suspect that they started as pohutukawa forests, as seen today on the youthful Rangitoto Island. Over time the light-loving pohutukawa is replaced with the shade tolerant species. So today in these much older rock-forests we see the largest trees being mangleo (*Litsea calicaris*), mahoe (*Meliclytus ramiflorus*) and titoki (*Alectryon excelsus*). These three are frequently the most abundant trees, usually associated with karaka (*Corynocarpus laevigatus*), pigeonwood (*Hedycarya arborea*), kohekohe (*Dysoxylum spectabile*), puriri, puka (*Griselinia lucida*) and ngaio (*Myoporum laetum*). Houpara (*Pseudopanax lessonii*) is frequent in the subcanopy and the commonest shrubs are kawakawa (*Piper excelsum*), coastal karamu (*Coprosma macrocarpa* subsp. *minor*), mapou (*Myrsine australis*) and hangehange (*Geniostoma ligustrifolium*). Ferns are frequent on the rocky ground along with patches of peperomia (*Peperomia urvilleana*). The forest has its own special feeling with the trees coming straight out of the rock (Fig. 2), in places their roots snaking over the ground. Bryophytes and lichens can be common on the shaded rocks and tree trunks (Fig. 3). Contrary to Esler (2004: 49), there is at least one photograph and one painting showing the Mt Eden rock-forest present in early European times: an 1860s photo by John Kinder (held by the Auckland Museum and reproduced in Hayward et al. 2011: 130) and an 1876 watercolour by Alfred Sharpe (reproduced in Wilkins 2016: 92–93).

## Government House grounds (4.0 ha)

Clint Jensen of Bark Limited welcomed us to Government House grounds (Fig. 4) with an introductory talk about the grounds and their management on the margin of the Governor's Lawn (Fig. 5) and then he led us around for two hours. Bark Ltd has had the management contract for the grounds since 1997 and during this time has been active on weed control, particular focusing on wandering Jew (*Tradescantia fluminensis*) and

reducing the amount of fruit salad plant (*Monstera deliciosa*). Earmarked for future removal were the bay trees (*Laurus nobilis*) (naturalising vigorously, Fig. 6) along with several tree privet adults (*Ligustrum lucidum*).

Some of the tree plantings date from the 1870s, and the garden in several places retains the natural lava outcrops and the original vegetation that were once a feature of the wider area. Exotic species of trees are increasingly complemented by trees and shrubs native to New Zealand. The house was built in 1921 by Sir Frank and Lady Mappin who spent 45 years combining the natural features of the site, existing trees and new plantings to develop the garden we see today. The Mappins gifted the house and garden to the Crown in 1966 for use as a vice-regal residence. We learned that it is a permanent challenge to maintain the original character of the garden in a climate that encourages lush growth. Maintenance and development of the garden is under the direction of a management plan and a garden committee. Management goals are based on the recognition that the garden is a national treasure, and seek to conserve its historical, botanical and design values.

The management plan states that the grounds will be maintained "in sympathy to the Mappin wishes". This allows a certain freedom for placing of individual species as long as the overall tree landscape is maintained. Clint gave the example that they recently had removed a large storm-damaged Norfolk Island pine (*Araucaria heterophylla*) near the Mountain Road gate, which leaves a certain number of mature trees and they have a similar number of young trees in readiness to plant out when required. The garden is endorsed as a "Garden of National Significance" by the New Zealand Gardens Trust ([www.gardens.org.nz](http://www.gardens.org.nz)).

In 1999 the author had measured the diameter (DBH) of the impressive Queensland kauri (*Agathis robusta*) on the side of the drive from Mountain Road (Fig. 7) (Cameron 1999b), and re-measured the tree during our 2014 visit (Fig. 8). The result indicates an increased diameter of 22.3 cm in 15 years = 1.5 cm

**Figs. 2-12:** **2.** Rock-forest at Almorah Reserve, the large central puriri (c.80 cm DBH) with several smaller karaka trees. Photo: EKC, 20 Oct 2018. **3.** The leafy liverwort *Frullania spinifera*, and the pale patches of the crustose lichen *Porina exocha*, locally both common, on the shaded trunk of a large titoki tree, driveway margin of Rannoch Sculpture Forest. Photo: EKC, 1 Aug 2014. **4.** Bot Soc Entering the gate of Government House from Savannah Street. Photo: Philip Moll, 19 Jul 2014. **5.** Clint Jensen of Bark Ltd introducing Bot Soc to Government House grounds, on the Governor's Lawn. Photo: EKC, 19 Jul 2014. **6.** Bay tree (*Laurus nobilis*) seedlings in the rock-forest – adults close by; Government House grounds. Photo: EKC, 7 Dec 2014. **7.** A giant Queensland kauri in Government House grounds, with 2.1 m DBH. Photo: Philip Moll, 19 Jul 2014. **8.** The DBH of the giant Queensland kauri being re-measured by EKC. Photo: Philip Moll, 19 Jul 2014. **9.** A large tree of *Michelia doltsopa*, native to the eastern Himalayas, in full flower at the western end of Government House grounds. Photo: Mike Wilcox, 19 Jul 2014. **10.** The large mangleo tree in the rock-forest area of Government House grounds; DBH 67.5 cm. Photo: Mike Wilcox, 19 Jul 2014. **11.** *Lastreopsis microsora* – one of several common ground fern species in the rock-forest area of Government House grounds. Photo: Philip Moll, 19 Jul 2014. **12.** *Arthropteris tenella* – local, creeping over the rocks in the rock-forest area of Government House grounds. Photo: Philip Moll, 19 Jul 2014.



**Table 1: Diameter of two large trees at Government House grounds: Queensland kauri and mangleao.**

Tree	Date measured	DBH (cm)
Queensland kauri	Aug 1999	187.7
	Jul 2014	210.0
mangleao	Aug 1999	65.8
	Dec 2014	67.5

increase in diameter/year (Table 1). Some 4 m up, the trunk branches into two, and the canopy looked healthy. This tree has the largest diameter of any Queensland kauri in Auckland, and perhaps in New Zealand (cf. Cameron 1999b)? The well-known century-old kawaka (*Libocedrus plumosa*) near the Mountain Road gate had been dying for the last five years and was removed earlier in 2014 (C. Jensen pers. comm.). It was the largest known cultivated kawaka in New Zealand.

After walking around the upper western part of the garden (Fig. 9) we proceeded past the house and down to the rock-forest on part of the northern boundary of the grounds (block C, adjacent to Glenfell Place). There is an area of rock-forest here (0.4 ha), dominated by karaka; mahoe is locally common, with occasional titoki, pigeonwood, puriri and whau (*Entelea arborescens*). There are two adult mangleao present and the author returned later and also re-measured the largest mangleao here by the track (Fig. 10) which had hardly grown since it was last measured, with an increased diameter of only 1.7 cm in 15 years = 1.1 mm increase in diameter/year (Table 1). We admired some of the ground ferns growing here (Figs. 11, 12), but the locally common half-exotic hybrid, *Asplenium × lucrosum*, should be removed.

Jessica Beaver noted the weedy moss, *Fissidens taxifolius*, flourishing on soil in Government House grounds (see Appendix 2). A more welcome sight was a species of pin-cushion moss (probably *Leptostomum macrocarpon*), high on an untamed rock outcrop, at the western margin of the rock-forest area. *Leptostomum macrocarpon* was later seen at an accessible site by the author, epiphytic on one of the cultivated conifers near the main house.

#### **Eden Gardens (2.2 ha) – a planted quarry site**

Since 1964 Eden Gardens has been planted in the remains of an old basalt quarry – which shares its northern boundary with Government House grounds. There is an entry charge, toilets and a cafe – our lunchtime visit tested their food and drink delivery services. The basalt cliffs are a real feature of the garden along with *Rhododendron*, *Camellia*, *Magnolia*, bromeliad species and native New Zealand plants, including tree fern species. Mike Wilcox pointed out a nice Himalayan spindle tree (*Euonymus pendulus*) by the waterfall feature.



**Fig. 13.** Terrestrial puka (not the largest) with roots spreading over the rocks, and secondary roots wrapped around the trunk. Withiel Thomas Reserve. Photo: Joshua Salter, 4 Nov 2018.



**Fig. 14.** Tree privet stumps on the eastern boundary of the Almorah Reserve, above Gillies Ave motorway onramp, cut down a few evenings before this photo. Photo: EKC, 4 May 2016.

