Vascular flora and some fauna for a chain of six Hauraki Gulf islands east and southeast of Waiheke Island

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The vascular flora of a chain of six inner Hauraki Gulf islands east and southeast of Waiheke Island is presented (Appendix 1), and their totals are summarised, plus their area, maximum height and distance to the nearest larger island is also presented (Table 1). The islands arranged north to south are: Tarahiki, Rotoroa, Ruthe, Ponui, Pakihi and Karamuramu (Fig. 1). Four of the island floras are published here for the first time and for these four the treatments are more in-depth. All six islands have been surveyed by EKC and PdL individually and/or jointly between Nov 1990 and Nov 2007; with flora and fauna observations by GAT mainly for Tarahiki; mainly fauna observations by JMcC for three islands;

Table 1. Vascular plant totals in different groups, the area, maximum height and proximity to a larger island for six islands east of Waiheke Island.

Plant Group	Ta*	Ro	Ru	Po	Pa	Ka	Totals
Native ferns & fern allies	14	26	8	75	22	3	**79**
Native conifers	-	1	-	8	-	-	**8**
Native dicots	51	99	49	110	60	18	**143**
Native monocots	25	48	16	85	40	7	**103**
Sub total	90	174	73	278	122	28	**333**
Naturalised ferns & fern allies	-	2	-	-	-	-	**2**
Naturalised conifers	-	4	1	3	2	1	**5**
Naturalised dicots	28	153	23	95	69	48	**195**
Naturalised monocots	17	65	14	44	27	22	**81**
Sub total	44	224	38	142	97	71	**283**
Overall totals	135	398	111	420	220	99	**616**
% native	67	44	66	66	56	28	**54**
Area, height, & distance to a larger island							
Area (ha) (from Taylor 1989)	5.9	90.0	0.6	1795.0	114.0	7.3	
ASL (m)	68	76	20	173	125	20	
Proximity to a larger island (km)	2.5	0.9	0.2	1.3	1.3	0.4	

*Ta = Tarahiki; Ro = Rotoroa; Ru = Ruthe; Po = Ponui; Pa = Pakihi; Ka = Karamuramu Islands.

and forest data by PJB for Pakihi. Pakatoa Island is part of this chain; however, apart from 12 collections in AK herbarium (mainly ferns collected by Anthony Wright in 1973) it appears that no one has fully surveyed the vascular plants of this island and it is therefore not included in this account. All except Tarahiki have one or several species of rodents, and Tarahiki has had Norway rats at least once in the past. Other fauna observations are included for birds and lizards, especially for the newly reported islands.

These six islands are often omitted from popular books on the Hauraki Gulf (e.g. Ell 1982), because they are privately owned and without public access. However, Shirley Maddock (1983) includes a chapter in her book on the Gulf islands titled "A parcel of islands" which begins with the purchase in 1826 from the Maori by the first New Zealand Company of four Hauraki Gulf islands (Taratoia [Pakatoa], Paki [Rotoroa], Ponui and Pakihi) in an attempt to form a colony of "fearless Englishmen" (most were Scots). The settlers were briefly put ashore on Pakihi when a Maori canoe came close to shore and the settlers feared for their safety and retreated back to their ship and lost the desire to settle on the islands. The reason they chose Pakihi was that they thought the red chert was iron ore (JMcC, unpublished data). Some of the early European history of Ponui and Rotoroa Islands is also covered in this chapter by Maddock (1982). Monin (1992, 2001) provides a much fuller account of this period in the Inner Hauraki Gulf of contact between Maori and early Europeans.

Tarahiki (Shag Island) (Fig. 2)
This island list is based on an overnight visit by PdL and Ian McFadden on the 18-19 Oct 1994, a 1 hr visit to the western side by EKC on 27 Sep 2007, 5 minutes ashore on the northeast end by PdL on 18 Nov 2007, eight plant additions and fauna observations by GAT from a visit he made on 29 Oct 1988, and bird and lizard observations by JMcC based on many visits since 1978, including evenings and an overnight visit. The first botanical visit appears to have been by Donald Petrie in Dec 1908 who collected *Lachnagrostis littoralis* and

