

being flexuous (wavy), short between sterile nodes and elongated between the fertile nodes.”
(from de Lange 2023)

Key (from Gardner 1998b, p. 56)

“If one has only sterile specimens it is still possible (with some luck) to distinguish *Schoenus carsei* from the very similar *Machaerina tenax* and *Tetraria* [*Netrostylis*] *capillaris* using just a razor blade and x10 lens [see Gardner's fig. 1, reproduced here as Fig. 17] as follows:”

1. Culms at c. 1/2 way up usually less than 0.8 mm diam., pith finely but distinctly septate; mucro of basal sheaths us. projecting less than 5 mm long beyond sheath apex and minutely setose on the basalmargins ***Tetraria* [*Netrostylis*] *capillaris***

1. Culms at c. 1/2 way up usually 0.8–1 mm diam., pith continuous (but liable to compress or break

down under the blade in *S. carsei*); mucro of basal sheaths glabrous **2**

2. Pith of culms longitudinally traversed by denser (living?) plates of tissue in longitudinal section, pale but with one or more darker streaks or lines; mucro rarely exceeding sheath apex by more than two mm ***Baumea tenax* [*Machaerina tenax*]**

2. Pith of culms uniformly pale-parenchymatous; mucro sometimes several cm long ***Schoenus carsei***

(from Gardner 1998b, p. 56)

Local Western Northland records

AK246919 *Schoenus carsei*, Lisa Forester, North Dargaville – Maitahi, 26 November 1999.

AK363118 *Schoenus carsei*, Alan Esler, Poutu – Punahaere, 30 September 1975.

Flora and vegetation of Rākino Island group, inner Hauraki Gulf

Part 1: islets and main reef stacks

Ewen K. Cameron and Shelley Heiss-Dunlop

Introduction

Rākino Island lies in the inner Hauraki Gulf, some 20 km northeast of downtown Auckland City. Heading northeast from the Waitematā Harbour, it is near the end of an island chain, stretching from Rangitoto, Motutapu, Rākino to the Noises/Ōtata Islands (Fig. 1). Rākino covers 150 ha, three-quarters the size of the better-known Hauraki Gulf island, Tiritiri Matangi. It is owned by multiple private owners, with 125 small land parcels and 25 ten-acre (4.05 ha) blocks (Parker 2018), and a permanent population of 20 people and 120 houses (Peart & Woodhouse 2020: fig. 7.1). Rākino lies within the Hauraki Gulf Maritime Park.

Most of the island is covered in rank kikuyu grass (*Cenchrus clandestinus*), a reflection of an earlier era of sheep (and cattle) farming now mainly ceased. An oblique aerial photograph taken by Lloyd Homer (1986) shows the island as predominantly pasture, with a few houses/baches and woody vegetation mainly restricted to large pōhutukawa trees (*Metrosideros excelsa*) scattered around the steep coastal slopes. Over the last decade quite extensive areas of the kikuyu pasture have been planted with thousands of native seedlings, mainly tree species –

no planting has been carried out on any of the islets. Geologically, Rākino Island has Kawau Subgroup (basal Waitematā) conglomerates exposed on the north end of Māori Garden Bay, sitting unconformably on Waipapa Terrane greywacke (Bruce Hayward pers. comm.). Norway rats (Atkinson 1986) were manually eradicated from the Rākino group (referring to Rākino I. and all of its islets) by Auckland Regional Council, assisted by Task Force Green workers, in 2000 (Mike Lee, pers. comm.) and the island group has been mammalian-pest-free since then. Such a pest-free status is unusual for a human-populated Hauraki Gulf island.

Apart from a ‘preliminary vegetation’ report listing 59 native and 12 exotic vascular species by Willmott (2002), no extensive botanical survey of the island has ever been carried out, making it one of the largest Hauraki Gulf islands without a published vascular flora. Presumably this is because the group is so modified, with little original vegetation remaining. Since 2017 we have been irregularly visiting Rākino Island and its islets, recording its flora, vegetation types, obvious fauna and collecting herbarium specimens. This article records the flora, vegetation and birds of the eleven main Rākino islets

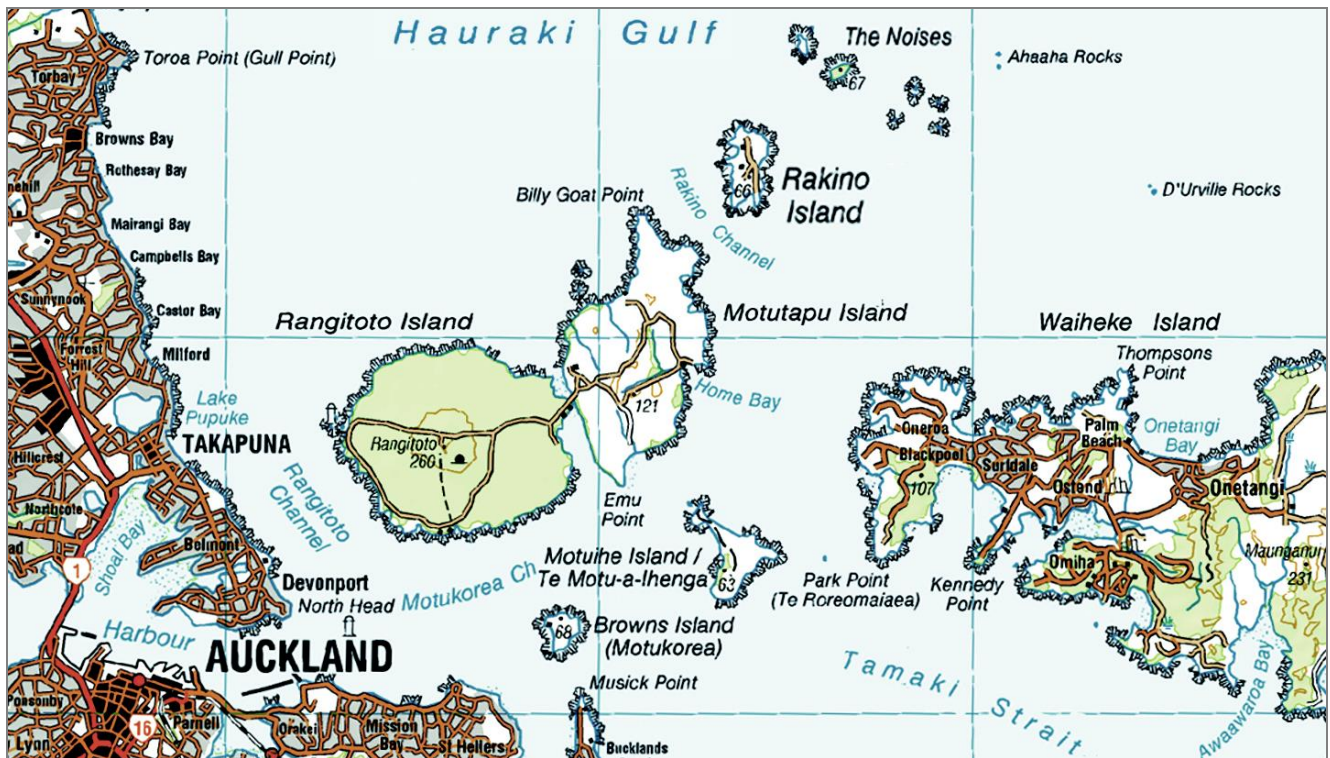


Fig. 1. Location of Rākino Island, inner Hauraki Gulf, Auckland. NZ Topo Map 250, modified by Joshua Salter. Scale = grid of 10 km squares.



Fig. 2. Rākino Island showing the location of its outer islands and islets, and the coastal rock platforms. NZ Topo Map modified by Joshua Salter. Scale = grid of 1 km squares.

(and several stacks) (Fig. 2). A later account (Part 2) will cover Rākino Island itself for which we have recorded over 420 wild vascular species (36% being native).

The greywacke coast is sharp on the feet, and native rock oysters are abundant in the intertidal areas, making landing on the islets challenging (especially in an inflatable) – only two islets possessed small beaches (the innermost of the Three Sisters group and Sandy Bay I.). This feature helps protect these fragile islets from frequent human visitation and none of the islets appeared to have suffered due to human visitors.

Method

Between Feb 2020 and Aug 2023 all islets/reef stacks were visited jointly by us, one or two times, recording all vascular plant species, the more obvious bryophytes and all bird species seen; an estimate of their abundance, general notes and photographs were taken of the vegetation. Voucher plant

specimens were collected and lodged in the Auckland Museum herbarium (AK). For the reef stacks, access was by foot from Rākino Island around low tide and by inflatable (Puffin) from a motorboat to the seven islands/islets permanently separated by water from Rākino Island. The survey days are included under the individual islet accounts below. Survey times varied for each islet depending on its size and ease of physically surveying the vegetation. From GeoMaps the altitude, length, breadth and area of each islet/stack was calculated (unless otherwise stated all measurements were calculated at an estimated high tide level). Where possible an attempt was made to circumnavigate each islet and climb to the summit to inspect the main vegetation and plant species. The inner Three Sisters islet and a stack on southern Woody Bay were the only ones where we did not reach the summit. Birds were recorded when seen or heard when we were on the islets, and also by using binoculars from the boat.

Sources of the islet data

NZ Archaeological Association website, *ArchSite*, was checked for possible archaeological sites. Apart from our own observations, a search was made for previous herbarium specimens held in New Zealand herbaria, *iNaturalist* records, Auckland Council, Department of Conservation (DoC), general reports

and publications. In addition, historical photographs were searched for, and a local landowner questioned. John MacKenzie in 2003-05 (pers. comm.) carried out some informal weed control (boxthorn and rhamnus) on Woody Island/and islet, and West islet – this explains why we saw old, dry and cut boxthorn (*Lycium ferrocissimum*) on these islets. Later, during Feb 2022 Auckland Council contracted Extreme Heights to control rhamnus (*Rhamnus alaternus*), boxthorn and gorse (*Ulex europaeus*) on Woody Island, Woody islet, Three Sisters and Sandy Bay Island (Deryn Dromgoole, pers. comm.). Note – some of the more recent weed control was carried out after our survey.

The islets and Results

The main 11 Rākino islets are numbered and listed below, see Figs. 1 and 2 for their location. Only two previous records were located: herbarium specimens, one collected by Rhys Gardner on 7 Oct 1984 (AK 222080) as part of a personal survey, and the second by Jonathan Boow (AK 287485), 28 Feb 2004, when working for the DoC on island biosecurity work (J. Boow pers. comm.). Several historical photographs were located. All the islets commonly had much exposed greywacke rock usually covered by crustose and foliose lichens. Their vegetation varied, as expected, depending on the

Table 1. Vascular plant species totals in different plant groups, native and naturalised for the main 11 islets of Rākino Island and their combined totals, along with areas and altitudes for each islet.

Plant group	Woody I. A	Woody islet B	"West islet" C	3 Sisters inner D	3 Sisters mid E	3 Sisters outer F	South I. G	Little Sandy Point inner stack H	Little Sandy Point mid stack J	Little Sandy Point outer stack K	Sandy Bay I. L	Totals
<u>Natives:</u>												
Ferns	6	4	2	3	4	3	2	1	1	1	3	9
Dicots	29	23	19	10	17	13	12	13	11	13	17	36
Monocots	11	6	6	5	9	2	2	2	1	5	5	17
<u>Exotics:</u>												
Conifers	-	-	-	1	1	-	-	-	-	-	1	1
Dicots	23	17	12	8	13	13	12	9	6	17	9	32
Monocots	15	9	9	10	11	8	11	6	5	11	9	22
Totals	84	59	48	37	55	39	39	31	24	47	44	117
% native	55%	56%	56%	49%	46%	46%	41%	52%	54%	40%	57%	53%
m asl	23	15	14	23	20	13	13	10	7	14	22	
Area (ha)	0.24	0.18	0.09	0.29	0.22	0.04	0.06	0.03	0.02	0.05	0.55	1.77



Fig. 3. Common seaweeds at the lower intertidal level included: *Splachnidium rugosum* (tubular brown stems), with *Codium convolutum* (dark green corrugated crust) and *Hormosira banksii* (dull green strings of beads), often associated with rock oysters. Photo: south side Mid Sister, SHD, 29 Feb 2020.

time of year visited, especially for recording the annuals, which generally dried up in the summer. Ideally, the surveys were made before the islets' vegetation became dry.