### Withiel Thomas Reserve (0.7 ha)

After lunch we reconvened just inside the Withiel Thomas Reserve (0.5 km distant) and heard from three people involved with the reserve, starting with Alice Baranyovits, a PhD student at the University of Auckland. Alice outlined her study on kereru in urban Auckland, looking at various aspects including diet, where they were spending their time, movement and a plant phenology study. She had radio-tagged 14 birds, including two from Government House grounds (the radio tags transmit their data every 28 days). She found that most birds didn't move far, usually staying within 3 km of where tagged. However, one female bird had been to Helensville and back (40 km each way). Almost on cue: while Alice was talking a kereru flew into the titoki canopy above her. Gabriel Daniels, Operations Manager for Te Ngahere, then spoke about the contract weeding and pest management work that his company has been doing in the reserve. This was followed by local conservation volunteer and champion weeder, Sel Arbuckle, who personally removed most of the wandering Jew that used to be abundant in the reserve. Sel mentioned the main weeds that he was finding: climbing asparagus (*Asparagus scandens*), Japanese hill cherry (*Prunus serrulata*), loquat (*Eriobotrya japonica*), *Homalanthus populifolius*, and by the western boundary he pointed out a hedge of *Mackaya bella* (Acanthaceae) where there were also some seedlings (now vouchered).

We walked the loop track made long ago by Prof Thomas through the rocky reserve under a tall canopy of titoki, mangeao, terrestrial puka (Fig. 13) and mahoe. The subcanopy and shrub layer was houpapa, kawakawa and coastal karamu; on the rocky ground there are scattered ferns, locally peperomia, occasional shrub and tree seedlings and very few weeds. We diverted to the upper eastern margin to see the northern tree rata (*Metrosideros robusta*), Hall's totara (*Podocarpus laetus*), rimu (*Dacrydium cupressinum*) and the Australian Illawarra plum pine (*Podocarpus elatus*) – evidently all planted by Prof Thomas. During the loop walk we recorded a single seedling of both tamarillo (*Cyphomandra betacea*) and Bangalow palm (*Archontophoenix cunninghamiana*) – both new records for the reserve (see Appendix 2). This reserve is the type locality for *Coprosma macrocarpa* subsp. *minor* A.P.Druce ex R.O.Gardner & Heads. The voucher was collected by the author in July 1999 (AK 239596) and it is a common understory tall shrub in this forest.

From Withiel Drive most of us walked to Almorah Road via Mountain Road, passing the entrance to 114 Mountain Road – the driveway to the Prof Thomas's old house 'Trewithiel'. Cranwell (1981: 13) records that Thomas's "...lovely garden ...was the first on a large scale to be wrested from the lava of this area..." As we walked we noted that many of the

street trees on Almorah Road were appropriately titoki, one of the main rock-forest components. However, in the adjacent Gilgit Road most were the exotic silver birch (*Betula pendula*). These should be replaced with appropriate locally-sourced rock-forest species. Several of the properties still had components of the rock-forest in their sections, including ngaio, mangeao, karaka, mahoe, puriri, kawakawa, coastal karamu and many fern species. The long frontage of 18 Gilgit Road was a particularly large forest patch topped by a tall mangeao.

### Almorah Road

Between Almorah Road and Gillies Avenue, predominantly on private land, is the largest continuous piece of remaining rock-forest in Auckland, covering 1.4 ha. In 1999 the Government put up for sale the largest parcel of land within this block, the old Sir William Goodfellow property (50% forested). In late 2001 a deal was finally struck after a public outcry with the purchaser (a developer) resulting in 0.63 ha of the rock-forest being purchased by the Department of Conservation and vested in Auckland Council as a reserve (Wilkins 2016). This then allowed the developer to sell off property lots, mostly contiguous with the forest, and mostly partially forested. On the 19 July 2014 visit, the nine house lots on the adjacent private land, 'Almorah Glade', were laid out with access driveways in place but at that stage none had been sold (the first sections sold in April 2016). Currently (Oct 2018) three luxurious townhouses have been built on the least-forested lots and are for sale. Sel informs me (pers. comm.) that several trees have already been cut down. Soon after publishing my previous account of the rock-forest (Cameron 1999a), stating that puka was absent in the Goodfellow property, I found a good-sized terrestrial puka on the higher land on the south side of the property; Sel informs me that there is also an epiphytic one in the adjacent reserved piece of rock-forest.

In 2014 we did a loop though the rock-forest beginning above the Gillies Avenue motorway on-ramp where tree privet was locally common. Two years later, around 40 tree privets were removed from here (Fig. 14) over three nights in May 2016 – a big under-taking as the motorway on-ramp had to be closed so the contractors could crane out the cut trees one by one (Wilkins 2016). Further into the forest itself it was hard to realise that we were in central Auckland – the forest was stunning, with long views between the tree trunks through to the Rannoch Forest at the northern end. In a large hollow the litter was covering the rocks and here there were large king ferns and several tall (>4 m trunks) nikau (*Rhopalostylis sapida*). We carefully weaved our way, admiring the trees coming out of the rock, with basal water-shoots numerous on several species, especially pigeonwood (Fig. 15) and mahoe. Many ferns were present. We came out near

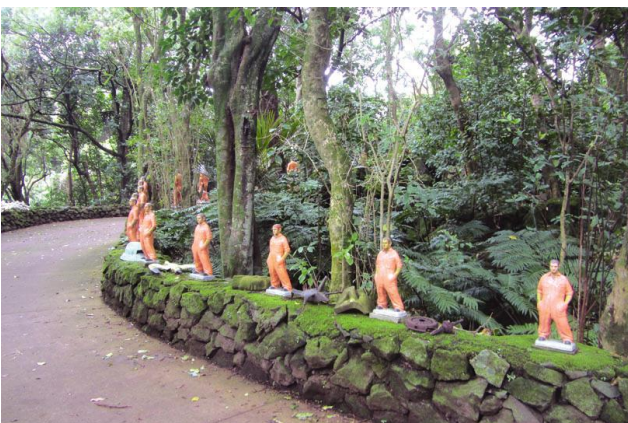




**Fig. 15.** Many of the tree-bases were encircled by water-shoots – perhaps a sign of stress by drought? Pigeonwood, Almorah forest. Photo: EKC, 21 Oct 2018.



**Fig. 16.** Inappropriate Council planting of *Clivia miniata* over four years ago on the street-frontage of 'Almorah Glade' in an area that the rock-forest (in background) could have been extended into. Photo: EKC, 21 Oct 2018.



**Fig. 17.** Vehicle entrance via the rock-forest sculptures to Rannoch House, 77 Almorah Road. Photo: EKC, 1 Aug 2014.

the gate on Almorah Road and went back down the drive to a tall mangleo in the open on the higher south side, with a low water-shoot bearing male flowers out of season.

A recent collection of *Hymenophyllum flexuosum* in Almorah reserve by Ben Goodwin and R. Prime confirmed the earlier literature record of Wall and Cranwell (1936). Checking the herbarium database revealed an earlier collection of this fern by Ian Atkinson in 1954 from "Mt Eden lava forest; on basalt rocks, lava forest community" (AK 259473) – great to know that it's still there. In 2014 the Albert-Eden Local Board agreed to fund a five-year weed and pest control programme in the Almorah rock-forest. This was certainly needed because there was obvious possum-browsing, especially on the kohekohe, and rats would be limiting regeneration by eating many of the seeds. The new gate to the private property 'Almorah Glade' (69 Almorah Road) now excludes public access into the publically-owned best piece of rock-forest (not that I'm advocating for mass-visitation to this sensitive area). Sadly the "tidied-up" entrance to 'Almorah Glade' is a large bed of exotic *Clivia miniata* (Fig. 16).

#### Other visits

After the July 2014 visit, other visits by the author to these Mt Eden rock-forests included: 1 Aug 2014 to the Rannoch Sculpture Forest (0.4 ha) contiguous with the Almorah Road reserve; 7 Dec 2014 the rock-forest at Government House grounds for two hours during an open day; 4 May 2016 Almorah rock-forest with the NZ Geographic reporter and photographer; 7 Sep 2018 the plaque unveiling at Withiel Thomas Reserve; and 20 Oct 2018 Almorah Forest to take some photographs.

#### Rannoch Sculpture Forest (0.4 ha)

The author visited the largest privately owned piece of Mt Eden rock-forest, Rannoch Sculpture Forest, on 1 August 2014. The area is contiguous with the Almorah reserve (0.63 ha) and there is no boundary marking between them – both areas are in contiguous native rock-forest. Apart from the house (Rannoch), driveway and clivias (*Clivia miniata*), the main difference between the Almorah Road property and Rannoch Forest is the presence of large sculptures scattered through the bush (see Wilcox 2012: 37, Wilkins 2016, Fig. 17).