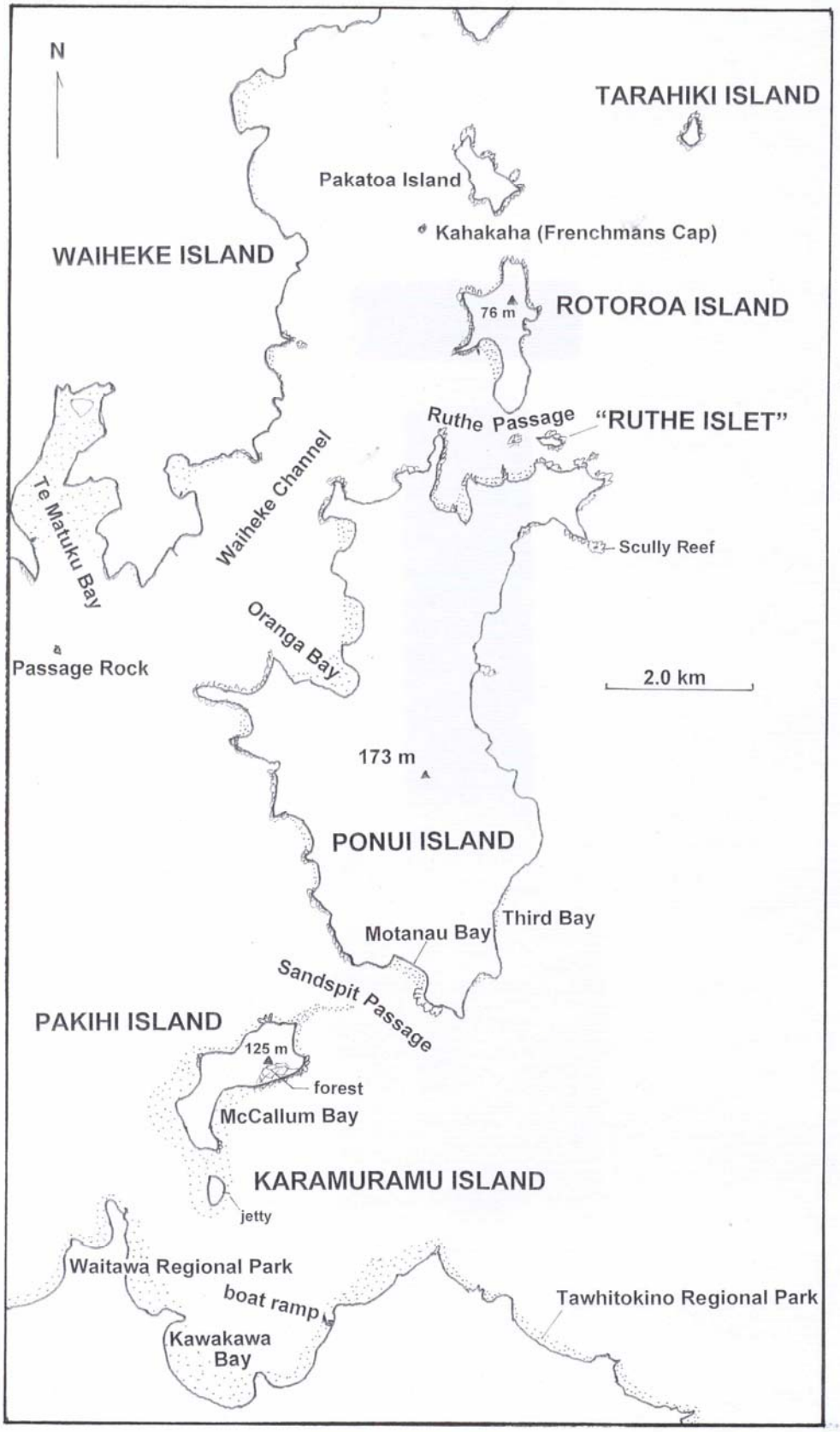

Fig. 1. Location of the six Hauraki Gulf islands.

Melicytus novae-zelandiae, followed by W.R.B. Oliver on 2 Jan 1915 who collected *Asplenium oblongifolium* and *Hebe stricta* (specimens in CHR & WELT herbaria). The island was returned by the Crown to Ngati Paoa in 1981 (Monin 1996).

Tarahiki comprises four steep, deeply dissected and weathered greywacke stacks linked by boulder falls, and is covered in native vegetation. In 1988 vines of smilax or bridal creeper (*Asparagus asparagoides*) covered tall pohutukawa (*Metrosideros excelsa*) right up to the

canopy, and in 1994 the northern two-thirds were clothed in dense tangles for smilax. In Sep 2007 smilax was still common but the plants had mostly yellow foliage caused by the self-introduced biocontrol rust (*Puccinia myrsiphyllii*) which had infected them – a wonderful sight! The rust was first observed in New Zealand in Nov 2005 near the Auckland airport, and it is likely that this South African native arrived via Australia where it was recently released for biocontrol (Landcare 2006).

This is the most remote of the six islands presented, and marginally it has the highest percentage of native to exotic species (Table 1). The dominant woody species are pohutukawa, houpara (*Pseudopanax lessonii*), taupata (*Coprosma repens*), karo (*Pittosporum crassifolium*) and wharangi (*Melicope ternata*). Common shrub and ground cover species include *Coprosma rhamnoides*, *Asplenium haurakiense*, shining spleenwort (*Asplenium oblongifolium*) and many grasses. A single large, female milk tree (*Streblus banksii*) (c.1.8 m dbh, 18 m tall) was seen in 1994 on the SE side of the larger "islet" of the group.

The island was apparently rodent-free when GAT visited in Oct 1988, and PdL and Ian McFadden over-nighted there in Oct 1994. However, Norway rats were detected by George Wilson in early 1999, and in Apr 1999 he coordinated hand-spreading of bait (talon 50WB) and later monitoring by him indicated that the rats had been successfully eradicated. Significantly PdL & Ian McFadden found an apparent absence of skinks (*Oligosoma*, *Cyclodina* spp.) and scarcity of geckos (*Hopalodactylus*) during day and night searches, and observed very low numbers of darkling beetles (Tenebrionidae), and no petrels in any of the numerous burrows present within the forest on the southern, and larger "islet". These findings suggested to them that Tarahiki had experienced a rodent invasion(s) in the past. However, GAT found the petrel burrows active in 1988 and JMcC found both *Hoplodactylus maculatus* and *H. pacificus* present in good numbers at night, and also a healthy breeding population of grey-faced petrels (estimated over 200 pairs). A large centipede (*Cormocephalus rubiceps*) was seen by GAT in Oct 1988, along with geckos, but no skinks. The presence of geckos (arboreal species) and the absence of skinks (not arboreal) may be related to the presence of Norway rats which are the least arboreal of the three rat species present in New Zealand. Although Tarahiki is 2.5 km offshore it's possible that both stoats and Norway rats may occasionally swim out to Tarahiki, especially in the warm rather calm seas of the inner Hauraki Gulf. Stoats are very effective predators of Norway rats, and could either severely reduce or even wipe out Norway rats which may reinvade at infrequent intervals. Such visitations would account for the variations in gecko and petrel numbers observed over the last 29 years.