The plant and bird totals for each islet are presented in Table 1 and individually listed in the Appendix. Their combined vascular flora was 117 species, 53% being native. The islets' total area was c. 1.77 ha, with Sandy Bay Island being the largest, at just over 0.5 ha. The second largest and tallest (equal with Woody I. at 23 m asl) is mid Sister (0.29 ha) in the Three Sisters group, and the third largest is Woody I. (0.24 ha) which had the highest number of native species (36 spp.). Despite the smaller size of Woody islet (0.18 ha) and its lesser stature (15 m asl) it had nearly the same number of native species as Woody I. (Table 1). Brief descriptions of each islet follow, with an aerial image and at least one view from the side – these three sources of information

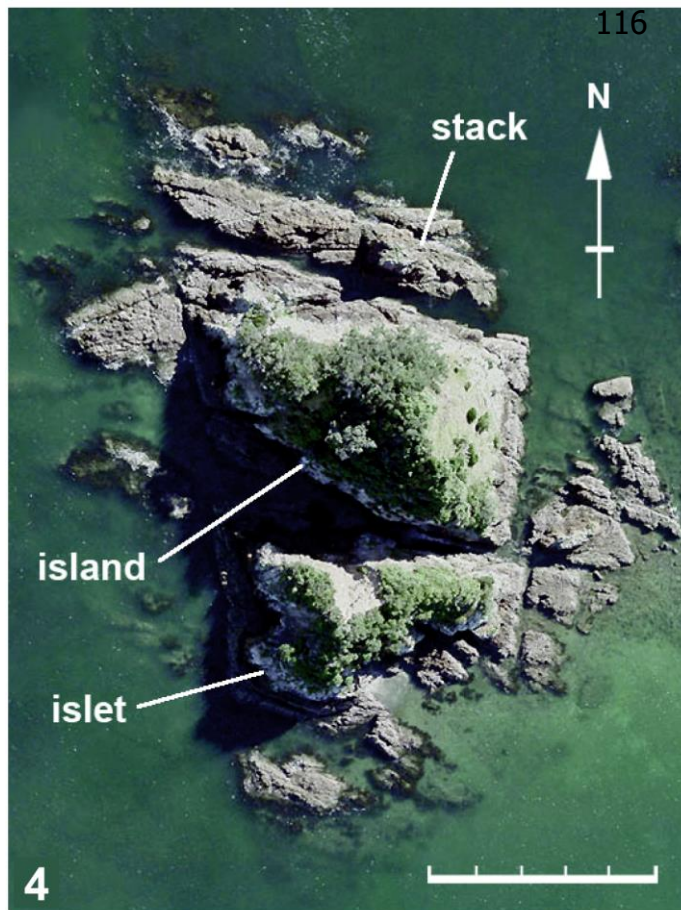
will give a reasonable idea of the physical and vegetation dimension of each islet.

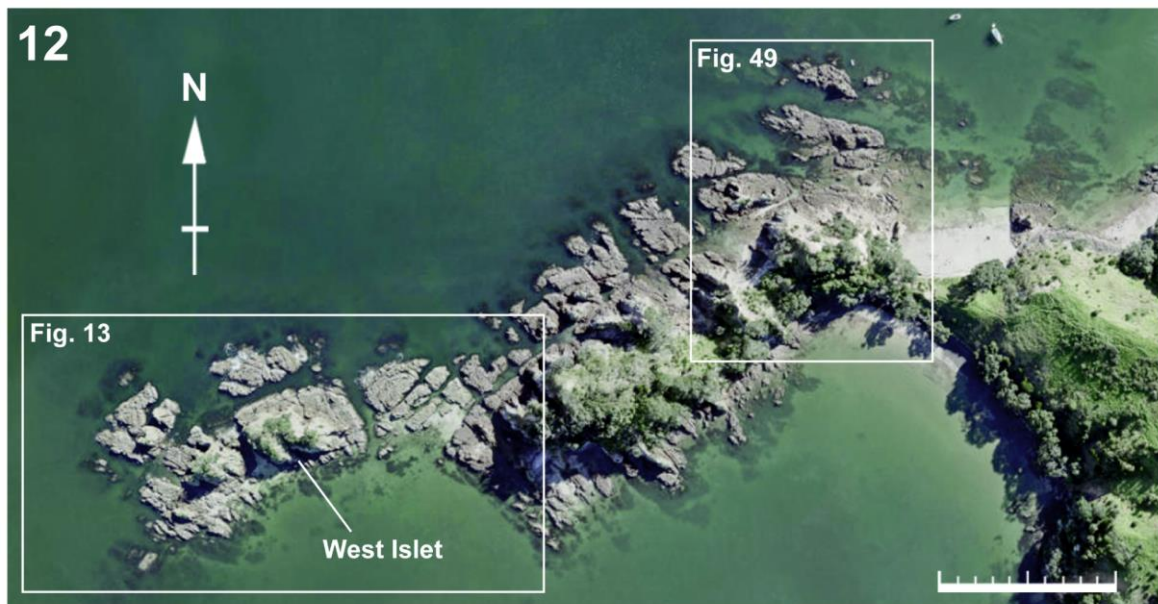
Rock oysters were usually abundant on the rocky lower intertidal zone where brown alga, *Cystophora torulosa*, *Hormosira banksii*, *Carpophyllum maschalocarpum* were common, often associated with *Splachnidium rugosum* (Fig. 3), and two greens, *Codium convolutum* and the exotic *C. fragile* subsp. *fragile*. After a storm *Colpomenia peregrina* attached to *Corallina* was common beach drift on the north side of Little Sandy Point. Where there were low tide pools on the islets large shore crabs (*Leptograpsus variegatus*) were evident.

A. Woody Island

Landed by inflatable 27 Nov 2021 and 6 Aug 2023 for c. 2 hours each time. John MacKenzie (pers. comm.) informed us that he used to be able to wade to this island at low tide, but now the channel is too deep – presumably the result of changes to sand levels in the channel. The islet measures 76 m × 43 m (roughly rectangular), 0.24 ha and 23 m asl (Figs. 4, 5). NZAA *ArchSite* (accessed Apr 2020) records the island as a possible pā site. During both visits we climbed to the top from the north side; an ascent from the east side also looked possible. Because of the steepness a circumnavigation was not possible. This is the largest islet in the Rākino group by area, and tallest (along with the inner Three Sisters islet). Much of the island is forested, except the steep east-facing slope which is grassland, and is the main side seen from Woody Bay beach. The flattish summit supports the best forest of all the islets, crowned by several spreading pōhutukawa 4–7(–9) m tall (wider than tall, indicating that they established in the open) (Figs. 6, 7), and common youthful houpara (*Pseudopanax lessonii*), karo (*Pittosporum crassifolium*) and māpou (*Myrsine australis*) to 3 m tall. A single coastal māhoe (*Melicytus novae-zelandiae*) c.2 m tall just west of the summit on the main ridge was observed, with a few mingimingi (*Leucopogon fasciculatus*) noted below on the steep

Figs. 4–11: **4.** Aerial image of Woody Island (central), Woody islet (below) and North Woody stack (above), at near low tide. Auckland Council GeoMaps (aerial base map 2017), modified by Joshua Salter. Scale bar = 50 m. **5.** Woody I. (RS) and islet (LS) showing their separation and the extensive grassland on the east-face of Woody I., looking NW from Woody Bay. Photo: EKC, 25 Feb 2021. **6.** Northern side of Woody I. near low tide, showing the forested summit, and the North Woody stack (centre). Photo: SHD from boat, 16 May 2020. **7.** Steep forested south side of Woody I. seen from summit ridge on Woody islet. Photo: SHD, 27 Nov 2021. **8.** The Nationally Threatened *Geranium retrorsum* occasional in the grasslands, Woody I. Photo: EKC, 6 Aug 2023. **9.** North Woody stack and (in the foreground) Woody Island with an oystercatcher nest with a single egg (arrow). Northern tip of Rākino behind. Photo: SHD, 27 Nov 2021. **10.** Summit ridge of Woody islet in foreground, showing Ewen amongst shrubby pōhutukawa at top of bare slip face that is fringed with ice-plant. Woody I. (left) and Rākino Island (background), looking NE. Photo: SHD, 6 Aug 2023. **11.** Common and healthy *Astelia banksii* clumps mixed with mainly low houpara, with pōhutukawa above on the steep southern side of Woody islet. Photo: SHD, 6 Aug 2023.





southern slope. Ground ferns were frequent and included *Asplenium oblongifolium*, *A. haurakiense* and a large patch of hound's tongue (*Lecanopteris pustulata*), along with "shrubby" *Solanum americanum* (to 1.2 m tall after all the wet weather during 2023), NZ spinach (*Tetragonia trigyna*), *Chenopodium triandrum*, *Astelia banksii*, *Dichondra repens*, inkweed, and close together, seedlings of ngaio (*Myoporum laetum*, ×2), cabbage tree (*Cordyline australis*, ×1) along with a clump of *Pelargonium inodorum*. The tallest tree on the islet was not in the summit forest, but standing out on its own, midway down on the south side, a pōhutukawa c.16 m tall.

There were two dominant grassy areas, the largest being the east-facing slope (Fig. 5) and a smaller south-facing slope just west of the summit (appears to be an old slip site), both areas dominated by exotic grasses including: sweet vernal (*Anthoxanthum odoratum*), ratstail (*Sporobolus africanus*), redleg grass (*Bothriochloa macra*), danthonia (*Rytidosperma racemosum*), perennial ryegrass (*Lolium perenne*), ripgut brome (*Bromus diandrus*), soft brome (*Bromus hordeaceus*), hare's-tail (*Lagurus ovatus*), shivery grass (*Briza minor*), vulpia hair grass (*Festuca bromoides*), along with a couple of natives, microlaena (*Microlaena stipoides*) and long-hair plume grass (*Pentapogon crinitus*). Other species in this grassland included: *Geranium retrorsum* (Fig. 8), narrow-leaved plantain (*Plantago lanceolata*), catchfly (*Silene gallica*), *Pellaea rotundifolia*, *Cheilanthes sieberi*, along with two species of clover (*Trifolium glomeratum*, *T. subterraneum*), *Lotus subbiflorus*, and fleabane (*Erigeron sumatrensis*). The islet's coastal fringe was dominated by prostrate taupata (*Coprosma repens*), with karo, rhamnus and boxthorn, and herbaceous species included NZ spinach, glasswort (*Salicornia quinqueflora*), *Ficinia nodosa*, *Astelia banksii*, and many exotic species. On the south-facing cliffs *Peperomia urvilleana* was common along with *Astelia banksii*.

New weeds are arriving: a single small shoot of kikuyu grass on the north side, in a crack of bare rock was removed during our first visit and another above this site in the upper forested margin was removed during our second visit, as was a mature flowering boneseed shrub (*Chrysanthemoides monilifera*), also on this north-facing slope (no others observed), and a single woolly nightshade (*Solanum mauritianum*) seedling on the east-facing grassland on the second visit. A large adult moth vine (*Araujia sericifera*) was removed by us from the summit forest (west side) on 27 Nov 2021. This vine had likely already seeded, because seedlings and a juvenile vine were observed scattered in three localities during our second visit; time permitted only a partial removal. Of all the islets, Woody Island supports the largest vascular flora of 84 species with 55% being native (Table 1).

