

Vascular flora and some fauna of Papakohatu (Crusoe Island), inner Hauraki Gulf, Auckland

Ewen K. Cameron



Fig. 1. Papakohatu (Crusoe Island) and its extensive intertidal reefs, midway between Motuihe and Waiheke Islands. Image: Auckland Council GIS Viewer (adapted by Joshua Salter).



Fig. 2. East side of the main Papakohatu Island, 21 Dec 2017. All photos by EKC.

Introduction

Papakohatu (Crusoe Island) is a small, isolated flat-topped island (0.7 ha), and lies nearly midway between Waiheke (1.2 km to the east) and Motuihe Islands (1.1 km to the west). The island and its two stacks are connected by an intertidal reef lying roughly north/south, c.300 m long, and up to c.70 m across (Fig. 1). At the southern end a narrow intertidal shingle bank extends another 440 m SSE and curving towards the east. There is also a separate intertidal reef c.100 m long 50 m off the island's NW coast. Vascular plants are confined to the central island (Fig. 2) and the two stacks, one off its northern end (three joined blocks) (Figs. 3, 4) and a smaller one off the southern end (Fig. 5). A sign of past human contact is an old broken metal post c.0.5 m tall on the summit of the northern stack – the remains of a navigation sign? The forested central island is 120 m long × 60 m across, steep-sided, and reaches 13 m asl. The two stacks are less than half the height of the main island.

Papakohatu is Maori customary land, and the name literally means "rocky flat land" (Bobby Newson pers. comm.). According to the geological map (Kermode 1992) the island is mainly undifferentiated Jurassic argillite and greywacke, with some ocean floor basalt (Waipapa spilite) and beach gravels. There are several small gravel beaches around the island.

The vegetation is recovering, presumably from fire, emergent pohutukawa (*Metrosideros excelsa*) dominating the main island with an understorey of native broadleaf trees and shrubs, and at the northern end more open, with gorse (*Ulex europaeus*) and bracken (*Pteridium esculentum*) locally dominating. Tall rhamnus (*Rhamnus alaternus*) trees used to dominate much of the island, especially the central area, until the Auckland Regional Council Biosecurity team, encouraged by Councillor Michael Lee, removed them during many visits, beginning in March 2001. Weeding trips continued, often involving Whakanewha Regional Park rangers (Lee 2011). In June 2002 twenty-two pohutukawa (Motuihe provenance) were planted to fill in where the rhamnus had been removed (Beauchamp 2002, M. Lee pers. comm.).

Papakohatu has had many scientific visitors, collecting and documenting its biota. The first appear to have been in 1931 and included botanist Lucy Cranwell (1907–2000) and ornithologist Robert Falla

(1901–1979), both from the Auckland Museum. Graham Turbott (1914–2014), who went on to be an ornithologist, also visited the island that year on 17 Dec 1931; he had just left school and Falla had invited him (G. Turbott pers. comm., Jul 2009). It was his first island visit, and as Lee (1999) reported, Turbott remembered it well. He re-visited it again several times. English naturalist Mary Gillham visited the island in 1957 as part of her study of vegetation of tern and gannet colonies in northern New Zealand (Gillham 1960). Terry Greene, Graeme Taylor and Alan Tennyson visited the island on 18 April 1989 noting flora and fauna in their notebooks (partly published in Lee 1999). There is a good introduction to the island, mainly covering its flora and fauna, by Michael Lee as part of his survey in 1996–97 of the biota of seven islets off Waiheke Island (Lee 1999). During this time, he visited the island nine times. This has been followed up with numerous nearly annual visits involving weeding, monitoring bait stations and recording fauna diversity.

My observations are based on two visits of 3–4 hours each time on: 18 Sep 2009 (with three Department of Conservation (DoC) staff and Bruce Hayward, Peter Hutton, Margaret Morley and Mike Wilcox); and 21 Dec 2017 (with four Auckland Museum staff and Cr Michael Lee). The December visit followed a long dry spell and the annuals were already dried out. This article has benefitted from observations by Michael Lee (pers. comm.) from his numerous trips to the island over the last 22 years.

Vegetation

The flat summit area is dominated by pohutukawa with spreading limbs to c.8–10 m tall and trees twice as wide as tall. The main understorey shrub is karo (*Pittosporum crassifolium*) 2–4 m tall, locally mapou is present to 3 m tall (one tree is twice this height at the southern end), occasional shrubs of houpara (*Pseudopanax lessonii*), mingimingi (*Leucopogon fasciculatus*), and scattered ground cover of *Carex testacea*, *Solanum opacum*, *Asplenium haurakiense*, clumps of *Astelia banksii*, and extensive mats of native spinach.