Note – King (2005) lists stoats as present on islands up to 3 km off the mainland (Rangitoto and Motutapu); and the smallest island with a permanent stoat population was Te Kakahu (514 ha). Therefore small islands (under 100 ha) and within 3 km of a larger land mass (>500 ha) are at risk from stoats occasionally getting to them but are unlikely to retain resident stoats.

Tarahiki is a key-nesting site in the Hauraki Gulf for spotted shags near their northern nesting limit. In Oct 1988 they were abundant and breeding, but in October 1994 PdL & Ian McFadden observed numerous dead or dying chicks. Although the nesting area on Tarahiki wasn't visited during our two brief visits in 2007, no spotted shags were seen around the island, although pied shags were present during the September visit. Observations in recent years suggest spotted shags have abandoned several northern nesting sites (GAT pers. ob.).

Rotoroa Island

This island list is based on a trip by the Auckland Botanical Society (ABS) on 4 Nov 2006, with 20 additions by two previous visitors (Mairie Fromont in Dec 1992, Rhys Gardner in Dec 2005). A full report of the ABS visit and what was observed is reported by Cameron (2007). The island has been farmed for over a century and the surviving native vegetation is mostly scrubby and mainly restricted to eroding, coastal greywacke cliffs. Rotoroa Island is the third largest island of the six presented, it is highly modified which is reflected by the low percentage of native species compared with exotics. However, it does contain a large number of native species – the second largest number of the six islands (Table 1). Based on the findings presented here it is also botanically one of the best explored islands in the chain.

"Ruthe Islet" (Fig. 3)

This islet was visited by GAT on 28 Oct 1988 for 1.5 hours, EKC on 10 Nov 1990 for 3 hours and their observations jointly published (Cameron & Taylor 1992); and a 30 minute visit by PdL and Ian McFadden on 19 Oct 1994 (de Lange & McFadden 1995). For this article we have given it the informal name "Ruthe Islet" after the Ruthe Passage that it lies in – between Rotoroa and Ponui Islands which takes its name from the early European owner of Rotoroa Island. The islet is well clothed in native vegetation with eroding greywacke cliffs along the northern side (Fig. 3, and fig. 5 in Cameron (2007)). The species list is based on the above surveys and has the second highest percentage of native species compared with exotics (Table 1). A small colony of grey-faced petrels was present in Oct 1988 (Cameron & Taylor 1992), but by Oct 1994 there was no evidence of them breeding (de Lange & McFadden 1995). Norway rats were eradicated in Mar 1992 (Cameron 1992), but later re-invaded (Mike Lee pers. comm.).

Ponui (Chamberlains Island)

This island, the largest of the chain was well explored over a week (Aug-Sep 1978) by the then Auckland University Field Club (Brown 1979). Since then there

have been two Auckland Botanical Society visits to southern Ponui Island on 20 Nov 1999 (Cameron 2000) and 16 Oct 2005 (Cameron and de Lange 2006). This island (1795 ha) is privately owned by three owners and it is extensively farmed. However, excellent areas of native forest survive, especially in the southern part of the island. Ponui Island contains by far the largest number of native species of the six islands (Table 1).

Pakihi (Sandspit Island) (Fig. 4)
This island list is based on two visits by EKC on 13 Apr 2004 and 18 Feb 2006, a forest report by Ian Barton (1996), over 30 years of observations on the island by JMcC, and three previous herbarium collections: *Scleranthus biflorus* (AK 211331, *L.B. Moore*, Dec 1936); *Apium prostratum* (AK 211731, *H.R. McKenzie*, Jun 1940); and saffron thistle (*Carthamnus lanatus*) (AK 159076, *A.E. Wright 4687*, 6 Mar 1982).

The southern part and the elevated northern parts of the island is chert, with greywacke underneath, a fault runs through the centre of the island with the SW portion uplifted c.150 m and there is a dip to the west of about 70° W (Hutton 1869). In places the much harder chert slides over the more easily weathered greywacke underneath causing localised areas of erosion – a slump basin exists near the island's summit. The island reaches c.45 m asl at the southern end, 125 m at the northern end, and the middle is low-lying (mostly < 20 m asl). There is also a long sandspit (c.1 km long) exposed at low tide off the NE point which curves towards Ponui Island and is marked by a permanent navigation light. The island is privately owned, partly farmed (since 1996 only cattle), partly in exotic pines (planted 1992-96), and partly in native vegetation (scrub and forest).