On Woody Island we recorded the largest number of bird species of all the islands, with a total of 19 species either seen or heard. In the forested summit and on the upper southern slope there were c. 10 bird burrows. Several appeared to be occupied (clean around the opening) and a feather by such a burrow most likely belonged to a grey-faced petrel (G.A. Taylor pers. comm.). A variable oystercatcher nest with a single egg (Fig. 9) was seen on a northwest-facing rocky outcrop. The pukeko record (see Appendix) was based on a dry dropping. We noted some small holes amongst the dense grass on the eastern slope, possibly from prospecting white-faced storm petrels?

North Woody stack

We used the inflatable in the narrow channel to cross from Woody Island on 27 Nov 2021. The oblong stack measures 36 m × 12 m, 0.03 ha and 7 m asl, and the low herbaceous vegetation is limited to the summit area (< 3 m × 2 m) (Fig. 9). The vascular flora consisted of four native species: glasswort, ice-plant (*Disphyma australe*), *Senecio lautus*, *Spergularia tasmanica*, and a single exotic

Figs. 12–17: **12.** Aerial view of peninsula between Woody Bay and West Bay. West islet at western end (see Fig. 13), and several rock stacks on north side (see Fig. 49). Auckland Council GeoMaps (aerial base map 2017), modified by Joshua Salter. Scale bar = 100 m. **13.** Aerial image of West islet at near low tide and to its west three stacks not surveyed. Auckland Council GeoMaps (aerial base map 2017), modified by Joshua Salter. Scale bar = 50 m. **14.** West islet and connecting reef (on left) and uninvestigated islet and stacks (on right). Motutapu beyond. Photo: from summit area of Woody islet looking SSW, SHD, 6 Aug 2023. **15.** West islet and two uninvestigated stacks to the west (right) on the rocky intertidal reef. Northern tip of Motutapu beyond (at left). Photo: from Woody Bay looking SW, SHD, 22 Feb 2021. **16.** Steep southern slope with grass (exotic spp.) among a moss mat of *Hypnum cupressiforme* appearing orange, West islet. The woody shrubs are mainly karo, boxthorn and rhamnus. Photo: EKC, 15 Nov 2020. **17.** The herbaceous vegetation of the rocky gut on West islet. Healthy silvery tussocks of *Astelia banksii*, a clump of *Linum monogynum* (arrow), a large clump of *Peperomia urvilleana* (central). Scattered grasses and patches of *Asplenium haurakiense* and *Senecio lautus* are frequent on the lichen-clad rocks. A small taupata is present bottom left. Photo: EKC, 15 Nov 2020.



Figs. 18–25: **18.** Aerial image of the Three Sisters. Auckland Council GeoMaps (aerial base map 2017), modified by Joshua Salter. Scale bar = 50 m. **19.** The Three Sisters, with Motutapu behind, looking south from the summit of West islet. Pine trees dominate the inner islet (left) and there are a few on the middle one; the sandy beach at the NE side was an easy place to land. Photo: SHD, 8 Oct 2023. **20.** Mid (left) and inner Sisters, looking NE with Rākino I. on right; near low tide. Photo: SHD, 19 Mar 2022. **21.** Drought damage, pine intolerance or both? Large *Astelia banksii* bases with depauperate leaves, on rocky face with *Pyrrosia elaeagnifolia* and lichens, over-topped by tall pine trees. south-facing, inner Sister. Photo: SHD, 29 Feb 2020. **22.** Mid Sister showing the dead area of rhamnus after recent Council control (pale brown central area) – now ideal for pine establishment. The area of the important coastal māhoe is on its right; most of the tall pines are on the inner Sister behind; and the channel between the outer and mid islets is too deep to wade cross. Photo: from outer Sister summit, SHD, 12 Mar 2022. **23.** Female coastal māhoe fruiting well, green to purple-black fruit present below the leaves, some ten adult plants (see Fig. 22 for their location) with māpou on the SW slope of mid Sister. Photo: SHD, 29 Feb 2020. **24.** Long strands of *Pimelea urvilleana* spread over several metres clinging tightly to the east-facing eroding steep slope of mid Sister – the only location of this species seen for the whole Rākino group. Photo: SHD, 29 Feb 2020. **25.** Outer Sister, showing a dry grassland, and the healthy tussocks of *Astelia banksii* that aided our ascent up the SE side (left side in photo). Note dead rhamnus on mid Sister (foreground), and the lone sailor (Ewen) in the small inflatable! Photo: from mid Sister, SHD, 12 Mar 2022.

species, sickle grass (*Parapholis incurva*) – all five species were present on the adjacent Woody Island. Black-backed gulls probably nest there.

B. Woody islet

Landed by inflatable 27 Nov 2021 and 6 Aug 2023 for c. 2 hours each time. The islet measures 57 m × 38 m (roughly rectangular), 0.18 ha, 15 m asl (Fig. 4). Because of the steepness a circumnavigation on foot was not possible. The islet is only just separated from Woody Island by a narrow gut (Figs. 4, 5), probably humanly negotiable at low tide on the east side. On the north side a 10-m-wide swath has slipped into the sea from the W–E summit ridge relatively recently, judging from the lack of vascular plants established on it (Fig. 10).

Apart from the slip area, along the narrow summit ridge and steep drop-offs, the islet is crowned by stunted multi-stemmed pōhutukawa 3–6 m tall, with trunks c.15 cm dbh, associated with shorter houpapa, karo, boxthorn and shorter rhamnus. Apart from a grassy ledge on the western side (dominated by ripgut brome), the islet lacks the grasslands of Woody Island. On the outer steep margins, below the pōhutukawa canopy, and subcanopy of houpapa and occasional kawakawa (*Piper excelsum*), clumps of healthy *Astelia banksii* were common (Fig. 11), along with low-spreading taupata shrubs, bare rock (often with a good covering of lichens). Scattered halophytes (i.e., ice-plant, glasswort, *Senecio lautus*) are present, but not abundant.

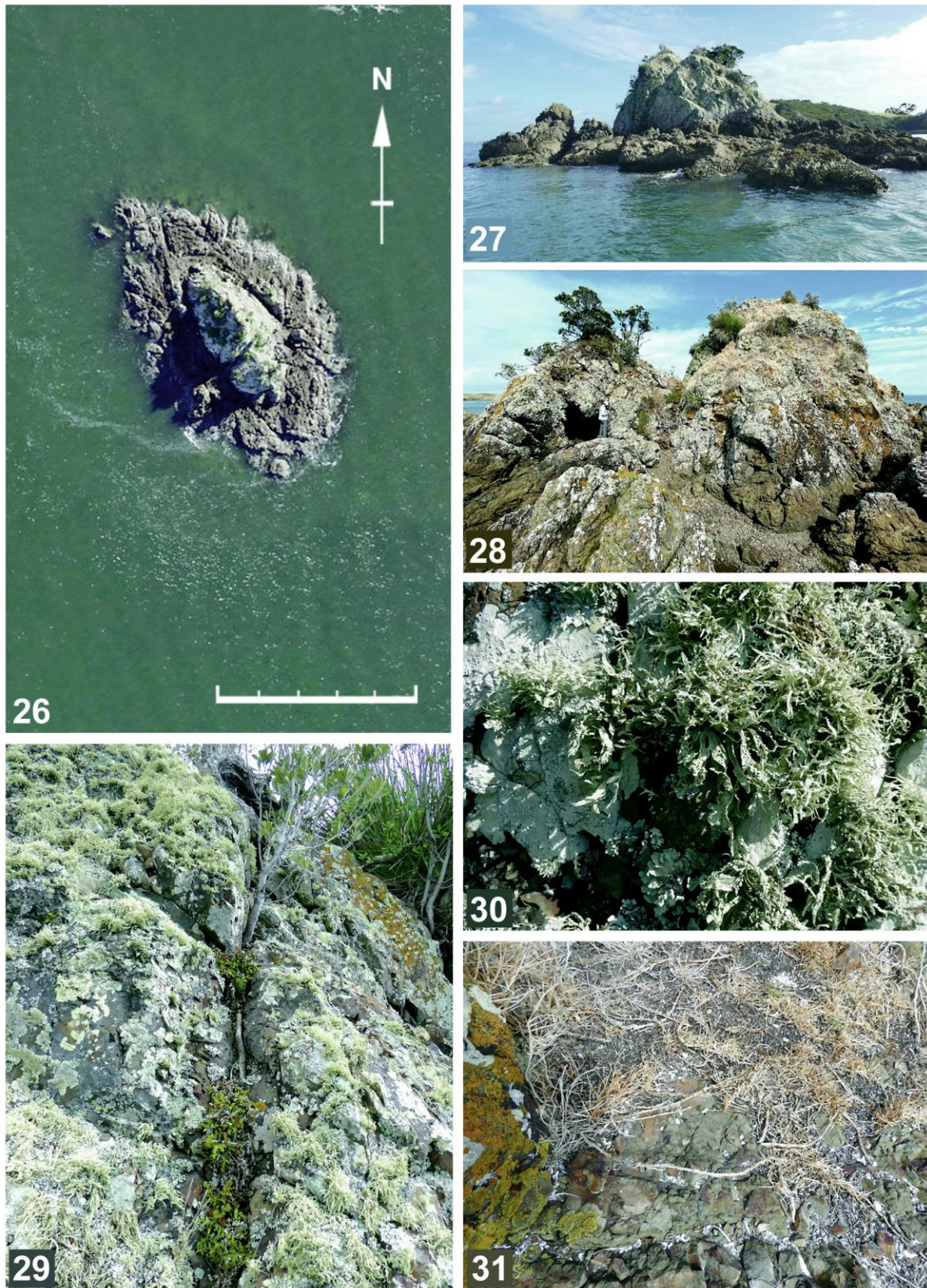
Locally on the south side, several clumps of harakeke/flax (*Phormium tenax*) were growing close together (possibly the largest amount that we observed growing wild in the whole Rākino group), with leaves to c. 1.2 m long. Oddly there were no rengarenga (*Arthropodium cirratum*) present on this islet and the adjacent Woody I., despite there being suitable habitat. Woody islet supports the second-

largest vascular flora of 59 species with 56% being native (Table 1).

Scattered seabird burrows were noted on the SW forested slope, two occupied by little penguins/kororā (seen and heard). There are likely to be grey-face petrels present as well.

C. "West islet" stack

We walked out to West islet stack c. 2 hours before a spring low, on 15 Nov 2020 for c. 2 hours. It measures 48 m × 29 m (roughly rhomboidal shape, large gut on S side), 0.09 ha, 14 m asl (Figs. 12, 13). It is joined to Rākino by a rocky reef separated by a shallow sandy channel (Figs. 14, 15). The main woody vegetation is karo and four coastal māhoe to 1 m tall under a pōhutukawa; the pōhutukawa (c. 5 m tall) crowns the islet (E end) and is the tallest tree; clumps of *Astelia banksii* are frequent. A moss mat, c. 6 × 4 m, of *Hypnum cupressiforme* (Fig. 16), dominated a south-facing area just below the summit ridge, with grasses and *Thelymitra longifolia* emergent, and threads of the leafy liverwort, *Chiloscyphus semiteres*, through it. In the open, *Geranium retrorsum* was locally present in a predominantly exotic grassland on the summit ridge. Below the woody vegetation and clumps of *Astelia banksii* on the side of the rocky gut, an open area was dominated by colourful-flowering native herbaceous species (Fig. 17), including: *Wahlenbergia vernicosa* (with pale blue flowers), *Linum monogynum* (white flowers) the only Rākino locality for this species, *Senecio lautus* (yellow flowers), *Peperomia urvilleana*, *Asplenium haurakiense*, along with exotic species of subclover (*Trifolium subterraneum*, white flowers), suckling clover (*Trifolium dubium*, yellow flowers), hare's-tail grass and vulpia hair grass. West islet supports 48 species of vascular plants with 56% being native (Table 1).