The tallest and most diverse woody vegetation was at the southern end of the central island (Fig. 6) which included the tallest pohutukawa tree on the island, one with a horizontal branch festooned with *Asplenium haurakiense* and leather fern (*Pyrrosia elaeagnifolia*) along the top. Mahoe and coastal mahoe appeared to be restricted to this end of the island. The island's steep coastal slopes were dominated by karo, houpara, scattered mainly youthful pohutukawa, taupata (*Coprosma repens*), large clumps of *Astelia banksii*, ground cover as in the plateau forest with more annual weeds such as *Silene gallica*, *Vicia sativa*, *Trifolium dubium*, and locally *Lotus suaveolens*.



Fig. 3. The larger northern stack (the foreground stack is part of the central island), from the northern end of Papakohatu at mid tide, 21 Dec 2017.



Fig. 4. The east side of the northern stack of Papakohatu, nearly high tide, 21 Dec 2017.



Fig. 5. Southern stack and adjoining intertidal reef to Papakohatu, from the main island, near low tide, 21 Dec 2017.



Fig. 6. The tall forested southern end of the main island, from the southern stack, at near low tide, 21 Dec 2017.



Fig. 7. Open northern end of the main island, habitat for *Geranium solandri* amongst the gorse and grasses. From the northern stack, at low tide, 18 Sep 2009.



Fig. 8. Freesias in full flower dominate some of the grassy open slopes in the spring, NE Papakohatu, 18 Sep 2009. They are also present on both stacks.

Open areas exist, especially at the northern end (Fig. 7) and near the middle of the plateau. Such areas are dominated by low gorse (≤ 1 m tall), in places with bracken, bounded by karo and pohutukawa. Two tall exotic grasses, *Avena barbata* and *Bromus catharticus*, were commonly emergent through the gorse, and in places *Muehlenbeckia complexa* mats, shrubs of karo and the occasional youthful rhamnus were establishing and over-topping this low vegetation. Open rocky ledges were dominated by hare's-tail grass (*Lagurus ovatus*) with *Ficinia nodosa*.

The vascular floras of two rock stacks (recorded on 18 Sep 2009, and for the southern stack also on 21 Dec 2017), was 14 species for the northern stack and 17 species for the southern stack; a total of 20 species with eleven species in common (see Appendix). The exotic herb twin cress (*Lepidium didymum*) was only seen on the northern stack – absent from the main island. The vegetation of both stacks (Figs. 4, 5) is mats of low, salt-tolerant herbs, with ice plant (*Disphyma australe*) shore groundsel (*Senecio lautus*), *Poa annua* and *Crassula sieberiana* dominating. A few taupata are the only woody

species present. On the southern stack a patch of *Muehlenbeckia complexa* (2 m across) is present and the annual exotic grasses, *Parapholis incurva* and *Vulpia bromoides*, are locally abundant.

Vascular flora updated

The original records from Taylor (from his field notebook) and Lee (1999) are presented in separate columns in the Appendix. The results from the recent two surveys add 33 new records (64% naturalised, see the Appendix) to the published vascular flora by Lee (1999). Karamu (*Coprosma robusta*) and mahoe (*Melicytus ramiflorus*) are the only woody additions, the largest group being the herbaceous adventives (21 species), and many represented by small populations (see Appendix). The wild vascular flora now totals 101 species (see Table 1), of which 43% are indigenous.

Apart from some of the showy monocotyledons and the sharp buttercup (*Ranunculus muricatus*) there are no surprising species present for an uninhabited island in this part of the Gulf. Although the naturalised flora is larger than the native flora most of the vegetation is now dominated by native

Table 1. Vascular Flora totals of Papakohatu (Crusoe Island) in the different plant groupings, and native and naturalised status.

Plant group	Native	Naturalised	Totals
Ferns	6	—	6
Dicots	23	36	59
Monocots	14	22	36
Totals	43	58	101
% of the total	43%	57%	

species. The only Nationally threatened plant species present is *Geranium solanderi*: At Risk – Declining (de Lange et al. 2018). Other interesting indigenous species include: coastal mahoe close to its inner Gulf limit which is Motuihe I. (de Lange & Crowcroft 1999); *Solanum opacum* which is a third species present in New Zealand belonging in the *S. americanum* / *S. nigrum* group (Sandra Knapp, pers. comm.; Sarkin et al. 2018); and *Cyperus insularis* × *C. ustulatus*. *Cyperus insularis* is generally a plant of the outer Gulf and of more exposed islands (see Heenan & de Lange 2005). Based on the Auckland Museum herbarium (AK) records this is the only Hauraki Gulf record for sharp buttercup, an annual – a European/African/Asian native. It has however, been on the Auckland mainland for over 140 years.