The canopy of Rannoch Forest was dominated by titoki, mahoe, karaka and pigeonwood; also noted were mangleo, kohekohe, puriri, ngaio ( $\times 1$ ), and a single large pohutukawa hybrid (*Metrosideros excelsa*  $\times$  *M. robusta*) (see Table 2 for measurements of a selection of large canopy trees). One mangleo in the Almorah forest was a particularly impressive tree (Fig. 18). Cranwell (1981: 13) reported mangleo here as up to 1 m thick. The subcanopy and shrub layer was dominated by



**Table 2: Selected measurements of large canopy trees present in Rannoch Forest.<sup>1</sup>**

Tree species	DBH (cm)	Approx. height (m)	Comments
mangeao	88.4	24	Near margin of long driveway (S end of property); some rot down one side; trunk unbranched for 7m (Fig. 18)
mangeao	70.4		Below the long driveway (E side); healthy
puriri	63.2		Between house and Almorah Road
Hybrid pohutukawa × rata	60.0		Canopy tree in gully SE of long driveway; only 1 seen
karaka	52.9	16	
titoki	52.4		
titoki	50.2	18	In gully to SE of long driveway; with 7m-straight trunk
pigeonwood	38.8	15	

<sup>1</sup> = measured by the author on 1 Aug 2014

kawakawa and coastal karamu; hangehange was locally present; and nikau (trunkless) and houpara were scarce. The commonest plants covering the rocky ground were ferns: *Asplenium lamprophyllum*, *A. oblongifolium* (both locally common), and locally large king ferns (*Ptisana salicina*). On a rock wall *Pellaea falcata* (×2) and *Asplenium flaccidum* (×1) were present. The only epiphyte observed was *Pyrrosia elaeagnifolia* in a kohekohe; it was also locally common on the rocky ground where there was more light. No tree ferns or conifers were present, but bryophytes and lichens were common (Fig. 3).

The forest appeared to be weeded to some extent, there being no obvious weed problem. There was a scattering of wandering Jew, a patch of *Plectranthus ciliatus*, a single 4 m-tall *Euonymus japonicus*, *Acanthus mollis*, fruit salad plant, and a Madeira vine (*Anredera cordifolia*) locally on the boundary of Almorah Road. My main concern was the abundance of clivias that had been planted and were looking very at home in the shade, setting seed and starting to spread (Fig. 19). Hearteningly, the owner of the property, Sir James Wallace, has said (Wilkins 2016: 93): "Fallen trees and branches are cleared from around the sculptures, but other than possum trapping and removal of weeds, the remainder of the forest is left to itself.". However, in October 2018 one of the canopy kohekohe looked severely possum-browsed.

### Unveiling of the plaque at Withiel Thomas Reserve

By the invitation of the chair of the Albert-Eden Board, Peter Haynes, the author attended the unveiling of the Council plaque for Withiel Thomas Reserve on Withiel Drive, on 7 September 2018. The attendance was small but included six descendants of Prof Sir Algernon Phillips Withiel Thomas (Fig. 20), Albert-Eden Board representatives, Sandra Coney, a representative from Epsom Girls Grammar School, Mick Clout representing the Science Faculty of the University of Auckland and Sel Arbuckle.



**Fig. 18.** Possibly the largest mangeao on the Auckland isthmus, unbranched trunk for 7 m (c.24 m tall; 88.4 cm DBH) in the Rannoch Sculpture Forest. Photo: EKC, 1 Aug 2014.



**Fig. 19.** *Clivia miniata* planted and naturalising in Rannoch forest. The gnarled tree (centre-right) is a ngaio. Photo: EKC, 1 Aug 2014.





**Fig. 20.** Unveiling of the Council's new interpretative sign for Withiel Thomas Reserve. Three generations of Prof Thomas's family were present (left to right): Peter Thomas (grandson), Fiona Thompson (granddaughter), Christopher Thompson (great grandson), Katherine Ward (great granddaughter) and Sienna and Emilia Ward (great great granddaughters). Photo: Sandra Coney, 7 Sep 2018.

Prof Thomas's granddaughter, Fiona Thompson, was the only one present who actually remembered Thomas. Fiona's son, Christopher Thompson, spoke and mentioned that the property was bare, apart from some macrocarpas (*Cupressus macrocarpa*), when Thomas purchased the land in 1890 and that Thomas had landscaped and planted the area. He later kindly sent me a couple of historic images from the family collection, believed to have been taken by Prof Thomas, showing the land to be rather bare (Figs. 21, 22). There was also mention from the Thomas descendants of his love of hybridising daffodils (*Narcissus* spp.), and a few living examples with numerous perianth-lobes were brought to the unveiling. The fact that the area was planted and landscaped by Thomas explains the low number of micro-land snails that Jim Gouldstone found in Withiel Thomas Reserve; also, the puka is terrestrial in the reserve, indicating that they had established in the open (see Cameron 1999a). Esler, too, noted "...the planting in the case of Withiel Thomas Park." (Esler 2004: 49).

Christopher Thompson also answered my query of why the reserve was called 'Withiel Thomas', when Prof Thomas's first name was Algernon: "I think my grandfather Norman, who actually gifted the reserve to the ACC in 1948, was disinclined to see the name Withiel alienated from the property; it had been known as 'Trewithiel' (i.e. from Cornish meaning gathering place of the Withiels, which, in turn means hill of wooded trees) since 1890. The name has long been a family name although it derives from APW Thomas' grandmother's surname and presumably her family originated in the eponymous Cornish village. The villagers of Withiel are quite proud of the connection; they have hung his framed photograph in the porch of their church."



**Fig. 21.** Prof Thomas's wife, Emily, digging around the base of what looks like a toppled macrocarpa (child unidentified). Photo: c.1891 most likely by Prof Thomas, from the Sir George Grey Special Collections, Auckland Libraries, 201-60 (or 210-63).



**Fig. 22.** Prof Thomas's property. Three men making a path? Photo: c.1891 most likely by Prof Thomas, from the Sir George Grey Special Collections, Auckland Libraries, 201-60 (or 210-63).

## Conclusions

It was wonderful that the tree privets have been removed from the Almorah forest and the slope to the on-ramp replanted in suitable species. The Council's Special Ecological Area offers some hope that the forest won't be further fragmented. All three areas are now being better managed for weeds and mammalian pests, but the housing development at the Almorah forest may significantly diminish the footprint of the largest remaining rock-forest remnant. If it is going to survive, every opportunity must be taken, where possible, to increase the footprint of this fragmented, threatened forest type.

The importance of the Mt Eden rock-forest becomes apparent when you realise the fate of other rock-forest areas in Auckland: Mt Wellington/Penrose (Cranwell 1981) and Western Springs have all been consumed by urbanisation (Wilkins 2016). Rhys

Gardner (2007: 76) described two rock-forest areas at Meola Creek: "...although they are of no great age or diversity they deserve better treatment" and Gardner and de Lange (2008) described a tree privet rock-forest at the mouth of Oakley Creek rich in bryophytes.

Forest ecologist Peter Bellingham informs me (pers. comm.) that the best rock-forest (basalt boulder field) that he has seen is the privately owned Jack's Bush in Northland, c.12 km east of Kaikohe, which has lush ferns and no weeds. The main forest species present here were described by Rawlings (1971) when reporting a *Peperomia tetraphylla* that he found there. Most of the species are the main ones present in the Auckland rock-forests. However, there are also several which have not been recorded in the Auckland forests, including: *Adiantum hispidulum*, *Asplenium bulbiferum*, *Dicksonia squarrosa*, *Notogrammitis* sp. (as *Grammitis billardierei* – not collected), *Fuchsia excorticata*, *Rhabdothamnus solandri* and *Urtica ferox*. The notes of a herbarium collection of *Hymenophyllum flexuosum* from Jack's Bush gives a feel for the forest: "Locally abundant creeping over basalt boulders in deep shade in puriri / kohekohe forest over a basalt boulder field; with abundant *Asplenium lamprophyllum* and *Arthropteris tenella*" (*PJ Bellingham 587*, 3 Jun 1993, AK 212523).

## Acknowledgements

Thanks are due to: the Governor-General for permission to visit Government House grounds; Clint Jenson of Bark Limited for an informative guided tour around Government House grounds; Sel Arbuckle for his observations and weed specimens; Peter Haynes, chair Albert-Eden Board, for inviting me to the Withiel Thomas Reserve plaque unveiling; Christopher Thompson (grandson of Prof Thomas) for information about the Withiel Thomas property and Prof Thomas, and supplying the two historical family images; Keith Giles of Auckland Central Library for locating the Thomas images (on negative film) and scanning them; Rannoch House residents for permission to survey the Rannoch grounds; John Braggins, Jessica Beever, Dan Blanchon and Dhahara Ranatunga for bryophyte and lichen identifications; Ben Goodwin for the collection of *Hymenophyllum flexuosum*; Sandra Coney, Philip Moll, Joshua Salter and Mike Wilcox for the use of their images; Hugo Geddes of Auckland Council for providing the SEA boundaries; Duncan Benzie for assistance in obtaining the Council map; Paula Legel for assistance with references; Joshua Salter for adapting the map; Peter Bellingham for his Northland rock-forest information; and Vijay Soma for assisting with the field trip list of participants.