Figs. 26–31: **26.** Aerial image of South Island. Auckland Council GeoMaps (aerial base map 2017), modified by Joshua Salter. Scale bar = 50 m. **27.** Southern side of South Island, Rākino Island's most southern and most remote islet, with Rākino I. behind. Photo: SHD, 12 Mar 2022. **28.** The two adjoining islets of South Island. Ewen standing beside an overhang on the shorter islet. Photo: SHD, 12 Mar 2022. **29.** Lichens were abundant on the exposed east-facing greywacke. *Xanthoria parietina* (orange, upper right), *Xanthoparmelia* sp. (yellow-grey foliose), *Parmotrema* sp. (grey ruffly foliose), *Ramalina celastri* ('shrubby'). *Asplenium haurakiense* in the crack along with a karo root. Photo: SHD, 12 Mar 2022. **30.** Close up of the common lichens: *Pertusaria* (white crustose with small lumps, left) and fruiting *Ramalina celastri* (flat ribbons) along with *Parmotrema* sp. (bottom centre). Photo: SHD, 12 Mar 2022. **31.** Unrooted stolons of kikuyu grass appeared to be associated with a black-backed gull nest on a stack, northern side South Island. Photo: SHD, 12 Mar 2022.

No seabird burrows were seen.

Three reef stacks west of the West islet contained vascular plants but were not investigated: a 13 m-tall stack on the west side of “West islet”, partly separated by a channel was crowned by a 5 m-tall pōhutukawa, with karo and grassy areas present (as viewed from West islet); a smaller 5 m-tall stack to its NW; and the smallest, a 5 m-tall stack to the south (Figs. 14, 15). We intend to revisit this West islet group to survey more fully.

D. Three Sisters – inner islet

Landed by inflatable 29 Feb 2020 for c. 1 hour. It measures 68 m × 57 m (roughly triangular), 0.29 ha, 23 m asl (Fig. 18). We surveyed around the base and partly up the SW side, but not quite as far as the summit – radiata pine needles (*Pinus radiata*) made the upper slopes slippery. Pine trees dominate the whole island (Figs. 19, 20), from seedlings to many adult trees to c.18 m tall and their needles covered much of the ground, physically suppressing the native vegetation which is sparse. Pōhutukawa were much less common than the pines and only reached c.8 m tall. In most places shrubs were absent; where present karo and rhamnus were the most common, followed by houpapa, boxthorn, taupata, and a single coastal māhoe observed on the southern side. Tussocks of *Astelia banksii* were common on the clifftops, most of them struggling (Fig. 21) from drought, pine tree intolerance or both? Note – after our visit an Auckland Council contractor controlled the rhamnus, boxthorn and gorse. The moss *Triquetrella papillata*, was locally abundant in the hollows and along the cracks on lichen-covered rocks, 2–4 m asl on the west side. The inner Sister supported 37 species of vascular plants with 49% being native (Table 1).

E. Three Sisters – mid islet

We walked around to the middle islet from the inner islet, near low tide, 29 Feb 2020 for c. 2 hours; and briefly landed on the SW side on 12 Mar 2022. The islet measures 43 m × 64 m (roughly oval), 0.22 ha, 20 m asl (Fig. 18). We climbed from the NW corner to the summit and descended down to the SW corner. Two tall pine trees dominated the summit area, and a few smaller pines were lower down on the east side (Figs. 19, 20, 22). Karo and rhamnus were locally common. In the SW quarter there was an interesting shrubland dominated by coastal māhoe (c. 10 adult plants 2–2.5 m tall, several fruiting heavily, Fig. 23) with māpou, karo and rhamnus. Pōhutukawa, houpapa and taupata and boxthorn were all occasional, scattered around the islet. On the steep, crumbling rocky slope in the

open, facing the inner Sister above the splash zone, were several small prostrate plants of *Pimelea urvilleana* sparsely spread over 1 × 8 m (Fig. 24), perhaps originally one plant? The glaucous native grass, *Anthosachne kingiana*, and prostrate taupata grew close by. In the gut between inner and mid Sisters there were two small seedling mangroves (*Avicennia marina*) in a crack in the rock. Note – between our visits the rhamnus and boxthorn had been cut and sprayed (Fig. 22). The middle Sister supported 55 species of vascular plants with 46% being native (Table 1).

F. Three Sisters – outer islet

Landed by inflatable 12 Mar 2022 and also briefly on 19 Mar 2022 for nearly 2 hours in total. It measures 24 m × 19 m (roughly circular), 0.04 ha, 13 m asl (Figs. 18, 25). and we climbed to summit (from the SE corner). The channel between outer and mid Sisters was too deep to wade across at low tide. The islet was very dry during our visit and identifying the annuals was more like forensic botany. The overall vegetation was a grassland, with limited woody vegetation mainly on the south and west sides. There were a few pōhutukawa, the main woody species present, the tallest c. 6 m tall partly up the NW corner and over-topping the summit. Karo, taupata and boxthorn were also occasional and a single houpapa was seen. A mingimingi c. 2 m tall was dead-standing in Feb 2020 (observed from mid Sister) and lying down but still present by the summit in Mar 2022. Rhamnus had been cut and or poisoned just before our visit and the pines have yet to reach the islet. Clumps of *Astelia banksii* were locally common and healthy (Fig. 25).

The grassland was dominated by: cocksfoot (*Dactylis glomerata*), hare’s-tail, *Ficinia nodosa*, narrow-leaved plantain, subclover, danthonia, vulpia hair grass; and more locally ratstail, catchfly, silvery hair grass (*Aira caryophyllea*), sow thistle (*Sonchus oleraceus*) and annual ryegrass (*Lolium rigidum*). The outer Sister supported 39 species of vascular plants with 46% being native (Table 1).

Bird burrows were present under the *Astelia banksii* tussocks – possibly grey-faced petrel.

G. South Island

Landed by inflatable 12 Mar 2022 for 3 hours. It measures 24 m × 40 m (elliptic), 0.06 ha (Fig. 26). Being 170 m from the main island, it is the most remote island/islet of the Rākino group. The island consists of two islets abutting each other, 13 m asl (N islet) and 9.3 m asl (S islet), with a storm platform c. 12 m-wide surrounding it, that is connected to 4 narrow stacks, 2–4 m tall (Fig. 27). Walking right around the storm platform was straight forward. There is very little soil; most of the island is

exposed greywacke with abundant lichens (crustose and foliose, Figs. 28–30) and little else, as are all the islets in the Rākino group. The lichens included: *Xanthoria parietina*, *Xanthoparmelia* sp., *Parmotrema* sp., *Ramalina celastri*, and *Pertusaria* – as identified by Dan Blanchon from our photographs.

Because of the thin soils, grasslands (dry) are common; along with the occasional shrub (five species) and clumps of *Astelia banksii*. The grasslands consisted of tall *Avena barbata*, *Bromus catharticus*, ripgut brome, with more delicate culms of danthonia, vulpia hair grass and annual ryegrass that were all locally common, and locally there was a sward of *Microlaena stipoides* with moss (*Thuidiopsis furfurosa*) through it. The tallest plants were three pōhutukawa to c. 4 m tall that crowned the shorter islet; other woody species: karo to 2 m tall, boxthorn to 0.8 m tall, were on the open summit of the tallest islet, rhamnus was more in the cracks and taupata lower down. None of the woody plants were common. Small tangles of low wire vine (*Muehlenbeckia complexa*) were mainly on the boundary of the grassland and exposed rock.

A feature of the island is four connected, narrow stacks on the storm platform, two with remnant black-backed gull nests. Associated with those nests were three local grasses, *Parapholis strigosa*, kikuyu and buffalo grass (*Stenotaphrum secundatum*), the latter two represented by 0.5 m-long shoots (Fig. 31) on separate stacks – most likely transported to the island as nest material by the gulls. South Island supported 39 species of vascular plants, with 41% native (Table 1). Surprisingly for the most distant islet from Rākino Island, this was nearly the lowest percentage of native species of all the Rākino islets.

The only birds seen on the island were a kingfisher and red-billed gulls, with white-fronted terns overhead. A workup of fish nearby attracted numerous fluttering shearwater and white-fronted terns with a few black-backed gulls and a pied shag. The islet was too rocky and lacking in soil for burrowing seabirds.

H. Little Sandy Point – inner stack

We walked out to the stack at low tide, circumnavigated and reached the summit, 4 Jul 2021, 10 Apr 2022 and 26 Oct 2022 for c. 2 hours in total for this stack. It measures 26 m × 12 m (elliptic), 0.03 ha, 10 m asl (Figs. 32, 33), and is an exposed, eroding rocky outcrop with only a few woody species, many annuals and some halophytes (Fig. 34). There were only a few plants of each of

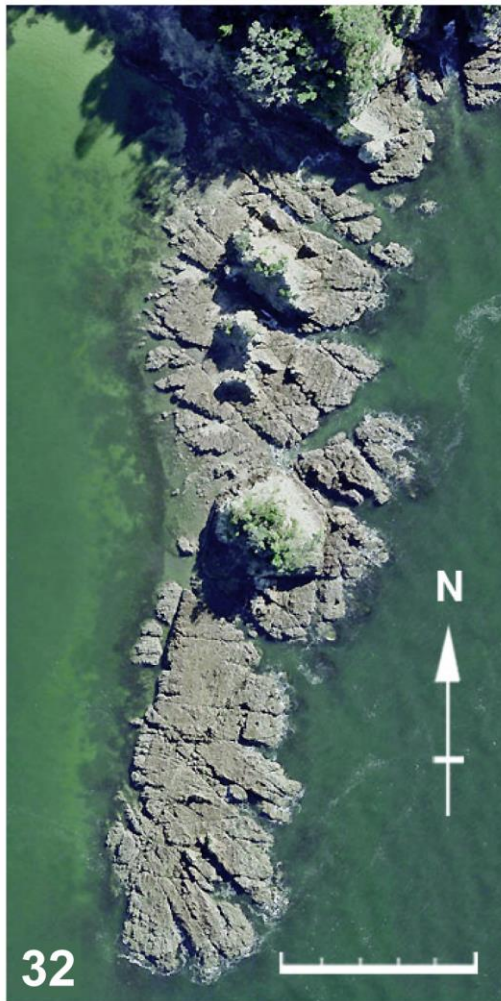
the five woody species present: pōhutukawa (one 6 m-tall part-way up the stack on the NW side was by far the tallest tree present – not visible in the 1880s (Fig. 35), karo (to 2 m-tall), taupata, rhamnus (<1 m-tall), and an occasional gorse bush (< 1 m-tall and most looking dead – drought/sprayed?). Halophytes such as glasswort and ice-plant (small patches) were locally common, and *Senecio lautus*, NZ spinach and *Spergularia tasmanica* were occasional. In spring, annuals dominated some of the ledges of fine rock debris, for example, a west-facing ledge was dominated by soft brome and also contained: annual ryegrass, *Lotus subbiflorus*, catchfly, scarlet pimpernel (*Lysimachia arvensis* s.str.), allseed (*Polycarpon tetraphyllum*), *Crassula sieberiana*, *Sagina apetala*, *Ficinia nodosa*, sow thistle, *Senecio lautus*, ice-plant and low gorse bushes (Fig. 34). On a steep south-facing slope there was a sizeable rocky herbfield of sickle grass, ice-plant, glasswort, *Spergularia tasmanica*, *Senecio lautus*, vulpia hair grass, *Dichondra repens* (local), *Ficinia nodosa* and wire vine (Fig. 36). The inner stack supported 31 species of vascular plants with 52% being native (Table 1).