Although 56 of the wild species are exotic, only c.12 species would be considered environmental weeds and warrant controlling. This would include all six of the woody species, a vine and five herbaceous species: blackberry, boneseed (*Chrysanthemoides monolifera*), brush wattle (*Paraserianthes lophantha*), gorse, rhamnus, woolly nightshade (*Solanum mauritianum*), moth plant (*Araujia hortorum*), *Allium triquetrum*, *Carex divulsa*, freesia (*Freesia refracta*, Fig. 8), *Oxalis pes-caprae*, and inkweed (*Phytolacca octandra*). At least five of these have already been managed on the island, and two of these (brush wattle and moth plant) may already have been eradicated – see Appendix for the current status of these species on the island.

Unaccepted records / redeterminations

The records of *Myosotis discolor* and *Stipa stipoides* (now *Austrostipa stipoides*) by Lee (1999) attributed to GA Taylor are a mistake – they were unrecorded by Taylor. The *Asplenium flaccidum* record by Lee (1999) on such a small island appears unlikely – it's more likely to be a misidentified *A. haurakiense*. The *Gladiolus undulatus* record has been redetermined to *Ixia polystachya*, the *Poa pusilla* record I now think is more likely to be *Poa trivialis*, and the *Hypochaeris glabra* may just have been the more abundant *H. radicata*.

Possible plantings

Only two species have definitely been planted on the island: *Cannabis sativa*, a single plant recorded by Lee (1999) in a hacked-out gorse clearing in Feb 1996; and 22 pohutukawa (of Motuihe provenance) planted in Jan 2002 after the main rhamnus weeding. Six of these survived (M. Lee pers. comm., Mar 2004). However, there are also several monocot species with showy flowers that are not usually found on remote uninhabited islands. They include: *Allium triquetrum*, *Amaryllis belladonna*, freesia, *Ixia polystachya*, and *Tritonia lineata*. The first of these

garden species were observed in 1989: *Ixia polystachya* and perhaps *Tritonia lineata* was present then as well (see Appendix). I suspect that someone decided in the 1970s–80s to “brighten up” the island by introducing these plants. Note – they all possess bulbs or corms which would have increased their chance of survival on this drought-prone island.

Bryophytes

It is a dry island and subject to summer droughts; therefore, it is not surprising that the collected bryophytes are few in number, and include three mosses (*Campylopus introflexus*, *Rhynchostegium tenuifolium*, *Sematophyllum contiguum*) and a liverwort (*Frullania pentapleura*). However, I'm sure a survey by a specialist bryologist would add to this total.

Lichens

Although frequent on the coastal rock outcrops, e.g. *Ramalina celastri*, they have however not been collected or studied.

Marine algae

In 1931 Lucy Cranwell collected seaweeds on and by Papakohatu Island, representing eight species which are spread over 20 herbarium sheets in AK: *Aeodes nitidissima*, *Codium convolutum*, *Glossophora kunthii*, *Grateloupia urvilleana*, *Liagora harveyana*, *Rhodoglossum gigartinoides*, *Scytothamnus australis*, *Xiphophora harveyana* subsp. *minor*. Mike Wilcox on 18 Sep 2009 studied the seaweeds on Papakohatu, and included a short account of them in his ‘Seaweeds of Auckland’ book where he listed 31 species (Wilcox 2018: 85–86), of which 19 were vouchered into the herbarium (AK).

Vertebrate Fauna

Mammals

Alan Tennyson, Terry Greene and Graeme Taylor visited the island on 18 Apr 1989, 10.02–12.30 pm. During their visit Alan (from his notebook), recorded a couple of big rat faeces, almost certainly Norway rats. However, the only definite mammal recorded for the island was a mouse [or mice?] and Lee (1999) documents what he thought was their eradication in 1996, but it was actually completed in 2001 (Lee 2011). Since 1996, bait stations have been maintained on the island. Lee (2011) suggests that the mice possibly reached the island in Oct 1949 when a Sanford fishing boat, *Olive*, ran aground on the island and everything was unloaded on to the island so that the boat could be salvaged.

Birds

Turbott (pers. comm. to EKC, Jul 2009) said that in Dec 1931 there was a colony of white-fronted terns nesting among the ice-plant on the two rocky stacks at each end of the island (he described this colony in

Turbott 1947: p. 60), which was later reduced to only one colony on the northern stack (Gillham 1960, treated this northern stack as three separate stacks); near the middle of the main island (E side) was a stunted pohutukawa by a cave, with a reef heron nest; during a subsequent visit (Nov 1946) the reef heron was still there and Turbott (1947: p.70) describes its nesting on Papakohatu in some detail. Lee (1999) recorded that Turbott during that 1931 visit observed grey-faced petrel burrows on what was then a grassy summit, and a juvenile petrel was collected for the Museum collection. Note – in both of Turbott's references above, he told me (pers. comm., Jul 2009) that "...in those days it seemed unwise to actually name the island in a publication – which could have given rise to an outbreak of vandalism or too much over-enthusiasm to visit!"