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## Appendix 1: Participants of the 19 July 2014 field trip to the rock-forests

A total of 68 people attended the field trip: Sel Arbuckle, Chris Ashton, Alice Baranyovits (at Withiel Thomas), Hugo Baynes, Jessica & Rosemary Beever, Dan Blanchon, Colleen & Warren Brewer, Jan Butcher, Bruce Calvert, Ewen Cameron (leader), Esther Dale, Gabriel Daniels, Neil Davies, Frances Duff, Frank & Mary Frazer, April Glenday, Justin Gohdes, Sharen Graham, Leslie Haines, Peter Hutton, Mike Hynard, Graeme Jane, Clint Jensen (Bark Ltd), Wendy John, John Lambert, Mei Nee Lee, Miriam Ludbrook, Richard Mairs, Christine Major, Melissa Marler, Tim Martin, John Millett, Philip & Terry Moll, Michelle Moloney, Carol & Garry McSweeney, Helen Nicholson, Stephanie Parkes, Gordon Perry, Helen Preston Jones, Dhahara Ranatunga, Juliet Richmond, Leigh Rumney, Anna Ryken, Joshua Salter, Doug Sheppard, Bryony Smart, Vijay Soma, Adrienne Stanton, David Stejskal, Claire Stevens, Cheryl Taylor, Merje Toome, Lenka Trefulkova, Charlie Truell, Liz Walker, Eugene Wong Doe (at Almorah Road), Julia Watson, Mike Wilcox, Tony Williams, David Wilson, Sarah Wyse, Angelina Young, Maureen Young.



## Appendix 2: Additions to the Mt Eden Rock-Forest Species List of Cameron (1999a).

c = common; l = local; o = occasional; s = scarce (< 5 plants seen)

AF = Almorah Forest; WT = Withiel Thomas Reserve

Plant name	Plant group	Almorah (Goodfellow) & Rannoch	Withiel Thomas	Govt. House	AK voucher	Date of observation
<i>Hymenophyllum flexuosum</i>	fern	s <sup>1</sup>			295473 371040	May 1954 Jun 2018
<i>Pellaea falcata</i>	fern	s			353466	17 Aug 2014
<i>Clerodendrum trichotomum</i> *	dicot	s			357121	Mar 2015
<i>Cyphomandra betacea</i> (tamarillo)*	dicot		s			19 Jul 2014
<i>Griselinia lucida</i>	dicot	s				2000
<i>Mackaya bella</i> (forest bell bush)*	dicot		l		353873	19 Jul 2014
<i>Archontophoenix cunninghamiana</i> (Bangalow palm)*	monocot	l	s			Jul 2001 (AF) 19 Jul 2014 (WT)
<i>Clivia miniata</i> (clivia)	monocot	lc			353609	1 Aug 2014
<i>Fissidens taxifolius</i> *	moss			o		19 Jul 2014
<i>Leptostomum macrocarpon</i>	moss			l	355532	19 Jul 2014
<i>Plagiomnium novae-zelandiae</i>	moss	lc			353468	1 Aug 2014
<i>Thuidium sparsum</i>	moss	l			353468	1 Aug 2014
<i>Rhynchostegium tenuifolium</i>	moss	l			353468	1 Aug 2014
<i>Frullania fugax</i>	liverwort	o			353470	1 Aug 2014
<i>Frullania spinifex</i>	liverwort	lc			353467	1 Aug 2014
<i>Lejeunea</i> cf. <i>flava</i>	liverwort	o			353469	1 Aug 2014
<i>Porina exocha</i>	lichen	lc				1 Aug 2014

<sup>1</sup> = confirms the earlier literature record of Wall & Cranwell (1936)

## A northern range extension for *Hymenophyllum bivalve*, Kaiwaka, Northland

Jack Warden

On the 14 May 2018 the Auckland Botanical Society (ABS) descended on the Worsfold and Wright Farm just outside of the village of Kaiwaka, Northland. It was an amazing day with a great turn-out of people. Heath Worsfold, one of the landowners, gave us an in-depth history of the local area and his family.

The day was spent exploring the bush remnants known under the Natural Areas of Rodney Ecological District (Northland Conservancy) as the Kaiwaka – Mangawhai Road bush remnants (Goldwater, et al. 2012). A full detailed list of the flora of the bush remnants is currently being updated and will be published later, to capture some of the species that will appear as the seasons change.

The bush area is significant because the Worsfold and Wright families had the foresight to protect patches of bush from the ever-hungry herds of cattle they run. Compared to many of the identified Natural Areas in the district, it is always a bonus to have a bush area with an undisturbed array of ground tier species.

Although the bush area has been fenced for some time, the signs of past activities from Maori excavations, shell midden, old felled kauri (*Agathis australis*) stumps and old decaying fence lines cannot be overlooked. The bush area in a generalised sense consists of kauri – podocarp – broadleaved forest with kauri and associated podocarps dominating the

upper ridgelines, and broadleaved species such as taraire (*Beilschmiedia tarairi*), tawa (*Beilschmiedia tawa*), kohekohe (*Dysoxylum spectabile*) and titoki (*Alectryon excelsus*) dominating the lower areas around the streams.

The dense bush with its associated streams provides a great array of habitats for filmy ferns (*Hymenophyllum* spp.). During the initial reconnoitre, and later during the actual ABS field trip, a total of seven filmy ferns were recorded from the bush area.

The new northern record of *Hymenophyllum bivalve* was not as simple as it appears. During the ABS field trip the small filmy fern with toothed pinnae growing on an old decaying kauri stump was deemed to be *Hymenophyllum multifidum*. This being a new species for me and others, several photos were taken. In the days following the field trip, the observation was put up on iNaturalist NZ to be scrutinised by the wider online botanical community. Jacqui Geux had some great photos and it was first brought to our attention by David Hutchinson that we may need to take a closer look. Further comments came from some of New Zealand's leading fern authorities, Leon Perrie and Pat Brownsey, including from Leon:

"Pat agrees that it is *Hymenophyllum bivalve*. With regard to getting a specimen, he says 'It would be a significant new record, putting the species north of Auckland for the first time.'"

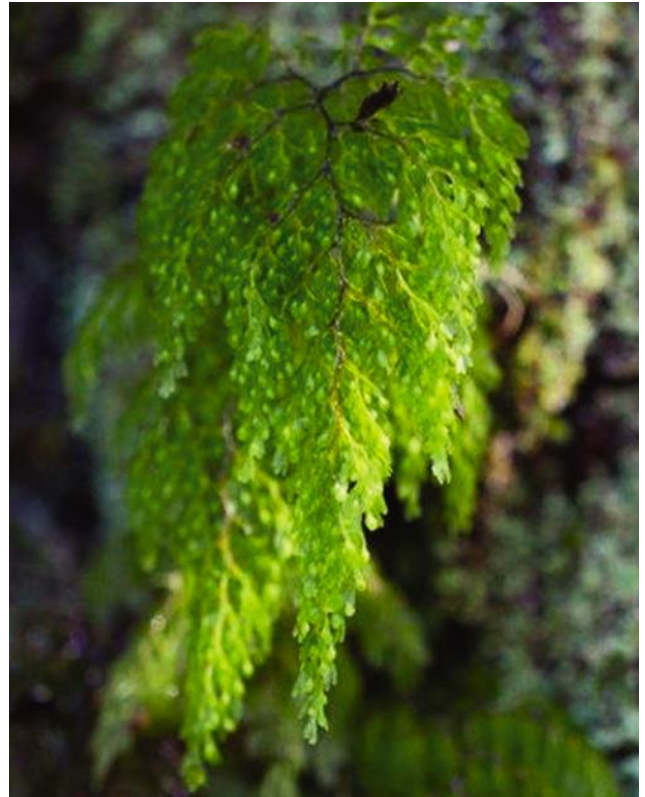
With the new-found information and the thought of a new northern record, on 24 June 2018 Maureen Young and I set out to verify the initial identification. Luckily, finding the exact location of the old kauri stump wasn't too much trouble and on closer inspection we were able to put all the small pieces of filmy fern anatomy together.

The filmy fern, *Hymenophyllum bivalve* (Figs. 1, 2, 3) is indigenous to New Zealand, found in the North, South, Chatham and Auckland Islands. The prior northern-most record was from Centennial Park at Campbells Bay (Auckland) (AK 293291, *EK Cameron 13161 & S Jones*, 21 Sep 2005) with the species scarce north of Waikato. It also occurs in Australia (Queensland to New South Wales) (Brownsey & Perrie 2016). This discovery of it at Kaiwaka extends its northern New Zealand range by approximately 70 km.

The fern is found from coastal to montane forest, either terrestrial or as a low epiphyte on tree trunks and roots (Brownsey & Perrie 2016). The location (Kaiwaka) and habitat in which the new specimen (AK 371013) was collected is approximately 1 km from the upper reaches of the Kaipara Harbour and approximately 6 km from the upper reaches of the Mangawhai estuary, 60 m above sea level.



**Fig. 1.** *Hymenophyllum bivalve* on an old kauri stump. Photo: J. Geux, 14 May 2018.



**Fig. 2.** A full view of *Hymenophyllum bivalve* fronds and growth habit at Kaiwaka. Photo: J. Warden, 24 June 2018.



**Fig. 3.** *Hymenophyllum bivalve* at Kaiwaka with sori in the plane of the frond. Photo: J. Geux, 14 May 2018.





**Fig. 4.** *Hymenophyllum multifidum* at Windy Canyon, Great Barrier Island with upwards-bent sori. Photo: J. Warden, 15 September 2018.