Most of the native bush is scrubby and confined to the outer coastal slopes – gorse (*Ulex europaeus*) is often present. Reasonable fenced native vegetation exists along the steep SW coast including good numbers of tawapou (*Planchonella costata*) as trees and seedlings, but by far the best forest is an impressive pohutukawa forest (Fig. 5) on the NE part of the island on a south-facing slope. It extends along the shoreline for c.500 m and inland (steep in places) for >150 m to within c.100 m of the trig. The lower section of this forest was fenced to exclude stock some 50 years ago and the upper part was fenced in 1996. The forest includes extremely large emergent pohutukawa, with broadleaf canopy mainly of kohekohe (*Dysoxylum spectabile*), puriri (*Vitex lucens*), mahoe (*Melicytus ramiflorus),* pigeonwood (*Hedycarya arborea*), rewarewa (*Knightia excelsa*), karaka (*Corynocarpus laevigatus*), kowhai (*Sophora chathamica*), and tawapou. The understorey is kawakawa (*Macropiper excelsum*), *Coprosma rhamnoides*, mapou (*Myrsine australis*), hangehange (*Genistoma ligustrifolium*), houpara, coastal karamu (*Coprosma macrocarpa*) and mamaku (*Cyathea medullaris*). The ground varies from gravel/rock to good litter; frequent plants include ferns (*Lastreopsis velutina, Pellaea rotundifolia, Polystichum neozelandicum*), *Uncinia uncinata*, *Oplismenus hirtellus*, and seedlings of the canopy species. On both Pakihi and Karamuramu there was no wild flax (*Phormium tenax*) it was all planted and it is now self-seeding.

Coastal forest on the south-facing slope was measured in April 2004 in two, 10 m x 10 m plots within which all stems ≥2.5 cm diameter at 1.35 m were identified. The plots were dominated by kohekohe. Basal area in the plots was very low (average 15.5 m^2 ha^{-1}), less than a third of the average of nine other rat-invaded islands in northern New Zealand and less than half that of nine islands with burrowing seabirds and no rats present (Fukami et al. 2006). Furthermore, tree diversity (stems ≥2.5 cm diameter) at the 100 m^2 scale was also low on Pakihi (average 2.5 tree species per 100 m^2) compared with that on other rat-invaded islands (average = 6.1; PJB, unpublished data). In contrast, the mean number of vascular plants per 100 m^2 plot on Pakihi (18.5) was higher than on many other rat-invaded islands (average = 16.1, PJB, unpublished data), and on Pakihi there were 12 species of woody plant present per 100 m^2, most of these as seedlings. This suggests that colonisation by a wide variety of woody species can occur in the forests on Pakihi, but that their onward growth and survival is difficult on the eroding chert (the study area was on chert, while immediately below it was greywacke). The result is that woody plant diversity declines to relatively few species of widely spaced trees, hence low basal area. Ferns (average 4.5 species per 100 m^2) were the next most frequent group of vascular plants in the forest plots.

Soils were sampled within the two 10 m x 10 m plots by excavating a randomly-positioned 1 m^2 subplot to a depth of 30 cm. Soils developed from the chert were red. Soil nutrients were quantified for each of 3 soil depths (0–10 cm, 10–20 cm, and 20–30 cm) using the same methods of Fukami et al. (2006). Total soil carbon, nitrogen, and phosphorus in the top 10 cm of soil were similar to those of other rat-invaded islands, but the levels of available soil nitrogen and phosphorus were lower and soil pH higher (cf. Fukami et al. 2006) (Table 2).

There is a single freshwater spring on the island (NW end) that is used for the water troughs, and a farm dam (empty) behind McCallum's Bay (N end). Behind the dam a patch of raupo (*Typha orientalis*) (c.20 m across) has colonised (Fig. 6) and it was associated with a grazed paddock dominated by wetland plants, such as the indigenous *Isachne globosa, Juncus planifoius, Eleocharis acuta, E. gracilis* and *Persicaria decipiens*, and exotic *Paspalum distichum* and *Ludwigia palustris*.

All the paddocks have been regrassed with cocksfoot (*Dactylis glomerata*), rye grass (*Lolium perenne*), white clover (*Trifolium repens*) and red clover (*Trifolium pratense*) and fertilised annually. Dominant pasture species observed included: microlaena (*Microlaena stipoides*), ratstail (*Sporobolus africanus*), paspalum

Fig. 2. Tarahiki Island, West side, 90 mins from low tide. Photo: EKC, 27 Sep 2006

Fig. 3. "Ruthe Islet" at half tide from NW showing the steep and eroding north side of the islet, Ponui island to the right and the Coromandel peninsula in the background. Photo: EKC, 4 Nov 2006.

Fig. 4. Pakihi (on right) with the best-forested slope on the right side, and Karamuramu (on left), from above Kawakawa Bay boat ramp, looking northwest at high tide. Photo: EKC, 25 Nov 2007.

Fig. 5. Fenced off pohutukawa forest, NE side of Pakihi Island, S-facing slope; trig – top right. Photo: EKC, 18 Feb 2006.

Fig. 6. Mid-Pakihi Island looking south, raupo wetland behind dry dam in foreground, bach near centre of McCallums Bay, native fence-line plantings behind the bay and radiata pines planted along pasture boundaries: Karamuramu Island (back centre), Hunua Ranges backdrop. Photo: EKC, 18 Feb 2006.

Fig. 7. Karamuramu Island from the east. Photo: EKC, 12 Apr 2006

Fig. 9. Planted pohutukawa and flax and contoured NE corner of Karamuramu Island. Photo: EKC, 12 Apr 2006.