Gillham (1960) recorded white-fronted terns nesting on Papakohatu as the densest of the various colonies that she studied in the Hauraki Gulf and the Bay of Plenty – they were nesting on all three of the joined northern stacks and also on the southern stack when she visited in 1957.

Alan Tennyson, 18 Apr 1989, recorded: "8 black-backed gulls + 7 old nests probably of this sp. + 1 dead adult; 3 pied shags; 14 red-billed gulls; 2 white-fronted terns, old nests at W end, 16 dead chicks, 4 dead adults + 8 old eggs (all about nest sites); 4 kingfisher; 1 arctic skua pale phase chasing w-f tern off coast; 5 chaffinch; 1 starling; blue penguin 1 moult site +1 dead on beach; 1 blackbird (heard); 2 little shag; 2 grey warbler; reef heron many feathers, poo, undoubtedly roost site; silvereye a few heard; 1 gannet flying offshore. Many small passerine feathers over the ground – a starling roost? Old burrows by summit collapsed and look long unused".

During his 1996-97 surveys Lee (1999) recorded grey warbler, silvereye, dunnoek, a dead blackbird chick, a mummified starling, black-backed gull 18–20 adults and 6–10 chicks, pied shag and little shag nesting together in a pohutukawa on eastern side, a small breeding colony of white-fronted terns on the northern stack, a pair of variable oystercatchers with a chick on the southern stack, two blue penguins nesting in a cave on western side of main island, and no petrel burrows.

During my visits the following birds were recorded.
Sep 2009: black-backed gull, blackbird, variable oystercatcher (1 pair), pied shag, kingfisher, goldfinch, grey warbler, and house sparrow.
Dec 2017: c.20 pairs white-fronted terns (nesting on N stack), gannets (flying close to the island),

black-backed gull nests and chicks on S stack, and 2 chicks on W side of main island; grey warbler; kingfisher (endless calling); goldfinch; silvereye; penguin (2 occupied burrows); variable oystercatchers (2 pairs – S stack, and mid-western side of main island); Caspian tern (1 mummified body on S stack); a reef heron behaving as if nesting on western side of main island; and a single grey-faced petrel feather in the forest (Matt Rayner, pers. comm.).

Lizards

Lee (1999) recorded no reptiles in his pit-fall traps for the island during 1996-97. In 2010 Lee (2011) organised the introduction to Papakohatu of 74 shore skinks (*Oligosoma smithii*) in part from Tawharanui Regional Park and part from a captive breeding program, and 30 common geckoes (*Woodworthia maculatus*) from Otata Island (part of the Noises Islands). Seventy Pacific geckoes (*Dactylocnemis pacificus*) were introduced from Little Barrier Island, on 29 Jan 2014 (Michael Lee pers. comm., Jul 2018). Many "lizard houses" (small corrugated sheets of *Onduline* roofing) were scattered around the island to assist the lizard establishment. During our Dec 2017 visit there were sight records of both geckoes and skinks.

Discussion

The total wild vascular flora of 101 species (see Table 1), 45% indigenous, is about average for an isolated inner Hauraki Gulf island of this size (unpubl. data). There are several vascular plant species that are common on the inner Gulf islands but surprisingly absent on Papakohatu Island. They include: kawakawa (*Piper excelsum*), rengarenga (*Arthropodium cirratum*), and *Chenopodium trigonon*. These absences are most likely due to past disturbances, perhaps fire.

From the dates on herbarium collections of rhamnus in the Hauraki Gulf, Cameron (1994) suggested that Motuihe was the most likely the primary source of rhamnus in the Gulf, where various exotic plantings were present. From Motuihe (very common in c.1930) it appears to have spread in most directions, including to Papakohatu, where Turbott recorded it as common in 1946 (AK 23281). Fromont (1997) recorded that rhamnus is carried by common exotic frugivorous birds which inhabit the Inner Hauraki Gulf: blackbird, song thrush, starling, Indian myna and the native silvereye. Its easy dispersal and rapid growth makes this woody environmental weed a priority to eradicate from the Gulf.

The presence of coastal mahoe and the hybrid sedge (*Cyperus insularis* × *C. ustulatus*) is interesting because these are more outer Hauraki Gulf taxa.

Although Motukaha (0.4 ha) on the west side of Waiheke Island is nearly half the size of Papakohatu, it has had a similar recent history, i.e. rhamnus invasion which has fairly recently been cut down and is now regenerating (Cameron 2013), a slightly larger flora and with a similar percentage being native. The larger flora is probably related to its close proximity (240 m) to a larger land mass.

Norway rats and then mice were eradicated from Te Haupa (Saddle) Island at Mahurangi in 1989 and 2008 respectively (Cameron 2014). The two native species whose increase seemed to coincide with the removal of rodents were totara (*Podocarpus totara*) and houpara. Totara is absent from Papakohatu and houpara seems to have been common on the island since 1989. However, the native spinach (*Tetragonia implexicoma*) wasn't recorded on the island until 2009, when it was locally common as quite large mats. It may well have been previously suppressed by the mice.