After a lot of searching, the fern appeared to be isolated to a single old moss-covered kauri stump from a tree felled 100–150 years ago (Fig. 1). The general canopy consisted of kauri, tanekaha (*Phyllocladus trichomanoides*) and rewarewa (*Knightia excelsa*). Understorey species of note included white maire (*Nestegis lanceolata*), mamangi (*Coprosma arborea*), *Coprosma spathulata* and lancewood (*Pseudopanax crassifolius*), and *Alseuosmia* spp. were common as small shrubs.

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As indicated above, *H. bivalve* could be confused with *H. multifidum*. However, *H. bivalve* can be distinguished by its larger size, brighter green fronds (Fig. 2) and more shallowly toothed margins. The most distinguishing feature is when the sori are fertile. In *H. bivalve* the sori are smaller, protected by two separate indusial flaps (bivalved), and lie in the plane of the frond (Fig. 3). In *H. multifidum* the two indusia are fused into a tapered cylinder, and the sori are typically bent upwards at 90 degrees to the plane of the frond (Fig. 4) (Brownsey and Perrie 2016).

#### Acknowledgements

Thanks again to the Worsfold and Wright families for allowing access to their properties; to Maureen Young for joining me to collect and identify the specimens; to Ewen Cameron at Auckland Museum herbarium (AK) for lodging the specimen and providing other records; to Leon Perrie and David Hutchinson for alerting us to the correct identification; to Jacqui Geux for providing images; and to the wider iNaturalist NZ community.

## Frugivory and seed dispersal in the Auckland region

**Andrew P. McK. Pegman**

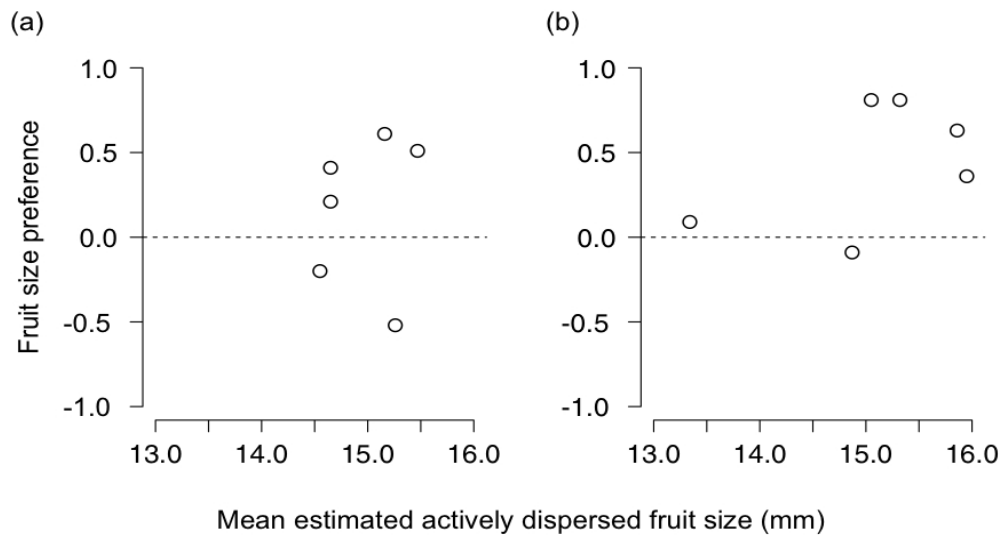
Pigeons are essential worldwide for seed dispersal, especially for tree species that have large fruit and seeds. In New Zealand, the endemic pigeon (*Hemiphaga novaeseelandiae*, Columbidae) is almost the sole volant canopy-based disperser of fruits of some indigenous tree species.<sup>1</sup> This is because many canopy tree species in New Zealand produce large fruit with minimum dimension >15 mm and *H. novaeseelandiae* is the only widespread avian frugivore capable of swallowing and dispersing such fruits and seeds due to its distensible beak gape.

Two recent papers complement each other to show how factors on both local and landscape levels interact

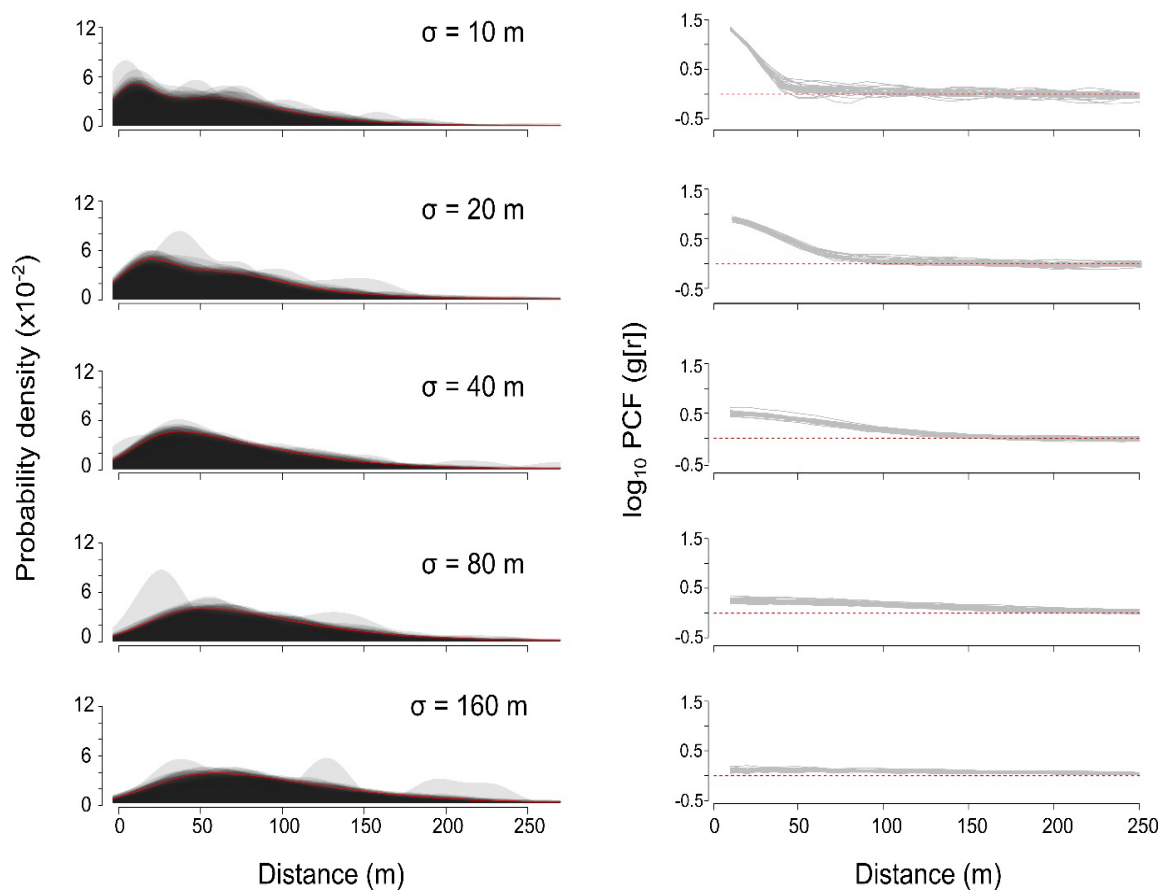
to affect the outcomes of seed dispersal processes: In the first paper, Pegman et al. (2017) found that actively dispersed seeds were significantly longer than seeds from passively dispersed fruit, suggesting frugivore preference for larger fruit in two large-fruited canopy tree species (*Vitex lucens* and *Prumnopitys ferruginea*) located in the Waitakere and Hunua Ranges and Wenderholm Regional Park, as shown in Figure 1. This is important because the non-random selection of fruits by frugivores can affect plant demography by changing the probability of seedling recruitment. For example, larger fruits usually contain bigger seeds, which often have higher seedling survivorship during establishment than small seeds (Moles & Westoby 2004).

In the second paper, which explored the interaction of frugivory by *H. novaeseelandiae* and tree spatial heterogeneity and its effect on seed

<sup>1</sup> In contrast, weka (*Gallirallus australis*) conducts flightless ground-based dispersal of seeds from large-fruited tree species, such as *Elaeocarpus dentatus* (Carpenter et al. 2018).



**Fig. 1.** The relationship between mean estimated actively dispersed fruit size (mm) and fruit size preference by *H. novaeseelandiae* across **a**, six *P. ferruginea* trees and **b**, six *V. lucens* trees, in one fruiting season, across Waitakere and Hunua Ranges and Wenderholm Regional Park. Fruit size preference was calculated by subtracting the mean passively dispersed fruit length from the mean estimated actively dispersed fruit length; values greater than zero indicate a preference for larger than average fruit and values less than zero represent a preference for smaller than average fruit.