Too rocky for bird burrows; two old black-backed gull nests present.

J. Little Sandy Point – mid stack

We walked out to the stack at low tide, circumnavigated and reached the summit, 4 Jul 2021, 10 Apr 2022 and 26 Oct 2022 for c. 2 hours in total. It measures 23 m × 13 m (“dumbbell” shape), 0.02 ha, 7 m asl (Figs. 32, 33). The main vascular species were similar to the inner stack, although fewer species overall – probably related to the smaller area and lower height. For the woody flora, boxthorn was absent, and gorse dominated the NW face, again appearing nearly dead (Fig. 37 – drought/sprayed?). The tallest tree was a wide-branching pōhutukawa, c. 4 m-tall, and over-topping the summit from the NW side. Annuals were again common on the ledges, especially redleg grass, soft brome and vulpia hair grass. The middle stack supported 24 species of vascular plants with 54% being native (Table 1). An undated photograph (c. 1964) in Maddock & Whyte (2017: 88–89 p) of these three rocky stacks (mistakenly captioned ‘The Three Sisters’) shows the wide-branching pōhutukawa on the mid stack which is still present (cf. Fig. 37) and what could be a head of a narrow pōhutukawa or a pine tree on the south side of the outer stack.

Too rocky for bird burrows.



Figs. 32–35: **32.** Aerial image of the three main stacks of Little Sandy Point. Auckland Council GeoMaps (aerial base map 2017), modified by Joshua Salter. Scale bar = 50 m. **33.** The three main stacks – inner (L), mid, outer (R) – on the reef of Little Sandy Point. Photo: from Home Bay looking SE, EKC, 4 Jul 2021. **34.** Inner stack, with pōhutukawa, and in front of figure (Shelley) a ledge of fine rock debris supporting soft brome and other annuals; Little Sandy Point. Photo looking SE: EKC, 26 Oct 2022. **35.** Historical image (1880s) of the three main stacks on the reef of Little Sandy Point showing less woody vegetation 140 years ago than today. Four people on the inner stack, two of them ladies in long skirts. Beere, Daniel Manders, 1833-1909. Ref: 1/2-096210-G. Alexander Turnbull Library, Wellington. Reproduced with permission. <https://natlib.govt.nz/records/23055092>



Figs. 36–41: **36.** A hanging rocky-herbfield on south-facing side of inner stack, of sickle grass, ice-plant, glasswort, *Spergularia tasmanica* and *Senecio lautus*, Little Sandy Point. Photo: EKC, 26 Oct 2022. **37.** Middle stack (in front) and outer stack to right, Little Sandy Point. Mid stack with a low sward of nearly dead gorse, pōhutukawa (behind top) and an erect karo (right); near low tide. Photo: SHD, 10 Apr 2022. **38.** Outer stack (centre, now cut off by the rising tide) and part of mid stack (right), seen from top of inner stack, Little Sandy Point, looking south. Photo: SHD, 10 Apr 2022. **39.** Soft conglomerate of colluvium c.0.5 m thick, undermined by c.10 unoccupied burrows (grey-faced petrel?), with boxthorn and wire vine above. Photo: south side of outer stack summit, Little Sandy Point, SHD, 10 Apr 2022. **40.** The end of Little Sandy Point reef with a few small stacks at the far end, is a favoured roosting spot for seabirds. Karo in foreground. Photo: from summit of outer stack looking south, EKC, 10 Apr 2022. **41.** Over 200 white-fronted terns resting on the southern tip of Little Sandy Point, Sandy Bay I. on right, and Otata I. (Noises) in the gap. Photo: from the boat, SHD, 10 Apr 2022.

K. Little Sandy Point – outer stack

We walked out to the stack at low tide, circumnavigated and reached the summit via the SW corner, 4 Jul 2021 (brief basal visit), 10 Apr 2022 and 26 Oct 2022 for c. 4 hours in total. It measures 27 m × 26 m (roughly circular), 0.05 ha, 14 m asl (Figs. 32, 33, 38). Although the most exposed of the three reef stacks, it is the largest, tallest and supports the most species. As with the other two stacks, it is mainly eroding greywacke. However, just

south of the summit area of this outer stack there is also a cap of soft conglomerate containing broken and whole shells, including speckled whelk (*Cominella adspersa*) and cat's eye (*Lunella smaragdus*), that petrels have burrowed into (Fig. 39).

"This looks like typical colluvium (= loose, unconsolidated sediments) that have been deposited at the base of hillslopes by either rainwash,

sheetwash, slow continuous downslope creep, or a variable combination of these processes or slip deposit. Where is the slope/cliff above? Eroded away has to be the answer. So, the deposit is likely older than Holocene (last 10,000 years) and probably younger than 1 million years, indeed probably younger than 500,000 years.” Bruce Hayward, pers. comm., based on our photographs).

The same six woody species as on the mid-stack were present, but on this stack the three exotic species were more common: boxthorn (to 2 m-tall), rhamnus (< 1 m-tall, forming small thickets) and gorse (< 1 m-tall). Also, unlike the other two stacks, the native/exotic woody cover was virtually continuous in the SW corner from the summit down to the splash zone. Again, the tallest tree was a pōhutukawa, this time c. 7 m tall on the SW side, and karo 2–3 m-tall. There was a herbfield on the southwest-facing rocky slope with *Cotula australis*, silvery hair grass, allseed, suckling clover, catchfly, narrow-leaved plantain, sow thistle, ratstail, ice-plant and NZ spinach. In October the open summit was dominated by fruiting ripgut brome. Two smallish plants of harakeke were present and oddly only a single plant of *Astelia banksii*. The outer stack supported 47 species of vascular plants with 40% being native (Table 1).

Notable were the c. 10 suspected grey-faced petrel burrows on the south and western slopes of the summit area under mature boxthorn and taupata, the burrows appearing inactive during our 10 Apr 2022 visit (Fig. 39).

Small stacks at the end of Little Sandy Point

Most of the reef (Little Sandy Point) is covered at normal high tides. The part of the reef south of the outer stack is separated by a channel (Fig. 40), and near the southerly tip there are several small stacks (≤ 2.5 m asl), the tallest with mats of ice-plant and tufts of glasswort. This southern part of the reef is a favoured roosting site of seabirds. On 10 Apr 2022 over 200 white-fronted terns, a juvenile Caspian tern, a variable oystercatcher, a spur-winged plover and a black-backed gull were noted roosting here at low tide (Fig. 41).

L. Sandy Bay Island

We landed by inflatable 30 Jan 2022 on a small beach at the NW corner for c. 3 hours. It measures 91 m $\times$ 91 m (roughly triangular, the long SE margin indented), 0.55 ha, 22 m asl (Fig. 42) It is a pā site (NZAA ArchSite); flat-topped, rather narrow ridges; extensive intertidal reef around most of the island;

deeply dissected greywacke, solid coastal rock by the sea, crumbly higher up. Predominantly exposed rock with a thin soil covering – a poor combination for native vegetation. We walked right around the island and up to the top from the NW corner – an alternative summit access route may be easier. It was the only islet where there was evidence of old building materials – timber and corrugated iron, some of it sliding over the cliffs on the upper SE side, possibly related to a Māori couple who attempted temporarily to live here in the 1970s (long-time resident Colin MacLaren, to John MacKenzie pers. comm.).

Radiata pine dominated throughout the island (Figs. 43, 44), c. 50 trees to c. 16 m tall and 60 cm DBH, all sizes down to small seedlings, thick pine needle litter covering much of the ground. These trees appear to have originated from a lone tree present in the 1970s (Fig. 45). The dominance of pine trees has had a negative effect on the native vegetation by drying out the substrate and growing more rapidly and taller than any of the native trees. Rhamnus was throughout, mostly young-looking shrubs, 1–2(–3) m tall; boxthorn was also widespread and common; gorse – scattered with many small plants. Of the native woody species, karo was common; houpara more local, mainly only shrubs; pōhutukawa – the main native tree on island to c. 8m tall – many looked unhealthy (drought?), no really large pōhutukawa; small low taupata around the lower vegetation fringe; and two small shrubs of coastal māhoe were present. *Astelia banksii* was locally common, many large leaf-bases present (plants quite old?) with no or few leafy shoots (Fig. 46) possibly killed by drought, pine trees or both? Fires have not happened for at least the last 25 years (John MacKenzie pers. comm.). Most of the native shrubs and trees appeared to be stunted, a combination of thin soils, droughts and competition with the pines?

There was little continuous native woody vegetation present on the outer margins – perhaps, the best patch was on a near vertical face in the SE gut, where it was present from the shore up to the ridge top (Fig. 44). It consisted of karo, houpara with pōhutukawa at top, and taupata at bottom. Rhamnus was also present and the pines overtopped it. Again, *Astelia banksii* was locally common here with large bases and little foliage. All harakeke plants were very small. In the same gut *Stellaria parviflora* was present on the cliffs along with *Lachnagrostis littoralis* and *Poa anceps* – they were not seen elsewhere on island. The authors were surprised not to see any kawakawa or māpou on the island. The



island supports 44 species of vascular plants with 57% being native (Table 1).

In general, bird numbers were relatively low for the island. Shore birds seen on the extensive rocky shelf included black-backed gull, variable oystercatcher and pied shag. A small colony of grey-faced petrels, c.10 burrows, was noted above the landing beach on the NW corner of the island under a predominantly pine canopy. An egg from the last breeding season was found outside a burrow (Fig. 47). Evidence of breeding birds included a kingfisher hole in a bank and a mass moulting of little penguin feathers located low down in the NE corner of the island.

Additional reef and stacks

Awash Rock

It is a wave-washed, jagged reef 620 m south of Rākino Island (Figs. 2, 48); running north-south when exposed at low tide, c. 105 m × 20 m, virtually submerged at hightide and therefore lacking vascular plants. When exposed it is utilised by seabirds for a roost (Fig. 48). There is a navigation beacon at the southern end. Viewed from a boat, not landed on.

Rock stacks along the north side of the peninsula between Woody and West Bays

We walked out to several stacks on the intertidal reef at low tide, 22 Feb 2021. Four stacks with vascular plants were on the reef but the outer stack (No.1, Figs. 49, 50) was separated by a channel which we didn't cross - it was crowned with scattered mats of ice-plant with a black-backed gull claiming ownership.

The dimensions of the four stacks (numbered 1–4 on Fig. 49): **1.** 10 × 7 m, 3.5 m asl; **2.** 6 × 5 m, 3.5 m asl; **3.** 8 × 4 m, 2.5 m asl; **4.** 25 × 11 m, 5 m asl (this more western one (Fig. 50) could have been split into two) – for their location see Fig. 12. We recorded 24 vascular species on the four stacks (the numbers in brackets refer to the stack they were recorded on): *Asplenium haurakiense* (2,4), *Chenopodium triandrum* (4), taupata (2,4), *Crassula sieberiana* (2,3), *Dichondra repens* (2), ice-plant (1-4), *Lotus subbiflorus* (4),

boxthorn (3), scarlet pimpernel (4), pōhutukawa (2-4), wire vine (2-4), karo (1,3), narrow-leaved plantain (4), allseed (4), glasswort (3,4), *Senecio lautus* (3), *Spergulara tasmanica* (4), NZ spinach (4), *Astelia banksii* (4), vulpia hair grass (2,4), *Ficinia nodosa* (2,4), perennial ryegrass (4), sickle grass (2-4) and ratstail (2,4). Rhys Gardner appears to have collected *Scleranthus biflorus* from one of these stacks (AK 222080, 7 Oct 1984): "Uncommon; cushions on dry fine greywacke debris of "stack" at coast. Woody Bay. 2 m asl". We failed to locate any. Some of the largest and healthiest mats of ice-plants were on small stacks like these, with plenty of guano from perching/nesting seabirds.