The rocky reefs surrounding the island, the steep rocky coast and no sandy beaches means that, for most people, it is not an inviting island to land on. The lack of visitors is a benefit for protecting its biota and not disturbing its nesting

birds. It has now been rodent-free since 2001. Like so many small islands in the Gulf, Papakohatu is important for indigenous biota and, with minor management to keep bait stations active and active weed control, it will continue to play an important part in the native ecology of the inner Hauraki Gulf.

Acknowledgements

I thank: Graeme Taylor and Alan Tennyson for copies of their 1989 field trip notes; Cr Michael Lee for his observations and enthusiasm for the island over many years; Art Polkanov (Sep 2009), Matt Rayner, Michael Lee and Ruby Moore (Dec 2017) for additional fauna field observations; Rhys Gardner, Peter de Lange, Sandy Knapp, Wendy Nelson for plant taxonomic comment; Jessica Beever, Allan Fife and Matt von Konrat for bryophyte identifications; the late Graham Turbott for his comments in 2009; Duncan Benzie and Joshua Salter for assistance for Figure 1; Bobby Newson for Maori translation; Ines Schönberger and Antony Kusabs for CHR and WELT herbarium records respectively; the two boat skippers for transport, Steve Meades of 'Aotea' (a DoC naiaid) and Matt Rayner (own boat); and Steve Benham (DoC) for organizing the first visit and Matt Rayner the second one.

References

- Beauchamp, D. 2002: Planting the islands. *Pohutukawa Post*. Auckland Regional Council [newsletter], Winter 2002: 7.
- Cameron, E.K. 1994: Environmental vascular plant weeds and new records for Motutapu, Waitemata Harbour. *Auckland Botanical Society Journal* 49: 33–40.
- Cameron, E.K. 2013: Motukaha – the vascular flora of a small island off western Waiheke Island, Hauraki Gulf. *Auckland Botanical Society Journal* 68: 136–146.
- Cameron, E.K. 2014: Updated flora and vegetation of Te Haupa (Saddle) Island, Mahurangi, Hauraki Gulf. *Auckland Botanical Society Journal* 69: 127–142.
- de Lange, P.J. 2003: The *Crassula tetramera* complex in New Zealand. *NZ Botanical Society Newsletter* 73: 11–13.
- de Lange, P. Crowcroft, G. 1999: The vascular flora of Motuihe Island Recreation Reserve. *Auckland Botanical Society Journal* 54: 19–30.
- de Lange P.J. et al. 2018: Conservation status of New Zealand indigenous vascular plants, 2017. Department of Conservation. New Zealand Threat Classification Series 22.
- Fromont, M.L. 1997: *Rhamnus alaternus* – environmental weed on Motutapu and Rangitoto Islands, Auckland. *Tane* 36: 57–66.
- Gillham, M.E. 1960: Vegetation of tern and gannet colonies in northern New Zealand with a comparative note on colonies in the Bass Strait, Tasmania. *Transactions of the Royal Society of New Zealand* 88: 211–234.
- Heenan, P.B.; de Lange, P.J. 2005: *Cyperus insularis* (Cyperaceae), a new species of sedge from northern New Zealand. *New Zealand Journal of Botany* 43: 351–359.
- Kermode, L. 1992: *Geology of the urban Auckland area*. Institute of Geology & Nuclear Sciences geological map 2 [R11]. Scale 1: 50,000.
- Lee, M. 1999: Biota of seven islets off Waiheke Island, inner Hauraki Gulf. *Tane* 37: 99–136.
- Lee, M. 2001: <http://www.mikelee.co.nz/2011/05/leaping-lizards-liberated-native-skinks-and-geckoes-alive-and-breeding/> (accessed 1 Jan 2018)
- Sarkin, T.; Poczar, P.; Barboza, G.E.; Weerden, G.M. van der, Baden, M., Knapp, S. 2018: A revision of the Old World black nightshades (Morelloid clade of *Solanum* L., Solanaceae). *PhytoKeys* 106: 1–223.
- Turbott, E.G. 1947: *New Zealand Bird Life*. A.H. & A.W. Reed, Wellington.
- Ussher, G. 2006: Crusoe Island ecological survey (invertebrates and reptiles). Monitoring Brief 003, unpublished report to S. Myers and G. Murdoch, Auckland Council, 24 Jan 2006. 4p.
- Wilcox, M.D. 2018: Seaweeds of Auckland. *Auckland Botanical Society Bulletin* 33. Auckland Botanical Society, Auckland. 400p.

Appendix. Vascular flora of Papakohatu (Crusoe Island) recorded for seven different time periods.