**Fig. 2.** The left hand column shows simulated seed dispersal kernels generated by 30 randomly selected *H. novaeseelandiae* from the total pool (light grey shaded areas), with the darkest curved area showing the kernel density estimated across all frugivores, with  $\sigma$ , the degree of tree aggregation, increasing from top to bottom (highly aggregated to diffuse trees). The right hand column shows the spatial association between trees and seed deposition events using the bivariate pair correlation function for each of 30 replicates (irregular lines) for each value of  $\sigma$ . The dotted horizontal line is the theoretical expectation ( $g[r] \equiv 1$ ) under a null homogeneous Poisson model, and the distance (x- axis) at which the irregular lines approach this value gives an estimate of the distances over which seed deposition occurred with respect to fruiting trees. The simulation model that was developed to generate these data was parameterized, in part, with empirical data obtained at Waitakere and Hunua Ranges and Wenderholm Regional Park (Pegman 2016).



dispersal kernels using a simulation model, Pegman et al. (2016) demonstrated that the spatial arrangement of the above two canopy tree species plays an important role in dispersal processes. Tree aggregation was correlated with a lower mean seed dispersal distance, as shown in Figure 2, although it was accompanied by occasional long-distance dispersal events. Conversely, tree dispersion was correlated with an increase in mean dispersal distance, potentially increasing the probability of seeds finding suitable habitats for germination and growth.

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The good news is that *H. novaeseelandiae* has been doing an excellent job in dispersing seeds from other large-fruited canopy trees too. For example, Pegman (in prep.) has shown that seeds of *Corynocarpus laevigatus* and *Beilschmiedia tarairi* (two other large-fruited indigenous tree species) were found under canopies of *V. lucens* and *P. ferruginea* in the Waitakere and Hunua Ranges, where almost no *C. laevigatus* and *B. tarairi* trees were observed.

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## ***Corybas rotundifolius* (Hook.f.) Rchb.f. in Woodcocks Kawaka Reserve, near Warkworth**

**Maureen E. Young**

During the time that I have been aware of the tiny helmet orchid, *Corybas rotundifolius* (Fig. 1), it has been known by three different names. When *Flora of New Zealand Volume II* was published (Moore & Edgar 1970) this orchid was confused with an Australian species, *C. unguiculatus*, and Lucy Moore, author of the orchid chapter in that publication, used that name. Later, when the *Corybas* genus was split up by two Australian botanists (Jones et al. 2002), the name *Anzybas rotundifolius* was used.<sup>1</sup> Much to the frustration of us ordinary mortals it has been changed yet again, and has now settled for the time being, as *Corybas rotundifolius*. In Moore and Edgar (1970: p.116) the distribution was given as:- "Known only from a few localities, all north of lat. 38°; near Kaitaia; north of Whangarei; Glen Eden slopes of Waitakere Range; Tauhei near Morrinsville; Moanatuatua near Cambridge .... rare and easily overlooked".

In 1981, David Given, then New Zealand's leading authority on rare and endangered native plant

species, published *Rare and Endangered Plants of New Zealand* (Given 1981), and compiled, together with Gordon Williams, the *Red Data Book on Threatened Species in New Zealand* (Williams & Given 1981). These two volumes brought to the attention of the botanical world the presence of many species that were poorly known, and with many more informed searchers out in the field a truer picture was gained of the numbers of these various plant species. *Corybas rotundifolius* was one of those species.

Although rather spasmodic in occurrence, *C. rotundifolius* is no longer considered to be a threatened plant, being found from Spirits Bay to Warkworth, with one outlier at Opuatia, near Rangiriri, and also on the Chatham Islands and Great Barrier Island. It is usually found in regenerating forest or gumland scrub amongst dense litter. A single ovate leaf up to 2.5 cm long, occasionally notched on each side, subtends a solitary maroon and white flower that stands directly over the leaf. It does not have the long, filiform lateral sepals and petals that are seen in many of the other *Corybas* species and give them the common name of "spider orchids".

And so the scene is set for the exciting discovery, in 1985, of *C. rotundifolius* in Woodcocks Kawaka

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<sup>1</sup> **Footnote from Editors** : Confusingly, in *Flora Vol II* the name *N. rotundifolia* is mentioned only in notes appended to the entry for *Corybas oblongus* (Moore & Edgar 1970, p.117), but Jones et al. (2002) clarified matters: *Anzybas rotundifolius* was based on the basionym *Nematoceros rotundifolia* J.D.Hook. in Hooker's *Flora Novae-zelandiae* 1: 251 (1853).

Reserve, c. 6 km from Warkworth. I was a new chum to all things botanical and my partner, Frank Hudson, was a "tree man" who ignored anything that wasn't taller than himself. Both Lucy Moore and I had not long before returned to our childhood hometown of Warkworth, and Frank and I would sometimes take her out on short botanical rambles.

On this June day we were poking around in an area of regenerating gymnosperms in this delightful reserve, when I spotted a small flowering *Corybas* orchid with no "whiskers". Frank and I had visited Great Barrier earlier in the year, and we had become familiar with *C. cheesemanii* (then known as *C. aconitiflorus*) which was also whiskerless, so I knew it was not that. I had spent time poring over Bruce Irwin's exquisite little line drawings of the *Corybas* species in *Flora Vol. II* and knew that there were only two without long lateral sepals and petals, the second being what was then considered to be the rare and endangered *C. unguiculatus* (a third such species, *C. carsei*, had been included in the concept of *C. unguiculatus* used in *Flora II*). I called out in excitement that I had found *C. unguiculatus*, and Lucy hurried over to confirm it. In my diary I noted that she was overjoyed and amazed. Frank arrived a minute later to tell us that he had found it elsewhere.

Searching confirmed that there were a good number of plants, though it was a little early for many to be flowering. According to my diary, as we drove home Lucy was in a ferment the whole way – who could she write to besides Bruce Irwin? No, maybe she would ring him up! (being familiar with the famous thriftiness of the Moore family, this was a turn up).

Over the intervening 33 years I have periodically paid a mid-winter visit to Woodcocks Reserve to check on our precious orchid and lately I had been rather sad that it seemed to be decreasing in numbers and perhaps heading for extinction there. However, this year Jack Warden and I visited at the end of July and found that it was in very good heart, with several large patches of healthy plants (Fig. 2), some leaves measuring 25 x 30 mm. Perhaps the wet conditions, so dismal for us humans, have suited a tiny winter orchid.

In my northern explorations, mostly in the company of my friend Anne Fraser, I have come across *C. rotundifolius* at 10 other locations, the most northerly being near the road to Spirits Bay on the wondrously named Sod Wall Track.



**Fig. 1.** *Corybas rotundifolius*, Woodcocks Kawaka Reserve. Photo: J Warden, July 2018.



**Fig. 2.** The habitat of *C. rotundifolius*, Woodcocks Kawaka Reserve. Photo: J Warden, July 2018.

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# 1. *Codia* J.R. Forst. & G. Forst.

Char. Gen. Pl. (ed. 1): 30 (1775), (ed. 2): 59 (1776); Labill., Serot. Austro-Caledon.: 45 (1825); D. Don, Edinburgh New Philos. J. 9: 95 (1830); Brongn. & Gris, Bull. Soc. Bot. France 9: 76 (1862), Ann. Sci. Nat. Bot., sér. 5, 1: 377 (1864); Benth. & Hook. f., Gen. Pl. 1: 649 (1865); Baill., Hist. Pl. 3: 381, 453 (1871), (éd. angl.) 3: 379, 452 (1874); Schtr., Bot. Jahrb. Syst. 39: 129 (1906); Engl., Nat. Pflanzenfam. (éd. 2) 18a: 259 (daté 1930, publ. 1928); Guillaumin, Bull. Bot. Soc. France 87: 254 (daté 1940, publ. 1941), Fl. Anal. Synopt. Nouv.-Caléd.: 142 (1948); Hutch., Gen. Flow. Pl. Dicot. 2: 12 (1967); Barnes & Hill, Austral. Syst. Bot. 12: 647 (1999) (fossiles); J. Bradford *et al.*, in Kubitzki (éd.), Fam. Gen. Vasc. Pl. 6: 107 (2004); H.C. Hopkins, Adansonia, sér. 3, 27: 243 (2005) (nomenclature); Pillon *et al.*, Mol. Ecol. 18: 2263 (2009) (phylogénie).  
 – Pfeifferago Kuntze, Rev. Gen. Pl. 1: 227 (1891), *nom. superfl.*  
 Type: *Codia montana* J.R. Forst. & G. Forst., Nouvelle-Calédonie.

**Arbuste ou arbre**, à système sexuel hermaphrodite. Jeunes rameaux ± aplatis aux nœuds. *Stipules* interpétiolaires, caduques ou persistantes, marge entière. *Feuilles* opposées ou verticillées par 3 (4), décussées, simples, pétiolées ou sessiles; marge entière; nervures secondaires brochidodromes, paraissant parfois eucamptodromes lorsque l'indument est épais; face inférieure glabre ou à indument clairsemé à dense, blanc à ferrugineux, persistant; domaties absentes. *Plantules*: stipules interpétiolaires; feuilles simples, marge grossièrement dentée, nervures secondaires craspédodromes à semi-craspédodromes, indument variable.