Fig. 8. "Pakihi or Sand Spit Id, Thames" – pen and wash by Charles Heaphy around the 1850s of Maori drying fish at McCallum's Bay. Note – Karamuramu appears at that time to be conical-shaped, at least as tall as adjacent Pakihi (>45 m asl) and lacked vegetation. Auckland Museum PD56(85)09.

Fig. 10. Stable and unplanted coastal slope on Karamuramu Island; workshop building and water tank, taken from the high jetty. Photo: EKC, 12 Apr 2006.

Table 2. Soil nutrient concentrations and pH from 3 soil depths under mature forest on Pakihi (soils pooled from subplots in two 10 m x 10 m plots). Mineral N is the combined percentage of nitrate and ammonia.

Soil depth (cm)	0–10	10–20	20–30
Total carbon (%)	6.33	2.55	1.50
Total nitrogen (N) (%)	0.48	0.22	0.13
Total phosphorus (P) (%)	0.13	0.13	0.10
Mineral N/total N (%)	1.70	1.41	1.48
Olsen P/total P (%)	1.92	2.75	4.78
pH	7.01	7.23	7.26

(*Paspalum dilatatum*), browntop (*Agrostis capillaris*), narrow-leaved plantain (*Plantago lanceolata*), hawksbeard (*Crepis capillaris*) and lotus (*Lotus pedunculatus*). White clover and rye grass were rather local.

There are several planted trees by the bach in the main bay (McCallum's Bay), including English oak (*Quercus robur*), two Norfolk pines (*Araucaria heterophylla*), Port Jackson fig (*Ficus rubiginosa*), totara (*Podocarpus totara*), pohutukawa, olives (*Olea europaea*), feijoa (*Acca sellowiana*), mandarin (*Citrus reticulata*), fig (*Ficus carica*), plum (*Prunus* x*domestica*), and a row of radiata pines (*Pinus radiata*) along the bay frontage (Fig. 6). Behind the bach much of the fencing is doubled-rowed with attractive plantings of native trees (2-5 m tall) along the c.3 m gap between the rows. These plantings include: kahikatea (*Dacrycarpus dacrydioides*), kauri (*Agathis australis*), miro (*Prumnopitys ferruginea*), rimu (*Dacrydium cupressinum*), totara, karaka, pohutukawa, puriri, rewarewa, taraire (*Beilschmiedia tarairi*), titoki (*Alectryon excelsus*) and cabbage tree (*Cordyline australis*). Taupata and flax has been planted in coastal areas; a small-leaved pine (*Pinus* sp.) at the summit; and a peach tree (*Prunus persica*) on the upper margin of the pohutukawa forest which descends from a Maori orchard growing in the 1860s which was used in trade with the settlement of Auckland.

There has been weed control by JMcC of pampas grass (*Cortaderia selloana* and possibly *C. jubata* as well), moth plant (*Araujia sericea*) (the few seen were eradicated), kikuyu grass (*Pennisetum clandestinum*), hawthorn (*Crataegus monogyna*), Chinese privet (*Ligustrum chinense*), meddick burr (*Medicago nigra*), saffron thistle, Californian thistle (*Cirsium arvense*), blackberry (*Rubus fruticosus* agg.), and control of woolly nightshade (*Solanum mauritianum*) is difficult – especially in the pine areas.

Fauna

Norway rats, mice and a stoat were present in 2006 (James Russell pers. comm.) – JMcC had never seen a stoat on Pakihi before this. Birds seen during the two visits by EKC included: pied shag (c.30 birds seen roosting at south end of the island – they don't breed on the island), little shag, reef heron, black-backed gull, kingfisher, fantail, blackbird, grey warbler, brown quail, pukeko, peafowl (feral), skylark, yellowhammer, paradise duck, grey/mallard duck, welcome swallow, magpie, chaffinch, goldfinch, myna, silvereye, tui and NZ pigeon. Pakihi was also a noted stronghold in 1940-43 for reef herons, with at one time up to 20 birds recorded, once 11 on a barge, once 18 were seen on a single pohutukawa tree (Edgar 1978). Currently 2-4 reef herons occur on Pakihi, but no nests have been observed.

Additional bird observations made since the mid 1970s by JMcC include NZ dotterel and variable oystercatcher which both nest on the island, and grey-faced petrels which overfly the island in August months (part of the Tarahiki population?), and on the odd occasion kaka fly overhead (e.g. 7 Apr 2007). Black shags regularly fish in the four farm cattle ponds, while grey teal (1 seen Feb 2007), pheasant (occasionally visit), brown quail (occasionally present), spotted shag (occasionally visit), little black shag (flocks of up to 120 birds sometimes communally fishing the coastline), red-billed gull, house sparrow, hedge sparrow, morepork (3 birds), white-faced heron, pied stilt, NZ pipit, harrier, South Island pied oystercatcher, Caspian tern, white-fronted tern, little blue penguin (breed/roost ashore), starling and kookaburra (heard S end of island Jan 1973) have been seen. Gannets and fluttering shearwaters are commonly seen close inshore feeding, and a flock of up to 50 galahs visit most evenings. These birds appear to roost on Ponui and fly over to the mainland most days, returning in evenings – this population is said to have originated from birds released by a seafarer bird smuggler onboard the explosives ship berthed at the nearby Waitawa wharf who panicked when the ship was being searched by MAF/Customs in the 1960s. During the ABS trip to southern Ponui in Nov 1999 we saw galahs and David Chamberlin told us at times they number 30-40 on the island (Cameron 2000). Brown teal were present on Pakihi until the early 1950s (there was a population at Ponui at the same time).