Threatened and At-Risk vascular plants and birds

There are thirteen Threatened and At-Risk vascular plant species on the islets, three are Nationally threatened, and ten are Regionally threatened, of which one, *Scleranthus biflorus*, is suspected to be locally extinct (see Table 2). Eight of these were only recorded for a single islet/stack, and only one species, *Chenopodium triandrum*, was recorded for more than five islets. Seven of these species were not recorded for the main Rākino Island (Table 2). Also, for the breeding birds on the islets, little penguin, which is breeding on Woody Island, Woody islet and possibly Sandy Bay Island as well, is Nationally At Risk-Declining, and variable oystercatcher, breeding on Woody Island, is Nationally At-Risk, Recovering.

Bryophytes

Although the islands were rocky and suffered from droughts there were usually some mosses on each of the islets, and in some cases they were locally prominent, e.g., mats of *Hypnum cupressiforme* (Fig. 16) and *Thuidiopsis furfurosa*. Only obvious bryophytes were collected when convenient, totalling six mosses and one liverwort (see Appendix) – the mosses were identified by Jessica Beever and John Braggins. Focused collecting would reveal many more.

Figs. 42–47: **42.** Aerial image of Sandy Bay, including Sandy Bay Island. Auckland Council GeoMaps (aerial base map 2017), modified by Joshua Salter. Scale bar = 100 m. **43.** Sandy Bay Island, looking across Sandy Bay, SE Rākino Island. Photo: looking SE from South Pacific Road, SHD, 13 Feb 2021. **44.** SE Sandy Bay Island, looking NE up the gut with the best coastal native vegetation. Photo: from boat, SHD, 13 Feb 2021. **45.** Sandy Bay Island, seen from Sandy Bay, c.1979. Note – the single tall pine tree. Photo: Colin MacLaren private collection. **46.** Large mainly dead bases of *Astelia banksii* were quite frequent on the cliffs of Sandy Bay Island, similar to the situation on the inner Sister islet (see Fig. 21) – caused by drought, pine trees or both? Photo: SE side, SHD, 30 Jan 2022. **47.** Grey-faced petrel egg, c.72 x 48 mm, nearly intact found outside a burrow above NW corner, Sandy Bay Island. Photo: SHD, 30 Jan 2022.

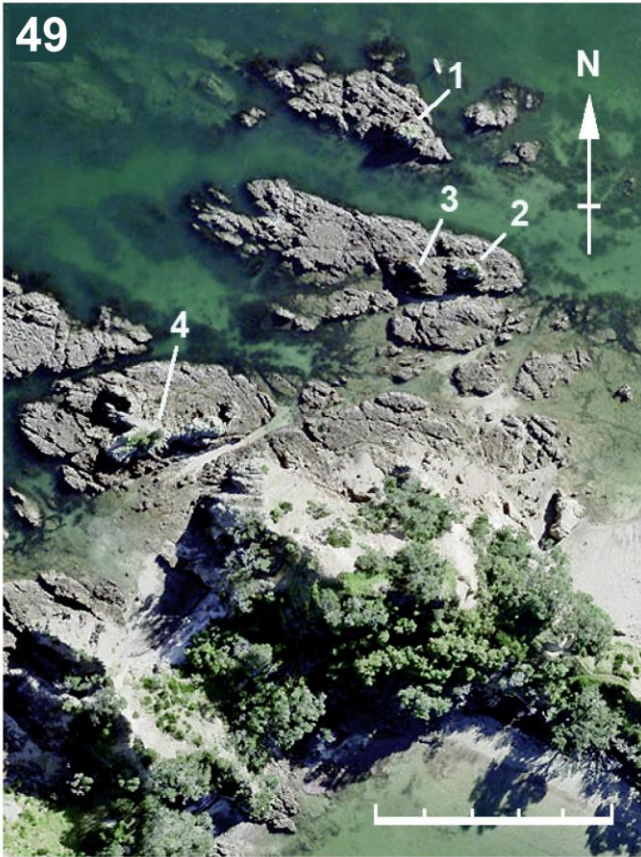


Table 2. National and Regional status of Threatened and At-Risk vascular plant species present on the main 11 islets. Rankings from Simpkins et al. (2022).

(n) = number in brackets is total number of islets the species is present on

= only recorded for the islets – not on Rākino Island

<u>Threat status</u>	<u>Species</u>
Nationally Vulnerable; Regionally At-Risk/Declining	<i>Geranium retrorsum</i> (2) #
Nationally At-Risk/Declining; Regionally Critical	<i>Linum monogynum</i> (1) #
Nationally and Regionally At-Risk/Declining	<i>Anthosachne kingiana</i> (3) #
Nationally Not Threatened; Regionally Critical	<i>Scleranthus biflorus</i> (1) # extinct?
Nationally Not Threatened; Regionally Endangered	<i>Pelargonium inodorum</i> (1) #
Nationally Not Threatened; Regionally Vulnerable	<i>Stellaria parviflora</i> (1) #
Nationally Not Threatened; Regionally At-Risk/Declining	<i>Carex breviculmis</i> (1), <i>Crassula colligata</i> (1) #, <i>Melicactus novae-zelandiae</i> (5), <i>Myoporum laetum</i> (1), <i>Pimelea urvilleana</i> (1) #, <i>Wahlenbergia vernicosa</i> (3)
Nationally Not Threatened; Regionally At-Risk/Naturally Uncommon	<i>Chenopodium triandrum</i> (8) (ranked by the threat panel but wrongly omitted in Simpkins et al. 2022)

Fauna for all the islets

Invertebrates – although not searched for, a few invertebrates were never-the-less recorded: the only darkling beetle noted (*Minopeus* sp.) (Fig. 51) was on Sandy Bay Island associated with an old grey-faced petrel egg; on the same island at the end of January the cicadas were singing loudly; a few black cockroaches were seen under a black plastic sheet on the northern slope of Woody Island; a forest shield bug (*Oncocentrus vittatus*) was found on the same island; and a common blue butterfly (*Zizina labradus*) was present on South Island. Targeted searching would reveal many more species.

Lizards – no lizards were recorded on any of the islets/stacks.

Birds – Rākino Island and its surrounding smaller islets are a hot spot for many bird species due to its mammalian-pest-free status, and at the same time

the vegetation cover across the islands has been developing. A total of 22 bird species were observed during our surveys, either on the islets or from them. For a full list of bird species see the Appendix. Many of the islands and islets are surrounded by extensive intertidal reefs providing good feeding grounds for shore birds especially variable oystercatcher. Some of the larger and more forested islets (Sandy Bay I., Woody I. and Woody islet) were found to be a refuge for grey-faced petrels and little penguin with nesting populations.

Discussion

None of the vegetation looked very old. The historical photograph by Whites Aviation 1954 (Fig. 52) confirmed that the islets all had much less woody vegetation nearly 70 years ago. We suspect that they must have been previously burnt and that the vegetation is still recovering. This is well-illustrated on Woody I. where several of the native woody

Figs. 48–52: **48.** The low-lying Awash Rock near low tide, with a red beacon (port-hand lateral marker) at its southern end – the jagged reef 620 m south of Rākino Island, supporting a pied shag, two black-backed gulls and no vascular plants. Photo: looking SSE, EKC, 29 Feb 2020. **49** Aerial image of four high-tide rock stacks (# 1 to 4) along south Woody Bay on the north side of the peninsula between Woody and West Bays. (See Fig. 12 for location). Auckland Council GeoMaps (aerial base map 2017), modified by Joshua Salter. Scale bar = 50 m. **50.** South Woody Bay stacks: Woody Island and Woody islet (in front of it), Woody beach (right) and below, three of the four rock stacks discussed in the text (# 1,3,4), south Woody Bay. Photo: from the peninsula between Woody and West Bays. Photo: SHD, 22 Feb 2021. **51.** A darkling beetle (*Minopeus* sp.) 12 mm long, that came out of a damaged grey-faced petrel egg on Sandy Bay I. Photo: SHD, 30 Jan 2022. **52.** Part of an oblique aerial photo of the northern end of Rākino Island, taken in 1954. Woody Island group (off the peninsula at left), and West islet and reef (right foreground). On Woody I., forest is lacking on most of the summit; there is shrubby vegetation on its main ridge and on Woody islet (at right of island). On West islet is extensive grassland with a small shrubby area. The northernmost tip of Rākino visible at left. Whites Aviation Ltd. Photographs. Ref: 23526041, taken looking NE. Alexander Turnbull Library, Wellington. 29 Jan 1954. Reproduced with permission.

Table 3. Environmental Weeds of the main 11 Rākino islets, present and future.

(n)= number in brackets is total number of islets the species is present on

Weed category	Weed species
1: Established on the Rākino islets	boxthorn (10), rhamnus (10), gorse (4), radiata pine (3)
2: Recent arrivals to the islets (within <10 years)	boneseed (1), moth plant (1), inkweed (2), gravel groundsel (<i>Senecio skirrhodon</i>) (1), kikuyu (2), buffalo grass (1) woolly nightshade (1)
3: Absent on the islets but present on Rākino Island	holly fern (<i>Cyrtomium falcatum</i>), tree mallow (<i>Malus arborea</i>), mile-a-minute (<i>Dipogon lignosus</i>), brush wattle (<i>Paraserianthes lophantha</i>), cineraria (<i>Pericallis × hybrida</i>), Mexican daisy (<i>Erigeron karvinskianus</i>), pampas spp. (<i>Cortaderia jubata</i> , <i>C. selloana</i>), phoenix palm (<i>Phoenix canariensis</i>), veldt grass (<i>Ehrharta erecta</i>)
4: Aggressive Hauraki Gulf weeds that are hard to manage, and so far absent from the Rākino group	climbing asparagus (<i>Asparagus scandens</i>), smilax (<i>A. asparagoides</i>), sweet pea shrub (<i>Polygala myrtifolia</i>)

species are only represented by a few young plants, e.g., kawakawa, ngaio, cabbage tree, and none of the present trees looked very old.

Islets-only records

There are fourteen vascular plant species recorded on the islets that are not on Rākino Island itself; ten native species: *Crassula colligata* (with sculptured seed), *Geranium retrorsum*, *Linum monogynum*, *Pelargonium inodorum*, *Pimelea urvilleana*, *Scleranthus biflorus*, *Anthosachne kingiana*, *Carex testacea*, *Lachnagrostis littoralis*, *Rytidosperma unarede*; and four naturalised species: *Trifolium ornithopodioides*, annual ryegrass, *Paratrophis strigosa*, *Poa pratensis*. In general, the naturalised species are likely to also be present on Rākino Island, but to date unseen by us. Seven of the 10 native species are threatened (see Table 2). The three unthreatened ones are: *Carex testacea*, *Lachnagrostis littoralis* and *Rytidosperma unarede*, and possibly they have gone from Rākino I. because of past grazing, disturbance, competition with weeds (especially kikuyu grass), and/or climate change.

Success of species on the islets

The Appendix shows which islets each species is present on. The highly successful species (14 native and 12 naturalised species) are present on 8–11 of the 11 islets. The less successful species can also be seen in the Appendix. Some of these may be dying out while others will be just beginning their spread. Hopefully this will be useful to any future botanical survey of these islets, for monitoring trends.