Key:

a = abundant
c = common
l = local
o = occasional
s = scarce (<5 individuals present)

x = recorded as present in 1996 by Lee (1999)
[] = square brackets indicate an identification most likely from original record which was a different species or as genus only
M = there have been attempts to eradicate this species

The time periods:

1930s/1933: moss collections in CHR herbarium by *LB Moore* in Feb 1933
1957: published account by Mary Gillham (1960)
1989: from Graeme Taylor's species list recorded in his field book, 18 Apr 1989
1996-97: from nine visits by Michael Lee (1999)
2009: from my visit, 18 Sep 2009
2017: from my visit, 21 Dec 2017

18

	1930s	1957	1989	1996-97	2004-05	2009	2017	Comments, generally from 2009 & 2017 visits, & herbarium voucher number
Ferns (6 + 0)(= native + naturalised)								
<i>Asplenium haurakiense</i>			c	x		lc	c	Fine-sized plants under forest. I suspect that the record of <i>A. flaccidum</i> by Lee (1999) is also this species. AK 227407, WELT P22992
<i>Asplenium oblongifolium</i>				x		s		Forest, S end.
<i>Cheilanthes sieberi</i>						l	l	Large patch, grassland, N end; and a small one NE side
<i>Microsorium pustulatum</i>			l	x		l		Terrestrial in forest
<i>Pteridium esculentum</i>			o	x		lc	lc	bracken. Small patches in forest openings
<i>Pyrrosia elaeagnifolia</i>			l	x		o	o	Terrestrial and epiphytic on pohutukawa branches
Dicots (23 + 36)								
<i>Araujia hortorum</i> * M					s(1)			moth plant. Only occurrence by Jack Craw and M. Lee (pers. comm.) on 25 Mar 2004, single plant (uprooted)
<i>Atriplex prostrata</i> *			l					"a few plants on shell bank" in 1989
<i>Cerastium glomeratum</i> *						o		Open and semi-open coastal slopes
<i>Chrysanthemoides monolifera</i> * M			l	x		o	l	boneseed. c. 15 seedlings (all uprooted), no adults seen in 2009. Large adult and c. 6 seedlings and saplings all on E side in 2017, all uprooted
<i>Cirsium vulgare</i> *						s		Scotch thistle. 2 seedlings; forest gap
<i>Coprosma macrocarpa</i>			s	x		s	s	coastal karamu. In forest
<i>Coprosma repens</i>		x	lc	x		lc	lc	taupata. Steep coastal slopes, including both stacks. AK 40225
<i>Coprosma robusta</i>						s		karamu. In forest
<i>Cotula australis</i>						l		Mainly coastal fringe, including both stacks
<i>Crassula decumbens</i> *						lc		On bare rocks, coastal fringe E side; plants red. AK 306150
<i>Crassula sieberiana</i>			s			lc	c	On bare rocky coast throughout, including both stacks. Some of the forms approach <i>C. colligata</i> , e.g. AK 306151

	1930s	1957	1989	1996-97	2004-05	2009	2017	Comments, generally from 2009 & 2017 visits, & herbarium voucher number
<i>Dichondra repens</i>			s			l		1 patch
<i>Disphyma australe</i>		lc	lc	x		lc	lc	ice plant. Especially on both rock stacks as extensive mats
<i>Erigeron sumatrensis</i> *			o			o		fleabane. Forest gaps
<i>Euphorbia peplus</i> *						l		Forest gap
<i>Fumaria muralis</i> *						lc		Open area in forest and near E coast fringe. AK 306149
<i>Galium aparine</i> *						s		Forest gap
<i>Geranium solanderi</i>						l		>12 plants N end main island, grassy open area. AK 306144
<i>Haloragis erecta</i>				x		s		In a forest gap
<i>Hypochaeris radicata</i> *			o					catsear. Possibly <i>H. glabra</i> also present (as recorded by Taylor, 1989 and Lee, 1999)
<i>Lepidium didymum</i> *						l		twin cress. N rock stack, among salt-spray tolerant species. AK 306147
<i>Leucopogon fasciculatus</i>			o-lc	[x]		lc	l	mingimingi. Main island plateau, especially N end. Wrongly mentioned by Lee (1999: p. 108) as <i>Cyathodes juniperina</i>
<i>Lotus suaveolens</i> *			x				l	W side, coastal slope
<i>Lysimachia arvensis</i> var. <i>arvensis</i> *			s			o-lc	l	scarlet pimpernel. Coastal fringe
<i>Malva parviflora</i> *			[?]			s		E side island and S stack. As <i>Malva</i> sp. by Taylor in 1989. AK 306134
<i>Medicago nigra</i> *			[?]			lc		Coastal fringe, and coastal ledges throughout. As <i>Medicago</i> sp. by Taylor in 1989. AK 306139
<i>Melicytus novae-zelandiae</i>			l			l	l	coastal mahoe. Shrubs c.2 m tall; coastal slope, S end of island
<i>Melicytus ramiflorus</i>						l	l	mahoe. S end of island, tallest c.4 m tall
<i>Metrosideros excelsa</i>			c	x		lc	c	pohutukawa. Dominant emergent woody vegetation, to 8-10 m tall and to twice as wide as tall
<i>Modiola caroliniana</i> *						s		Semi-open coastal slope, E side island. AK 306169
<i>Muehlenbeckia complexa</i>		x	c	x		o-lc	o-lc	Patches on coastal fringe, including S stack, to open forest plateau, climbing to c.1 m
<i>Myrsine australis</i>			o	x		l	o	S end of island, tallest c.6 m tall, and on flat summit
<i>Orobanche minor</i> *						s	s	Present at 2 localities, bush margins. AK 306137
<i>Oxalis pes-caprae</i> *						lc		Semi-shaded sites, summit to E slope. AK 306135
<i>Paraserianthes lophantha</i> * M			s	x			s(1)	brush wattle. 1 tree in 1989; single seedling in 2017 (uprooted). AK 229779
<i>Phytolacca octandra</i> *			s(1)	x		s		inkweed. A few plants on main island
<i>Pittosporum crassifolium</i>			a	x		a	a	karo. Commonest woody plant; present in all size classes
<i>Plantago lanceolata</i> *			o	x		o-lc		Coastal slopes