JMcC has recorded six species of lizards on Pakihi: *Cyclodina aenea, C. ornata, Oligosoma moco, O. smithi, Hoplodactylus granulatus* and *Naultinus elegans*. *N. elegans* has been observed only on a few other Hauraki Gulf islands, e.g. Waiheke, Little and Great Barrier Islands (JMcC pers. ob.), and Tiritiri Matangi by Paul Cashmore in c. 1994 (which remains unsubstantiated, Dave Towns pers. comm.). Similarly,

the record of *Hopalodactylus granulatus* is significant, as this species has never been recorded from any other small offshore island in New Zealand, being known otherwise only from Waiheke (JMcC pers. ob.), Great and Little Barrier Islands, and Kapiti.

Karamuramu Island (Figs. 4, 7)
Our listing of the vascular plants for this privately owned island is based on notes made by Anthony Wright compiled during a 1 hour visit on 6 Mar 1982 and a 6 hour visit on the 12 Apr 2006 by EKC. Unless otherwise stated all comments are based on the 2006 visit. There are extensive intertidal gravel flats at the northern end of the island extending out over 150 m at low tide. The island is composed of a red-coloured chert aggregate ("McCallum's chip") that is actively being quarried and until recently the chert was being used in the greater urban Auckland for footpaths. The centre of the island is a quarry pit with bare slopes and most of the island's surface is now covered in loose red rock. There is a rim around the outside of the quarry which is near 20 m tall, less on the east side There is a workshop building, water tank, crushing machinery, a tall jetty associated with the quarry, and a small, old batch at the northern end. The present flat-topped shape of the island is in marked contrast to its conical shape painted by Charles Heaphy in c. 1850s (Fig. 8), before quarrying began.

Apart from weed species locally on the top of the coastal rim, only the actual coastal slopes of the rim contained any vegetation. Some two thirds of these steep slopes were modified/re-shaped, they contained areas of: planted flax, pohutukawa (1.5-2.5 m tall) (Fig. 9), and to a lesser extent akeake (*Dodonaea viscosa*) and taupata; a sown (as a slurry) grassland dominated by cocksfoot, narrow-leaved plantain, browntop, red clover and locally stinkwort (*Dittrichia graveolens*); and a bare gravel area on the eastern side (Fig. 7). The southern cliffs (SW of the jetty) contained the most stable coastal slopes (Fig. 10) which supported wild native vegetation which was mainly scattered shrubby karo, coastal karamu, karamu (*Coprosma robusta*), and more commonly karamu hybrids (*C. macrocarpa* x *C. robusta*), the occasional taller pohutukawa, and locally koromiko hybrids (*Hebe pubescens* x *H. stricta*), bracken (*Pteridium esculentum*) and both species of pampas grass. The two tallest plants on the island were pohutukawa c. 10 m tall, located on the SW and SE sides of the island. The commonest plants on the island were narrow-leaved plantain, cocksfoot and pampas grasses; the latter were mainly juvenile plants. All flax on the island has been planted.

Twenty-six plant species appear to have been lost between 1982 and 2006 – 17 exotic and nine native (see Appendix 1). For 13 plant species Karamuramu is the only record in the chain of six islands discussed – 12 exotic and one native (Appendix 1). This isn't surprising because this island is a different substrate (entirely bare rock) from the other islands and has had a much higher degree of human modification.

Norway rats are present and possibly mice as well (James Russell pers. comm., Apr 2006), garden snails were also present. A few of the pampas grass culms had been chewed – rats? Birds seen during the 2006 visit: pied shag, little shag, NZ dotterel, variable oystercatcher, South Island pied oystercatcher, white-fronted tern, red-billed gull, black-backed gull, Caspian tern, white-faced heron, reef heron, spur-winged plover, kingfisher, blackbird, mallard duck (in quarry ponds), welcome swallow, goldfinch and pipit/skylark. JMcC records that NZ dotterel, variable oystercatcher and reef heron (1 pair by the jetty) all nest on the island, starlings are present, and that Ross McKenzie reported grey-faced petrels breeding there in Aug 1942.

Discussion
An overall vascular flora for the six islands is 616 species, with 44% of the species being native (see Table 1). The size of the six islands' floras and the percentage of native species compared to exotic species appear to be related to the area of each island and the degree of human disturbance (Table 1). The less disturbed islands have a larger percentage native figure, e.g. Tarahiki, Ruthe and Ponui Islands are less disturbed. With more fieldwork Tarahiki, Ponui and Pakihi Islands (the lesser botanically explored of the six islands) should provide a reasonable number of additional records. This chain of six islands along with nearby Waiheke Island provides a series of stepping-stones for the dispersal of plants and animals (native and exotic). Only 5% of the flora of the six islands (= 30 species, 55% native), were common to all six islands. However, this increases to 11% (= 70 species, 61% native) if five islands are considered. In both cases there are more native species in common rather than naturalised species – with time, without weed management, we would expect the native percentage to decrease as new naturalised species spread out along the chain.