**Inflorescences** en capitule sphérique, chacun sur un pédoncule grêle. Capitules denses de 25 à 140 fleurs sessiles sans bractées. *Fleurs* bisexuées; hypanthe obconique, surface externe densément velue (poils longs, ondulés et parallèles, apprimés). Calice à 4 à 6 lobes, elliptiques à triangulaires, ± coriaces, souvent velu, à préfloraison valvaire. Pétales absents ou alternant avec les lobes du calice, petits, membraneux, oblancéolés, généralement glabres, se détachant facilement. Étamines 2 fois plus nombreuses que les lobes du calice; filets linéaires, cylindriques; anthères souvent apiculées. Disque absent. Gynécée inférieur, à 2 (3) loges, surface supérieure velue; styles 2 (3), grêles, velus au moins vers la base; ovules 2 par loge, placentation axiale. Formule florale (cas le plus fréquent):  $K5^* C5^* \text{ ou } C0 A5 \leftrightarrow 5^* G(2)^* Yx4$ ; formule globale:  $K4-6^* C4-6^* \text{ ou } C0 A4-6 \leftrightarrow 4-6^* G(2)^* Yx4$ .

**Fruits** indéhiscents, nombreux par capitule, de taille comparable aux fleurs, couverts d'une laine brun-orange abondante sur la surface externe (sauf la base) et la surface supérieure de l'ovaire; lobes du calice, styles et parfois filets persistants; fruits se détachant à maturité du capitule, mais maintenus par les poils emmêlés. *Graines* 1 par fruit, rondes, lisses, pâles et dures.

Le genre *Codia* comprend 15 espèces, toutes endémiques de la Grande Terre et des îles adjacentes au nord de celle-ci (Néba, Yandé, îles Belep, Balabio); il n'est pas connu de l'île des Pins. Il se rencontre en maquis, en forêt, en lisière de forêt et dans certaines végétations secondaires ou dégradées (y compris la savane à niaouli – *Melaleuca quinquenervia* (Cav.) S.T. Blake, Myrtaceae), de 0 à 1050 m d'altitude, sur substrats ultramafique et non-ultramafique. Il est connu à l'état fossile en Australie (Barnes & Hill 1999).

Le nom *Codia* est dérivé du grec « kodia » ou « kodeia » désignant une fleur ou inflorescence en boule. Ce genre fut décrit par les naturalistes allemands Johann et Georg Forster qui accompagnèrent James Cook durant son deuxième voyage autour du monde. Ils récoltèrent cette plante lors de leur passage à Balade en septembre 1774.

Fig. 1. Pages 34 and 35 of *Flore de la Nouvelle-Calédonie* 26: Cunoniaceae, introducing the genus *Codia*. (see article on facing page)

## Book review: Flore de la Nouvelle-Calédonie 26: Cunoniaceae.

Rhys Gardner

The region between New Guinea and New Zealand is usually known as "the South-West Pacific", but the romantic French call it Océanie, and treasure as its jewel the uniquely interesting island of New Caledonia. How could the plants there be so diverse, on a landmass just a tenth the size of New Zealand, and one that was fully submerged a mere 37 million years ago? (See Heads (2013) and Nattier et al. (2017) for differing ideas about the island's biogeography).

The Flore de la Nouvelle-Calédonie ("FNC") series began in 1967 with Sapotaceae, one of the larger families: 75 species in an extraordinary 16 genera. Big volumes followed on ferns, Proteaceae, gymnosperms, Orchidaceae and Apocynaceae. Mainly smaller families have featured in the last twenty years but the era of the blockbuster is not over: the genus *Phyllanthus* has 116 spp., and John Dawson took two volumes to account for Myrtaceae (incl. 66 spp. of *Syzygium*!). About half the flora, including Cyperaceae and Poaceae, is still to be treated; see Jaffé et al. (2001) for a review.

FNC's first twenty-five volumes were produced by the Natural History Museum at Paris. They are standard-size books, in lateritic-orange paper covers, section-bound and of matt-finish paper, thus opening to lie non-reflective by one's elbow at the microscope. Their typeface is of a size and weight to suit ageing eyes and imperfect lighting. Each species is mapped, vouchered, and illustrated by a well-crafted ink drawing. They have been called "staid" but in my opinion they are classics of thoughtful, inexpensive, effective design.

However, there is a problem: FNC 1–25 is entirely in French. School education here at the wrong end of the subtropics gives some exposure to Polynesian languages (good if you want to do conservation work) but increasingly neglects European ones. Fortunately, the logical French have come to our rescue: FNC 26 has its principal keys duplicated in English (Hopkins et al. 2014).

There is another problem: many of us now want sugar in our *café au lait*; that is, in recent times publishers of taxonomy have discovered the marketing power of colour. *Taxon* now startles with viridescent close-ups and cladograms that look like Tokyo at night, and even its Reviews section flaunts miniature coloured book-covers in front of its underfunded readers.

I have to wonder if all this might not be an arms race, dooming at least the smaller publishers' efforts

to sustain print productions (*va/le* Blumea) — "Keep colour for the e-version" might be a rallying cry. Too late, however, for FNC to take notice: this new volume has been redesigned and is overflowing with colour. A less-attractive group of plants (if there is such a thing) might not have been able to carry it off, but by luck or prescience one of New Caledonia's prettiest has been chosen to make the grand entrance.

The introduction says that this change in format is to make the series more widely accessible (English speakers are not mentioned specifically, but "*amateurs d'un jour*" are!), that is, FNC 26 is intended to act as a field guide as well as a Flora. Its production is now in the hands of IRD, the cash-rich French government research and development agency that before 1998 was called ORSTOM. Colour appears in FNC 26's photographs, maps, text boxes, tables and headings (see Fig. 1, facing page), keys, "practical keys" and "quick keys". An entity named Zipshebam.com (now invisible to Web-searches, perhaps having loaded up with champagne and departed our galaxy "now that its work is done") is credited with the graphical design.

To more sober matters. Preliminary work for FNC 26's taxonomy was carried out by Canberra legend, the late Ru Hoogland. Its completion is largely due to Helen Hopkins, who has been studying Cunoniaceae "head down at Kew", that is, without much help from molecular investigations, since the 1990s. She first visited New Caledonia in 1996. Her young but well-published French co-author, and the work's other three taxonomic contributors, are likewise field-hardened veterans. Help from the professional ecologists at Nouméa, and from several amateurs, including Auckland Botanical Society's friends M. et Mme Letocart, is gratefully acknowledged.

Nearly all taxa have been seen in their natural habitats. There has also been an abundance of herbarium material. The *Liste du matériel examiné* is given without a total, but I estimate (having stopped counting at the first of H. S. McKee's efforts: c. 150 collections for *Codia*) that there might be nearly 3000 in all. This must have sometimes been felt as a plethora not a blessing, but it would have been essential in the making of comparable descriptions, the detection of hybrids (four are sufficiently common as to be treated fully), and the accurate presentation of flowering and fruiting times. The specimens are listed at the rear of the book, facilitating that most pleasant of herbarium tasks, the effort-free putting of correct names on duplicates.



The rest of this review relates some facts about Cunoniaceae in New Caledonia (hereafter "NC"), then examines the new style as shown in the treatment of the first genus there, *Codia*.

FNC 26 first discusses the family's morphology, ecology, etc., with particular reference to NC. This introduction covers 30 or so pages, and except for two keys to the genera, is entirely in French. To fully conform to the new mission statement, a good long summary in English would seem to be needed. The tribal classification is referred to, but I would have liked to see a cladogram too. The family has a distinctive look (hairy, opposite leaves and big stipules) but only *Vitex* and Rutaceae are noted as having a confusing resemblance.

We learn that NC contains seven genera. *Hooglandia* is a monotypic genus, very rare and apparently related to New Guinea's *Aistopetalum*. *Codia* and *Pancheria* are endemic and together have 42 spp. *Cunonia* is nearly endemic (*C. capensis*, only distantly related to the NC plants, is confined to South Africa) and contains 24 spp. The remaining species are in *Geissois* (NC to Fiji), *Spiranthes* (Molucca Is. to Samoa), and *Weinmannia* (widespread, but absent from Australia). This makes a total (excluding the four hybrid taxa) of 87 species. All are endemic. They occur on New Caledonia's Grande Terre (mainland) and the small islands but are completely absent from the low-altitude, limestone Loyalty Islands. More than half are confined to ultramafic substrates. Although a good modern reference to ultramafic vegetation is supplied (Jaffré et al. (2013)) I would have welcomed a summary of the latest geological thinking about the island's formation. A geological map, and also a topographical map with place-names, should be on the currently blank endpapers.

Many representatives are shrubs or small trees. Few are small-leaved. Most prefer stable habitats, higher altitudes, and damp rather than dry sites. Rather few appear to be colonizers of disturbed open ground or *Melaleuca*-dominated savanna. Generally, they seem not to be fire-adapted, but at least a couple regularly re-sprout after fire. One or two in each genus are 20–30 m tall trees. These are mostly widespread on non-ultramafic terrain, but *Codia jaffrei* seems to be confined to the ultramafics, and *Geissois hirsuta* and perhaps *Cunonia linearisepala* grow on both kinds of substrate (but whether these can get to their maximum size on both kinds of substrate is not clear).