	1930s	1957	1989	1996-97	2004-05	2009	2017	Comments, generally from 2009 & 2017 visits, & herbarium voucher number
<i>Polycarpon tetraphyllum</i> *			s			lc	lc	allseed. Open coastal fringe, including both stacks
<i>Pseudopanax lessonii</i>			o-lc	x		lc	c	houpara. Forested slopes and the plateau
<i>Ranunculus muricatus</i> *						s		A few plants, SE shaded slope; unusual species for a small Hauraki Gulf island. AK 306400
<i>Rhamnus alaternus</i> * M			a	x		o	o	rhamnus. Seedlings or resprouts only in 2009; young plants and a 3m-tall tree in 2017 - all cut down or uprooted. AK 23281 & 70741, CHR 143854 & 184326
<i>Rubus fruticosus</i> agg. *					s(1)	s		blackberry. Single small plant, main forest ridge. First noted by Lee (pers. comm.) on 25 Mar 2004
<i>Sagina apetala</i> *						lc		Coastal fringes
<i>Sagina procumbens</i> *			s			l		Open coastal slopes; W side island
<i>Salicornia quinqueflora</i>		x	lc	x		lc	c	On open rocky shoreline throughout, including both stacks
<i>Senecio lautus</i>		l	o			la	lc	Open rocky coast, including both stacks
<i>Silene gallica</i> *			x			o	o-lc	In open and semi-open coastal slopes
<i>Solanum mauritianum</i> * M				x		s	s	woolly nightshade. 2 small saplings in forest, SE end in 2009; 4 saplings to 1.5m tall in 2017 - all uprooted
<i>Solanum opacum</i>						o	o	Scattered groups of plants, mostly in openings in plateau forest. AK 306152
<i>Sonchus oleraceus</i> *			o			o	o	Scattered plants throughout, including the N rock stack; all plants dried out in Dec 2017. AK 229780
<i>Spergularia tasmanica</i>			o			lc	lc	On rocky shoreline, especially on the S stack. Wingless seeds consistent with Hauraki form as reported by Wilcox (2009). AK 306136 & 306154
<i>Stellaria media</i> *						lc		Semi-open sites, including the N stack
<i>Tetragonia implexicoma</i>						lc	c	native spinach. In patches including both stacks, and also in partial shade, largest patch c.10 x 15m near S end - expanded since mouse eradication?
<i>Trifolium dubium</i> *						o	o	On rocky, open ledges
<i>Trifolium subterraneum</i> *						s		Single plant, coastal ledge, W side. AK 306168
<i>Ulex europaeus</i> *			la	x		lc	lc	gorse. As patches in clearings and open coastal slopes, especially at N end, mostly <1m tall
<i>Vicia sativa</i> *			s			o	o-lc	Semi open sites
<i>Wahlenbergia vernicosa</i>			s			l	l	N end in grassland, and W side of forested plateau. Flowers pale mauve. AK 306143
Monocots (14 + 22)								
<i>Allium triquetrum</i> *						lc		onion weed. Open grassy cliffs, especially on W side of island. AK 306140
<i>Amaryllis belladonna</i> * M				x		l		naked lady. Only green leaves present in 2009, bush gap, S end; also present at N end in grassland? Leaves all dying back - sprayed? AK 306148