Looking at eight special "island plant" species (i.e. species that today are mainly confined to islands, at least in northern New Zealand), they are more frequent on the northern islands of the chain (Table 3). Rather surprisingly for such a modified island, Rotoroa has six of these "island species", while the notable less modified Tarahiki had five, and Ruthe Islet only two. The much larger, extensively farmed Ponui had three and Pakihi only one. Of these species most of those recorded from Rotoroa Island are represented as very small populations or even singletons. Tarahiki, despite its small size, is still relatively poorly explored botanically, and we suspect that given more time and search effort it will be found to have a larger flora, and

Table 3. Special "island plant" species recorded for each of the six islands.

Island	Ta*	Ro	Ru	Po	Pa	Ka
Arthropodium bifurcatum		+				
Blechnum norfolkianum	+			+		
Cyperus insularis	+					
Linum monogynum	+	+	+			
Melicytus novae-zelandiae (coastal mahoe)	+	+	+			
Scleranthus biflorus		+		+	+[2]	
Senecio scaberulus		+		+		
Streblus banksii (milk tree)	+	+[2]				
Totals:	5	6	2	3	1	0

*Ta = Tarahiki; Ro = Rotoroa; Ru = Ruthe; Po = Ponui; Pa = Pakihi; Ka = Karamuramu Islands
[2] = possibly now locally extinct (not seen by us)

probably more of the "island plant" component than is currently known.

The islet Kahakaha (Frenchmans Cap) (0.38 ha) lies between Waiheke, Pakatoa and Rotoroa Islands and it has a reported flora of 45 vascular plants (49% native) (see Lee 1999). Interestingly two exotic species found there are additional to our combined flora for the six islands: mile-a-minute (*Dipogon lignosus*) and *Vicia sativa*. The richness of the large flora of the 9333 ha Waiheke Island to the west is reflected by one documented area of the island: Whakanewha Region Park (274 ha) which contains 432 vascular species (58% are native) (Wilcox et al. 2002).

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References

Barton, I.L. 1996: Forest Management plan for John McCallum of Pakihi Island, Hauraki Gulf. Unpublished, held by John McCallum. 19p.
Brown, E.A. 1979: Vegetation and flora of Ponui island, Hauraki Gulf, New Zealand. *Tane 25*: 5-16.
Cameron, E.K. 1992: Ponui islet now rat free. *Auckland Botanical Society Journal 47*: 50.
Cameron, E.K. 2000: Field trip to southern Ponui Island, Hauraki Gulf, Auckland. *Auckland Botanical Society Journal 55*: 34–38.
Cameron, E.K. 2007: Rotoroa Island, Hauraki Gulf, trip report. *Auckland Botanical Society Journal 60*: 124–135.
Cameron, E.K.; de Lange, P.J. 2006: Vegetation and vascular flora of southern Ponui Island, Hauraki Gulf – a return visit. *Auckland Botanical Society Journal 61*: 3–14.
Cameron, E.K.; Taylor, G.A. 1992: Flora and vegetation of an islet ["Ruthe"] off Ponui Island, Hauraki Gulf, Auckland. *Auckland Botanical Society Journal 47*: 23–29.
de Lange, P.J.; McFadden, I. 1995: Additions and comments on the flora and fauna of Motukahakaha Island ["Ruthe Islet" not Motukahakaha], Hauraki Gulf, Auckland. *Auckland Botanical Society Journal 50*: 22–26.
Edgar, A.T. 1978: Reef heron (*Egretta sacra*) in New Zealand. *Notornis 25*: 25-58.
Ell, G. 1982: Wild Islands: exploring the islands of the Hauraki Gulf and beyond. Bush Press. Auckland.
Fromont, M. L. 1996: Plants recorded from a visit to Rotoroa Island, 2 Dec 1992. *In*: Lee, M. E., New Zealand the 10,000 Island archipelago. Unpublished MSc Thesis, University of Auckland. Pp 160-164.
Fukami, T.; Wardle, D.A.; Bellingham, P.J.; Mulder, C.P.H.; Towns, D.R.; Yeates, G.W.; Bonner, K.I.; Durrett, M.S.; Grant-Hoffman, M.N.; Williamson, W.M. 2006: Above- and below-ground impacts of introduced predators in seabird dominated ecosystems. *Ecology Letters 9*: 1299–1307.
Hutton, F.W. 1869: On the geology of the island of Pakihi. *Transactions of the New Zealand Institute 1*: 167-168.
King, C. M., Ed. 2005: The Handbook of New Zealand Mammals, 2nd. Ed. Oxford University Press, Melbourne.
Landcare 2006: Wedding present for bridal creeper. *What's new in biological control of weeds 35*: 1–2.
Lee, M. 1999: Biota of seven islets off Waiheke Island, Inner Hauraki Gulf. *Tane 37*: 99–136.
Maddock, Shirley 1983 (ed. 2): Islands of the Gulf. Collins, Auckland.
Monin, Paul 1992: Waiheke Island: a history. Dunmore Press, Palmerston North.
Monin, Paul 1996: The islands lying between Slipper Island in the south-east, Great Barrier Island in the north and Tiritiri-Matangi in the north-west. Report for the Waitangi Tribunal for claim Wai 406.
Monin, Paul 2001: This is my place; Hauraki Gulf contested 1769-1875. Bridget William Books, Wellington.
Taylor, G.A. 1989: A register of northern offshore islands and a management strategy for island resources. Department of Conservation, Auckland. Northern Region Technical Report Series 13.
Wilcox, M.D; Spence, A; White, P. 2002: Botanical features of Whakanewha Regional Park Waiheke Island. *Auckland Botanical Society Journal 57*: 34–46.