Judging from the keys and tables it appears that most of the morphological evolution of these plants has concerned their vegetative parts. The inflorescences are relatively uniform in each genus (but in *Cunonia* and *Weinmannia*, variable in their

aggregate arrangement). The fairly small flowers range from white to yellowish to red and are otherwise rather uniform (though some species of *Codia* are apetalous, and the colours vary sufficiently in *Cunonia* as to form the basis for a "quick key"). Pollination is largely accomplished by animals: by insects (work by New Zealander Barry Donovan is mentioned), birds (especially in the glorious *Geissois*), and probably by lizards too. Except for the drupe-bearing *Hooglandia*, the fruits are small-seeded capsules.

There are a few oddities. *Cunonia deplanchei* and a few other taxa are swamp-dwellers. The small-leaved *Pancheria minima* is a rare geoxylic (lignotuberous) shrub less than a metre tall and could well be fire-adapted. *Pancheria elegans*, which has willow-shaped leaves, may be a facultative rheophyte. Only *Geissois balansae* regularly has domatia. The big tree *Geissois hirsuta* and several smaller species are said to "hyperaccumulate" nickel (perhaps collections of these get a blue tinge on drying?).

Now for the treatment of the first genus, *Codia* (the logical French submitting, *bien sûr*, to the tyranny of the alphabet). Its first two pages face one another, and to help understand what I am talking about they are reproduced here as Fig. 1 (pg. 118). We see on the left a photograph of a *Codia* species and under it an assessment of the group's diversity, ecology and distribution, and also its etymology. On these two pages there are some very nice touches:

- a) The photograph introducing *Codia* is given a frame by the lowering of the text-box and the shortening of the lines of the synonymy opposite;
- b) the right-page has a coloured tab at its edge, and this carries on until the next genus is reached. The colour for each genus has been chosen to harmonize with the introductory photograph: dark green for *Codia* matches its matured leaves; mauve for *Cunonia* and scarlet for *Geissois* match their inflorescences, and dusky purple for *Pancheria* matches the bloom of its fruit-capsules. Elsewhere in the treatment of each genus the emblematic colour is repeated, for the box-lines, species' name headings and subheadings, and for the colouring of the ultramafic regions in the distribution maps.

The accounts of the fifteen *Codia* species are preceded by a comparative table, and a key in French, this repeated in English. A "quick key" then is given in both languages, but not so for a pictorial "practical key" and a table of comparison between four species that might often be confused — are we English neither practical nor easily confused?

Each species is given a page of description (including a modernized floral formula, which I cannot understand) and, on the next two or three

pages, notes on taxonomy and ecology, a line drawing (full- or half-page) and colour photographs. For *Codia* several artists have contributed the drawings, but their styles are very compatible. Some of the photographs would have benefited from a scale object.

Some fair time ago now an older botanist raised a courteous eyebrow on learning that I had not been to New Caledonia to see the plants I was studying. My thesis supervisor should have blushed too, though possibly he was acquainted with the island's distractions: the ORSTOM herbarium far too close to the beach at Anse Vata, the mind-blowing scenery, the balmy subtropical evenings.

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But away with these regrets, and with those for the old orange FNCs too. In the first paragraph of his account of what every good Flora should contain, *Taxon* reviewer Rudi Schmid (1979) said of multivolume productions:

“I can hardly expect the long-running [works like FNC] to change course significantly. After all, an ocean liner or aircraft carrier does not readily turn, let alone make a U-turn.”

But in Océanie, where nearly all botanical things are possible, a cruise ship has. *Bon Voyage!* to its helpful crew, and *Long Life!* to all its pretty passengers.

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## ***Wollastonia* and *Youngia* (Asteraceae): how they got their names**

**Rhys Gardner**

Towards the end of my Dictionary of Fijian higher-plant genera (Gardner 2017) there stand two giants of eighteenth century science, William Wollaston (1766–1828) and Thomas Young (1779–1829). They knew each other well and were fellow-secretaries of the Royal Society under Joseph Banks' long presidency (see Note 1, p. 123). They overlapped in their interests mainly in the field of physics, and share the glory of a major advance there, the realization that 'energy' is the crucial quantity in equations concerning heat, motion, etc.

Their busy, useful, and well-regulated lives are examined in the biographies of Robinson (2006) and Usselman (2015). The latter, on Wollaston, is particularly detailed, and anyone without a lingering fondness for school chemistry might find it rather gruelling revision.

In my Dictionary Young gets an adequate tribute but Wollaston certainly does not. To regain a balance, then, here is a very incomplete account of his scientific life.

First, we have Wollaston's youthful interest in botanical matters, culminating in his elucidating the nature of fairy rings (Notes 2 & 3). In these early days, as a doctor, he made discoveries in animal physiology too (Note 4).

Chemistry became Wollaston's focus. Using *platina* ore smuggled out of Spanish Colombia he made a long, arduous and secret exploration of its properties, and eventually found a way to bring its chief component, platinum, into a workable state. Metallurgy was the cutting-edge technology of the day, and platinum soon found use in the production of wires, crucibles, and (the inevitable military use) musket touch-holes that did not corrode. In this way Wollaston became quite adequately wealthy — rather to the annoyance of Banks, who felt that a Royal Society member should not have been so secretive.

In the later part of his career as a chemist Wollaston was able to provide accurate quantitative values for the combining of many of common substances, thus helping lay the basis for the atomic theory of chemistry.



From the sublime to the ridiculous: despite the stature of these men, botanical authors have commemorated them just in the names of two negligible daisies. It seems that no artist of any note has been tempted by *Youngia*, and for my Dictionary I had to make my own sketch (which does I think capture the essential scrappiness of the plant). Things are better with respect to

*Wollastonia*. Fig. 1 here is an illustration from one of the incomplete, ambitious and erudite works of the Viennese botanist Stefan Endlicher. Wollaston's love of precision would surely have been satisfied by this beautiful drawing, made by someone equally blessed with a sure hand and eye, the great Ferdinand Bauer, who saw the plant during his stay on Norfolk Island in 1804–5.

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**Fig. 1.** *Wollastonia uniflora* (Willd.) Orchard. Endlicher, *Iconographia Genera Plantarum*. (1839) t. 88, as *W. forsteriana*. Like the very similar *W. biflora* of the central Pacific Ocean region (e.g. Tonga), the Norfolk Island plant is a small, weakly woody, sprawling shrub, usually seen on limestone cliffs at the coast. In northern Australia it is said to sometimes be a sand-binder, when it roots at its nodes. It belongs to the sun-flower (*Helianthus*) tribe, and its yellow flowerheads are yellow and sunflower-like but only c. 2 cm wide. Its achenes (fruitlets) have no obvious means of dispersal but presumably are buoyant in seawater.

**Note 1.** "Wollaston's career was to become even more entwined with that of Thomas Young ... they served together as secretaries of the Royal Society, on various scientific committees, and on the Board of Longitude ... although they rarely interacted socially ... undoubtedly they probed one another for facts and opinions ... a question was posed at one of Joseph Banks' Sunday evening soirees to someone who replied, I cannot answer your question myself, but there stand Young and Wollaston, and between them they know everything." Usselman (2015: 64).

**Note 2.** "[Wollaston exhibited] always the same quickness and keenness of observation; he was fond of *Botany*, and soon knew the habitat of every rarer plant of which in this neighbourhood there are several. Nothing escaped his eye. When we were crossing a heath at a smart trot, I remember his suddenly pulling up, and exclaiming 'there's the *Linum radiola*', a plant well known, but so *minute* that his companion, when alighting from his horse, and looking close to the ground, could scarcely at first descry it." Usselman (2015: 20), quoting Wollaston's lifelong friend Henry Hasted.

We all have had similar experiences, even with larger plants. For the minute *L. radiola* in New Zealand (now *Radiola linoides*, a single record only, from Northland), see *Auck. Bot. Soc. Jnl.* 67 (2012) 102.

**Note 3.** "At Bury he became interested in the rings of darkened grass and barren soil commonly found in country pastures, known, then and now, as fairy rings. After five years study, he determined that at least five species of fungi produced fairy rings in the same general manner ... [e.g.], the inner circumference of the barren ring was marked generally by the decaying spawn of the outwardly expanding mushroom circle." Usselman (2015: 32).

**Note 4.** In the early part of his career (he had become a doctor) Wollaston made biochemical discoveries, including the composition of gout deposits and urinary stones, where he discovered cystine (the oxidized dimer of the amino acid cysteine). The study of inborn errors of metabolism may be regarded as starting here.

There was also some zoology much later, relating back to that earlier time of microchemical investigation. In 1821, the geologist William Buckland investigated a large collection of bones, teeth and other remains of 'pre-diluvial' animals found in a cave in Yorkshire. He sent samples of preserved dung to Wollaston, who found in them "the ingredients that might be expected in faecal matter derived from bones" (Usselman 2015: 36). This finding supported Buckland's conclusion that the dung was from a species of hyena which had in ancient times used the cave as a den.

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