Environmental weeds

Listed in Table 3 are Rākino islet environmental weeds, and those that threaten the islets are divided

into four different categories: 1 – already well established on the islets; 2 – suspected recent arrivals; 3 – close threats; and 4 – remote threats (Categories 3 and 4 are not exhaustive).

For the conservation integrity of the islets, it would be desirable to eliminate these threats as soon as possible, starting with category 2 populations on the islets, then progressing to Category 1 and 2 for the whole Rākino group, then category 3 on Rākino Island, and all the time monitoring for any Category 4 weeds establishing, and ready to remove them if they do. Seagulls are suspected to be the distribution vectors for some of the grasses, i.e., the most remote islet, South I., had long stolons of both kikuyu and buffalo grasses and both associated near black-backed gull nests. It would be near impossible to remove these Category 2 grasses from Rākino I. – therefore the islets need to be monitored for their arrival. Fortunately, neither had yet properly established on South Island. These smothering grasses have the potential to completely dominate an islet's vegetation and flora and smother any regeneration – as seen with kikuyu grass on the small, isolated island, Kahakaha/Frenchmans Cap on the east side of Waiheke Island (Cameron & Heiss-Dunlop 2023). It is remarkable that pampas grasses (*Cortaderia jubata* and *C. selloana*) that are both common along the roadside of Sandy Bay, some 150 m distant, haven't yet managed to establish on Sandy Bay Island, or any of the other taller islets.

Notes on three individual species

Harakeke/flax (*Phormium tenax*) - natural populations of wild harakeke are rare for the whole Rākino group, and in many cases, it will not be

possible to be sure whether wild or planted, because harakeke has been extensively used for revegetation plantings on Rākino Island. The best genuinely wild population is located on a steep south coast of Woody islet just above a gut, where some c. 10 clumps were present, close together with leaves up to c. 1.2 m long. Seed from these plants would be appropriate to use for future revegetation projects within the Rākino group.

Scleranthus biflorus - this species appears to be drying out and dying in Auckland and Northland regions (pers. obs.). We suspect this might be due to climate change, especially because of the more frequent droughts. A close known record from Motutapu Island on the Home Bay peninsula was recorded in October 2017 as part of a botanical survey, but it since appears to have gone (pers. obs. SHD).

Bird's-foot clover (*Trifolium ornithopodioides*) - the discovery of this European-NW African species growing in the cracks of bare rock just above the splash zone on the northern coast of Woody Island is consistent with the habitat of the only two other Hauraki Gulf localities recently discovered on the nearby Noises Islands (Cameron 2016, 2021). Woody Island rarely appears to be visited by humans and the rocky gut where it occurred would be inaccessible to boats. Discussing its possible means of dispersal with Rhys Gardner (pers. comm.), the most likely dispersal mechanism now suspected for this species is by the seed floating in seawater. Because this type of habitat is widespread in the Gulf it is therefore likely to be more common than the records suggest. It is presumably overlooked because it superficially looks like several common related weeds of the Hauraki Gulf that occur in rather similar habitats, such as suckling clover and *Medicago nigra*.

Fauna

The low numbers of invertebrates and no lizards almost certainly relates to a long period of occupation by rats (*Rattus* spp.). The presence of grey-faced petrels on these islets appears to have been unknown before our survey.

Future

It is wonderful that the mammalian pests have now been removed from the whole Rākino group for over two decades. However, there has been a general decline in seabirds in the Hauraki Gulf (Gaskin & Rayner 2017). It is long overdue to also manage/eradicate the most aggressive environmental weeds! Because they are mainly out

of sight the islets shouldn't be forgotten. They provide a habitat for nine native vascular species (including six threatened spp.) none of which appear to be represented on Rākino Island, and a habitat for breeding populations of little penguins and grey-faced petrels.

Because of seasonal variations, and areas that were not reached or surveyed, this species list (Appendix) will be incomplete. However, it should form a good baseline for any future management decisions or for any future surveys. Ideally, the lichens, which form such a feature on these rocky islets, should be included in any future surveys, along with a fuller survey of the bryophytes.

Recommendations

- First priority is to remove the pines from Sandy Bay Island and the inner and mid Sisters because it is straight forward to achieve, and they are drastically suppressing the native vegetation on three of the largest and tallest islets (Table 1) with potential to support excellent native vegetation and burrowing seabird populations. Note – the pines appear to be killing the large established clumps of *Astelia banksii* – their demise was only observed on the islets with pines.
- Prioritise other weed removal on all the islands and islets to encourage further natural regeneration and establishment of seabird breeding populations – it has been a good start by Auckland Council to recently carry out rhamnus control on the whole Rākino group, except West islet, Little Sandy Point stacks and South Island, and boxthorn and gorse control on the main islets.
- Woody Island and its adjacent islet are the most intact and contain the most advanced vegetation of all the islets and should therefore be a top priority for future weed control.
- Regular surveys of the islets every three years for aggressive fast-growing weed species should be carried out (particularly for moth plant), especially on the most important of the islets for conservation.
- Establish base-line information of the number and location of grey-faced petrel colonies and little penguin breeding populations – Auckland Council are considering conducting a grey-faced petrel survey to confirm their presence across the island group (Todd Landers, pers. comm., May 2022).
- Extend the proposed marine reserves to include the Rākino coast to increase food sources necessary to maintain the existing shore and

seabird populations in the future. Good seabird populations help to fertilise the islands' vegetation.

Acknowledgements

We thank: Ngāi Tai ki Tāmaki for supporting the survey; John MacKenzie for local information and encouragement; Colin MacLaren for local information and the use of one of his photographs; Rhys Gardner for assistance with vascular plant identifications; Jessica Beever and John Braggins for bryophyte identifications; Auckland Council staff for recent weed management information, especially Deryn Dromgoole; Gavin Carr of Extreme Heights for weed control information; John Early for identification of

invertebrates; Bruce Hayward for geological information; Matt Rayner and Graeme Taylor for comment on the egg found on Sandy Bay Island and a feather beside an active burrow on Woody Island; Dan Blanchon for lichen identifications from photographs; Mike Lee for rat eradication information; Louise Furey for archaeological site records from the NZAA *ArchSite*; Duncan Benzie for advice about GeoMaps; herbarium staff of CHR, NZFRI and WELT for checking for Rākino records; Joshua Salter for improving the text, producing the two maps and seven aerial views from GeoMaps; and Wolfgang Heiss-Dunlop for his patient and invaluable boat services.

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Appendix. Vascular plant species and bird observations on the main 11 islets of Rākino Island.

Key:

No. = number of islets the species is present on

AK = voucher in AK herbarium, (location in brackets)

a = abundant

c = common

o = occasional

l = local

lc = locally common

s = scarce (<5 plants seen)

×1 = only 1 plant seen (×2 plants seen, etc)

* = wild exotic species

cl = seen close by (birds only)

x = present

xx = breeding on the islet (birds only)

xx? = thought to be breeding on the islet

Islet:	A	B	C	D	E	F	G	H	J	K	L	Total no. islets where species observed	Voucher (from islet)
	Woody I.	Woody islet	"West islet"	3 Sisters inner	3 Sisters mid	3 Sisters outer	South I.	Little Sandy Point inner stack	Little Sandy Point mid stack	Little Sandy Point outer stack	Sandy Bay I.		
Ferns (8 + 0) (= native + naturalised spp.)													
<i>Asplenium haurakiense</i> Hauraki Gulf spleenwort	o	o	o	o	lc	o	o	s	s	s	o	11	
<i>Asplenium oblongifolium</i> shining spleenwort	lc	lc	l		s							4	
<i>Cheilanthes distans</i> woolly cloak fern							lc					1	

Islet:	A	B	C	D	E	F	G	H	J	K	L	Total	Voucher
<i>Cheilanthes sieberi</i> rock fern	l					l						2	AK(A)
<i>Lecanopteris pustulata</i> hound's tongue	l	s		l		s					s	5	
<i>Pellaea rotundifolia</i> button fern	s											1	AK(A)
<i>Pteridium esculentum</i> bracken					l							1	
<i>Pyrrosia elaeagnifolia</i> leather fern	l	s		lc	o						o	5	
Conifers (0 + 1)													
<i>Pinus radiata</i> * radiata pine				c	o						c	3	AK(D)
Dicots (36 + 32)													
<i>Apium prostratum</i> shore celery											s	1	
<i>Araujia sericifera</i> * moth vine	l											1	
<i>Avicennia marina</i> mangrove					×2							1	
<i>Centaureum erythraea</i> * centaury	s	s			lc	l	s			lc		6	
<i>Cerastium glomeratum</i> * annual mouse-ear chickweed	s								o			2	
<i>Chenopodium triandrum</i> berry saltbush	o	o	l			s		o	o	o	l	8	
<i>Chrysanthemoides monilifera</i> * boneseed	×1											1	
<i>Coprosma macrocarpa</i> coastal karamū	l	l	s									3	
<i>Coprosma repens</i> taupata	c	o	o	o	o	o	o	o	o	o	o	11	
<i>Cotula australis</i> common cotula	l									lc		2	AK(K)
<i>Crassula colligata</i> or hybrid with <i>C. sieberiana</i>		l										1	AK(B)
<i>Crassula sieberiana</i> Austral stonecrop	o	lc	lc			l	l	o	o	lc		8	
<i>Dichondra repens</i> Mercury Bay weed	o	o	o		lc	l	l	lc	o	o	s	10	
<i>Disphyma australe</i> ice-plant	l	o	o	o	o	o	o-lc	lc	s	o	o-lc	11	
<i>Erigeron sumatrensis</i> * fleabane	o	s			s	s	s			o	s	7	
<i>Gamochaeta coarctata</i> * purple cudweed	s					s						2	
<i>Geranium retrorsum</i> turnip-rooted geranium	o		l									2	AK(C)
<i>Haloragis erecta</i> shrubby haloragis	s											1	
<i>Hebe macrocarpa</i> koromiko					s							1	
<i>Helminthotheca echioides</i> * oxtongue				l								1	
<i>Hypochaeris radicata</i> * catsear		s										1	
<i>Lepidium didymum</i> * twin cress	l											1	
<i>Leucopogon fasciculatus</i> mingimingi	l	s			s	×1						4	
<i>Linum monogynum</i> rauhia			s									1	
<i>Lotus angustissimus</i> * slender birdsfoot trefoil	l		l		l					lc	o	5	
<i>Lotus subbiflorus</i> * hairy birdsfoot trefoil	o	lc	l				l	o	o	o		7	
<i>Lycium ferrocissimum</i> * boxthorn	l	la	l	o	o	l	o		o	lc	c	10	
<i>Lysimachia arvensis</i> s.str. * scarlet pimpernel	lc	o	o	o	o	l?	o?	s?	o?		o-lc	10	