	1930s	1957	1989	1996-97	2004-05	2009	2017	Comments, generally from 2009 & 2017 visits, & herbarium voucher number
<i>Anthoxanthum odoratum</i> *			o			lc	o-lc	sweet vernal. Open and partly shaded areas, especially in grassland at N end
<i>Astelia banksii</i>			o	x		o	o	Large tussocks in forest, mainly on coastal slopes
<i>Avena barbata</i> *			s				lc	Widespread, open grassy areas, plants to 1.5m tall
<i>Briza minor</i> *					x		o-lc	Widespread, semi-open areas. First collected on the island by <i>J Boow</i> on 18 Oct 2005. AK 333176
<i>Bromus catharticus</i> *			lc			o	o	Scattered tall individuals, open grassy areas, including both rock stacks (syn. <i>B. wilddenowii</i>)
<i>Bromus diandrus</i> *						la	o-lc	Semi-open and open coastal slopes, including S stack. AK 306553
<i>Carex breviculmis</i>						s		Near shoreline on NE side
<i>Carex divulsa</i> *							l	Single locality, scattered plants within 40 x 80 cm. AK 369942
<i>Carex flagellifera</i>			o-lc	x				Although not recorded by me, it is likely that this species and the similar <i>C. testacea</i> are both present.
<i>Carex inversa</i>						lc	l	Mainly in open vegetation at N end of island; but also in forest on E side
<i>Carex testacea</i>				x		o-lc	c	Throughout main island, semi-shade, leaves commonly with an orange tinge
<i>Cordyline australis</i>			s(1)			s(3)	s(1)	cabbage tree. 1 sapling in 1989; 3 plants in 2009, trunks c.1.4, 2.0, 3.0 m tall; One (trunkless) in plateau forest in 2017
<i>Critesion murinum</i> subsp. <i>leporinum</i> *						s		Gap in forest at southern end. AK306153
<i>Cyperus insularis</i> × <i>C. ustulatus</i>			[s(3)]			s(1)	s(1)	NE side, "black mark under umbel quite small, but leaves with a darker midrib". AK 306146
<i>Dactylis glomerata</i> *			s					cocksfoot
<i>Dichelachne crinita</i>			l					Local patch
<i>Ficinia nodosa</i>			o	x		o	o	Coastal slopes in the open and semi-open
<i>Freesia refracta</i> *						c	c	freesia. Throughout, in open and semi-shaded areas, including both stacks. AK 306142
<i>Gahnia lacera</i>				x				Presumably a single small plant that no one else has seen yet
<i>Ixia polystachya</i> *			[lc]	[x]				Central open areas in 1989 (previously wrongly recorded as <i>Gladiolus undulatus</i>). AK 229781
<i>Lachnagrostis littoralis</i>						s		Single plant seen on NE open grassy slope
<i>Lagurus ovatus</i> *						lc	c	hare's-tail. Open coastal slopes: mainly on W side in 2009; throughout in 2017
<i>Microlaena stipoides</i>						lc		Mainly N end of island, semi-open sites open
<i>Oplismenus hirtellus</i>						s	s	In forest
<i>Parapholis incurva</i> *			s			l	la	Rocky coastal fringe, upper splash-zone, including abundant on the S stack

	1930s	1957	1989	1996-97	2004-05	2009	2017	Comments, generally from 2009 & 2017 visits, & herbarium voucher number
<i>Paspalum dilatatum</i> *				x			s	paspalum. Plateau in semi-open, towards N end
<i>Poa anceps</i>			l	x				Local patches
<i>Poa annua</i> *		lc				la		Open areas, especially coastal fringe, including both rock stacks. Gillham (1960) recorded it on the N stacks. AK 306141
<i>Poa trivialis</i> *				[x]			l	Semi-shaded slope at S end of island. The record by Lee (1999) of <i>Poa pusilla</i> is now suspected to be of this species. AK 370882
<i>Rytidosperma pilosum</i> *			lc					danthonia
<i>Rytidosperma racemosum</i> *						l	l	danthonia. Open grassy slopes
<i>Sporobolus africana</i> *			c-a			lc	lc	ratstail. Open and semi-open coastal slopes, frequently amongst other grass species
<i>Tritonia lineata</i> *			[?]			o-lc		In open grassy areas, especially at the N end. AK 306145
<i>Vulpia bromoides</i> *						lc	la	Open and semi-open coastal fringes, including S stack
Bryophytes								
<i>Campylopus introflexus</i>	x							On ground just above beach, <i>LB Moore</i> , 24 Feb 1933. CHR 545666
<i>Frullania pentapleura</i>	x							On pohutukawa overhanging beach, <i>LB Moore</i> , 24 Feb 1933. CHR 493021
<i>Rhynchostegium tenuifolium</i>						l		Steep coastal slope, on small ledge in the +/-open with <i>S. contiguum</i> , <i>EK Cameron</i> , 18 Sep 2009. AK 306211
<i>Sematophyllum contiguum</i>						l		Steep coastal slope, on small ledge in the +/-open with <i>R. tenuifolium</i> , <i>EK Cameron</i> , 18 Sep 2009, AK 306209