Islet:	Woody I. A	Woody islet B	"West islet" C	3 Sisters inner D	3 Sisters mid E	3 Sisters outer F	South I. G	Little Sandy Point inner stack H	Little Sandy Point mid stack J	Little Sandy Point outer stack K	Sandy Bay I. L	Total no. islets where species observed	Voucher (from islet)
<i>Medicago nigra</i> * bur medick							l					1	
<i>Melicytus novae-zelandiae</i> coastal māhoe	x1		x4	s	l						s	5	AK(E)
<i>Metrosideros excelsa</i> pōhutakawa	c	lc	l	lc	lc	o	o	o	o	o	c	11	
<i>Muehlenbeckia complexa</i> wire vine	o	o	l	l	l	l	o	o	o	lc	o	11	
<i>Myoporum laetum</i> ngaio	x2											1	
<i>Myrsine australis</i> māpou	o	l			l							3	
<i>Orobancha minor</i> * broomrape		s			s	l				s		4	
<i>Oxalis exilis</i> creeping oxalis	l					o	o					3	
<i>Pelargonium inodorum</i> kōpata	x1											1	
<i>Peperomia urvilleana</i> peperomia	lc	l	l	o-lc	o		o	s			o-lc	8	
<i>Phytolacca octandra</i> * inkweed	l	s										2	
<i>Pimelea urvilleana</i>					l							1	
<i>Piper excelsum</i> kawakawa	l	l										2	
<i>Pittosporum crassifolium</i> karo	c	lc	lc	o-lc	lc	o	o	o	o	o	c	11	AK(L)
<i>Plantago lanceolata</i> * narrow-leaved plantain	lc	o	o	lc	lc	lc	lc	o		lc	lc	10	
<i>Polycarpon tetraphyllum</i> * allseed	o	o	o					l		o		5	
<i>Pseudognaphalium luteoalbum</i> Jersey cudweed	s	l										2	
<i>Pseudopanax lessonii</i> houpara	c	lc	o	l	l	x1					o	7	
<i>Rhamnus alaternus</i> * rhamnus	c	lc	lc	lc	lc	o	o	o	o	lc	c	11	
<i>Sagina apetala</i> * pearlwort	o	o				o	lc	o		l		6	
<i>Sagina procumbens</i> * procumbent pearlwort											s	1	
<i>Salicornia quinqueflora</i> glasswort	o	s	l	lc	o	o	l	lc	o	lc	o-lc	11	
<i>Senecio hispidulus</i> fireweed	o	o	o							o		4	
<i>Senecio lautus</i>	o	o	o				o	l	o	s		7	
<i>Senecio skirrhodon</i> * shore groundsel		x1										1	AK(B)
<i>Silene gallica</i> * catchfly	lc	o	l	o	o	l	l	o		o	c	10	
<i>Solanum americanum</i> small-flowered nightshade	lc	lc										2	
<i>Solanum mauritianum</i> * woolly nightshade	x1											1	
<i>Solanum nigrum</i> * black nightshade		l										1	
<i>Sonchus oleraceus</i> * sow thistle	o-lc	o-lc	o	o	o	o	o	o		o	o	10	
<i>Spergularia tasmanica</i> native sea spurrey	l	l			l	l		o			s	6	
<i>Stellaria media</i> * chickweed		l	l							l		3	AK(B)

Islet:	A	B	C	D	E	F	G	H	J	K	L	Total	Voucher
<i>Stellaria parviflora</i> native chickweed											l	1	
<i>Tetragonia trigyna</i> NZ spinach	lc	lc	o	l	l	o	o	o	o	lc	c	11	
<i>Trifolium dubium</i> * suckling clover	o		c	o	o		l			lc	o	7	
<i>Trifolium glomeratum</i> * clustered clover	l				s					s		3	AK(E)
<i>Trifolium ornithopodioides</i> * bird's-foot clover	l											1	AK(A)
<i>Trifolium subterraneum</i> * subclover	l		l		l	lc				l		5	AK(E)
<i>Ulex europaeus</i> * gorse								o	lc	la	o-lc	4	
<i>Wahlenbergia vernicosa</i> coastal harebell	o	l	l									3	AK(C)
Monocots (17 + 22)													
<i>Aira caryophylla</i> * silvery hair grass			l			l				lc	l	4	AK(K)
<i>Anthosachne kingiana</i> blue wheatgrass	l			l	l							3	
<i>Anthoxanthum odoratum</i> * sweet vernal	lc	l			l							3	
<i>Arthropodium cirratum</i> rengarenga				l	l							2	
<i>Astelia banksia</i> coastal astelia	c	c	lc	c	c	lc	o			×1	c	9	
<i>Avena barbata</i> * slender oat	s		l				lc			o	l	5	
<i>Bothriochloa macra</i> * redleg grass	lc			lc	o				lc	l		5	
<i>Briza minor</i> * shivery grass	o	l	o		s							4	
<i>Bromus catharticus</i> * prairie grass							lc					1	
<i>Bromus diandrus</i> * ripgut brome	lc	lc	lc	o	o		lc		o	lc	lc	9	
<i>Bromus hordeaceus</i> * soft brome	o	o		l		s		la	lc	lc	o	8	AK(H)
<i>Carex breviculmis</i> grassland sedge					s							1	
<i>Carex testacea</i> speckled sedge	l	l	l		lc							4	AK(J)
<i>Cenchrus clandestinus</i> * kikuyu grass	x1						s					2	AK(A)
<i>Cordyline australis</i> cabbage tree/ti	x1											1	
<i>Cyperus ustulatus</i> giant umbrella sedge					s							1	
<i>Dactylis glomerata</i> * cocksfoot					lc	c				lc	o	4	
<i>Dianella latissima/nigra</i> tūrutu					s							1	
<i>Festuca bromoides</i> * vulpia hair grass	lc	lc	c	c	c	lc	c	o	c	lc	lc	11	
<i>Festuca myuros</i> [var. <i>megalura</i>] * vulpia hair grass	lc											1	AK(A)
<i>Ficinia nodosa</i> knobby sedge	o	o	l	o	o	c		l	o	o	o	10	
<i>Lachnagrostis billardiarei</i> sand wind grass		l		o								2	
<i>Lachnagrostis littoralis</i> coastal windgrass	l		l					l			l	4	
<i>Lagurus ovatus</i> * hare's-tail	lc	c	o	o	lc	c						6	
<i>Lolium perenne</i> * perennial ryegrass	lc		l									2	
<i>Lolium rigidum</i> * annual ryegrass				o	o	o	lc	l		l		6	AK(E)

Islet:	Woody I. A	Woody islet B	"West islet" C	3 Sisters inner D	3 Sisters mid E	3 Sisters outer F	South I. G	Little Sandy Point inner stack H	Little Sandy Point mid stack J	Little Sandy Point outer stack K	Sandy Bay I. L	Total no. islets where species observed	Voucher (from islet)
<i>Microlaena stipoides</i> microlaena	lc						lc			l		3	AK(A)
<i>Parapholis incurva</i> * sickle grass	c	lc	o	lc	lc		l	la	o	lc	l	10	
<i>Parapholis strigosa</i> *							l					1	AK(G)
<i>Pentapogon crinitus</i> long-hair plume grass	o											1	
<i>Phormium tenax</i> harakeke/flax	s	l								s	o	4	
<i>Poa anceps</i>	lc	o	o							l	l	5	
<i>Poa annua</i> *				l								1	
<i>Poa pratensis</i> * smooth meadow grass	o											1	AK(A)
<i>Rytidosperma racemosum</i> * danthonia	lc	o	l	c	c	lc	c	c		l	c?	10	
<i>Rytidosperma unarede</i> native danthonia	l											1	
<i>Sporobolus africanus</i> * ratstail	lc	lc		lc	lc	o	o	o		lc	lc	9	
<i>Stenotaphrum secundatum</i> * buffalo grass							s					1	
<i>Thelymitra longifolia</i> sun orchid			l		l							2	
Bryophytes (7 + 0)													
<i>Chiloscyphus semiteres</i>			lc									1	
<i>Hypnum cupressiforme</i>	l	lc	la				x					4	AK(A,C)
? <i>Rhynchostegium</i> sp.		l										1	AK(B)
<i>Rosulabryum</i> <i>campylothecium</i>								l				1	AK(H)
<i>Rosulabryum</i> ? <i>capillare</i>		l										1	AK(B)
<i>Thuidiopsis furfurosa</i>		lc										1	AK(B)
<i>Triquetrella papillata</i>	l		lc	la	la							4	AK(A,D)
Birds seen (or heard) (21 + 4)													
grey-faced petrel/oi burrows	xx	xx?			xx?	xx?				xx?	xx	6	
white-faced storm petrel/ takahikare-moana	x?											1	
Buller's shearwater							cl					1	
futtering shearwater							cl					1	
little penguin/kororā	xx	xx									xx?	3	
gannet/takapu	cl	cl									cl	3	
pied shag/karuhiruhi	x				x		cl				x	4	
pukeko	x											1	
variable oystercatcher/ torea pango	xx				x	x					x	4	
spur-winged plover				x								1	
red-billed gull/tarapunga	xx		xx				x					3	
black-backed gull/kororo	xx	x			xx	x	xx?				xx	6	
white-fronted tern/tara	xx	x	xx				cl				x	5	
shining cuckoo/pipiwharauoa	x											1	

Islet:	A	B	C	D	E	F	G	H	J	K	L	Total
kingfisher/kotare	x						x				xx?	3
welcome swallow	xx											1
silveryeye/tauhou	x	x									x	3
grey warbler/riroriro	x									x	x	3
blackbird *	x										x	2
tui	x											1
bellbird/korimako	x	x										2
house sparrow *	x					x					x	3
chaffinch *											x	1
goldfinch *											x	1
starling *	x	x										2

Lucy Cranwell's survey of the Rukuhia and Moanatuatua peat bogs, Waikato

Rhys Gardner

Introduction

In 1935 Auckland Museum's dynamic young botanist Lucy May Cranwell (1907–2000) was in Sweden, learning the new science of palynology from leader in the field Lennart von Post. For six months (a Stockholm winter) they worked together on peat samples collected in Otago and Fiordland by Swedish geologist Carl Caldenius; the result, a classic article on post-Pleistocene vegetation history (Cranwell & von Post 1936). Our first peat and pollen expert, Lucy Cranwell specialized in Southern Hemisphere palynology for the rest of her long life.

That story is well-known (Moore 1986; Cameron 2000). A less familiar episode in her career is examined here, the survey she made in 1934 of two Waikato peat bogs. I am not the only person to suspect that her next year's move into palynology was partly brought about by what she had seen in those places (Moore 1986: 30). Also, at the article's end, some additions and corrections are made to what has been written about the first decade of Lucy Cranwell's botanical work (Notes 1–6).

The Waikato survey

In the early 1930s the Soil Survey Branch of New Zealand's DSIR was looking at several places in the country whose productivity might be improved by a more scientific approach to soil quality. One of these, "a part of Waipa County", lay between the Waipa and Waikato Rivers south-west of Hamilton. Much of it had already been cleared for pasture but approximately a fifth was still covered by two restiad-dominated bogs, Rukuhia and Moanatuatua (generally called "swamps" at this time). Parts of

them had been cleared and drained, and in the numerous deep ditches and on the bog margins the vegetation of ancient times could be seen.

The fieldwork for this survey ran from 1933 to 1935, and the results were published four years later as a DSIR bulletin (Grange et al. 1939). A good, solid soils investigation from both the scientific and practical viewpoints, it also contained an agricultural account by the experienced P.W. Smallfield and an 8-page long botanical account of its two bogs by Lucy Cranwell (LMC hereafter).

The Introduction to that bulletin does not say why LMC had become involved—it was certainly not the case that conservation was being considered. But one of the pedologists, Norman Taylor, was an Auckland and could well have known her personally through his university studies. Perhaps the forthright LMC just made him the offer that she should be part of the team.

In the Auckland War Memorial Museum's Annual Report for 1934–5, page 17, LMC noted that the fieldwork for her survey occupied four days. The relevant collections in the Auckland Museum Herbarium (AK) and the Allan Herbarium (Landcare New Zealand, Lincoln) indicate that Rukuhia was investigated on 21–22 July and 3 Sept 1934, and Moanatuatua on 12 Jan 1935. They also indicate that LMC was accompanied on the July trip by her botanical friend Lucy B. Moore. Present with LMC at Moanatuatua for at least some of the time, to judge from the captions of two photographs (figs. 10 & 13 in LMC's report) was another friend of hers, the