Appendix 1. Vascular flora of six islands east and southeast of Waiheke Island.

Key
a = abundant
c = common
o = occasional
l = local
s = scarce (< 5 plants seen)
x1 = only one plant seen (x2 = only 2 plants seen)
* = adventive species
** Ta = Tarahiki; Ro = Rotoroa; Ru = Ruthe; Po = Ponui; Pa = Pakihi; Ka = Karamuramu Islands
*** = accession number for Auckland Museum herbarium (AK), and one from Te Papa (WELT) - when more inset these 2 linesthan 1 voucher, the cited record is selected in the following order: Rotoroa (Ro), Tarahiki (Ta), inset these 2 linesPakihi (Pa), Karamuramu (Ka), Ruthe (Ru), and lastly Ponui (Po) Island
? = indicates there is some uncertainty with the identification
+ = collected only in the settlement area on Rotoroa Island
# = recorded by someone else for Ponui Island without an abundance rating (see Cameron & de Lange 2006)
AW = collected &/or recorded by Anthony E. Wright, 6 Mar 1982 (unpublished list)
GT = recorded by Graeme A. Taylor, Oct 1988 (pers. comm.)
JM = recorded and removed by John McCallum pre-2004
LM = collected by Lucy B. Moore, Dec 1936
MF = recorded by Mairie L. Fromont, based on a day visit, 2 Dec 1992 (Fromont 1996)
Pl = planted
RG = recorded by Rhys O. Gardner, Dec 2005 (unpublished list)

	Ta**	Ro	Ru	Po	Pa	Ka	voucher***
FERNS AND FERN ALLIES							
Adiantum aethiopicum		s					
Adiantum cunninghamii		l		lc	lc		214813 Po
Adiantum fulvum				lc			214778 Po
Adiantum hispidulum		o		l	lc		
Arthropteris tenella		s		#			214678 Po
Asplenium bulbiferum				o			294106 Po
Asplenium flabellifolium				#			
Asplenium flaccidum	l	s		o	o		255468 Ro
Asplenium haurakiense	a	o	c	l	l		279317 Ro
Asplenium haurakiense x ? *A. flaccidum*			o				200586 Ru
Asplenium hookerianum				#			
Asplenium lamprophyllum				lc			275660 Po
Asplenium oblongifolium	lc	l	o	o	o		214860 Po
Asplenium obtusatum subsp. *northlandicum*				#			
Asplenium polyodon	l	s	s	o	o		214895 Po
Azolla filiculoides				lc			295653 Po
*Azolla pinnata**		l					
Blechnum chambersii				l			219999 Po
Blechnum filiforme		s		o	l		219965 Po
Blechnum fluviatile				s			
Blechnum fraseri				#			219986 Po
Blechnum membranaceum				l			219910 Po
Blechnum minus				l			
Blechnum norfolkianum	l			l			295647 Po
Blechnum novae-zelandiae		l		o	l		219897 Po
Cardomanes reniforme				l			220078 Po
Cheilanthes sieberi	o						228086 Ta
Ctenopteris heterophylla				l			220008 Po
Cyathea dealbata		lc	s	lc	o		220132 Po

Cyathea medullaris		o		lc	lc		220154 Po
Deparia petersenii				l			214924 Po
Dicksonia fibrosa				s			294043 Po
Dicksonia squarrosa		s		lc	l		220109 Po
Diplazium australe				#			214913 Po
Doodia australis	o	o		lc	lc		223042 Po
Grammitis ciliata				l			294032 Po
Grammitis rawlingsii				s			294034 Po
Histiopteris incisa		s		s			293939 Po
Huperzia varia		s		#	s		220203 Po
Hymenophyllum demissum				l			144525 Po
Hymenophyllum flabellatum				l			294041 Po
Hymenophyllum multifidum				#			
Hymenophyllum rarum				l			223190 Po
Hymenophyllum revolutum				#			222997 Po
Hymenophyllum sanguinolentum				#			223218 Po
Hymenophyllum scabrum				#			223240 Po
Hypolepis ambigua		s		l			
Hypolepis dicksonioides				l			295651 Po
Hypolepis distans				#			
Lastreopsis glabella				lc			118402 Po
Lastreopsis hispida				o			223316 Po
Lastreopsis microsora				l			223328 Po
Lastreopsis velutina					c		299473 Pa
Leptopteris hymenophylloides				o			223362 Po
Lindsaea linearis				l			223367 Po
Lindsaea trichomanoides				l			223398 Po
Lycopodium deuterodensum				#			220246 Po
Lycopodium volubile		x1		#			220364 Po
Lygodium articulatum				lc			223384 Po
Marattia salicina				la			223661 Po
Microsorum pustulatum	o-lc	o-lc	c	o	o	l	222808 Ta
Microsorum scandens				o	l		223088 Po
*Nephrolepis cordifolia**		s					
Paesia scaberula		s		l			
Pellaea rotundifolia	l		s	l	l		200597 Ru
Pneumatopteris pennigera				l			223178 Po
Polystichum neozelandicum	?l	s		l	o		297777 Ro
Psilotum nudum		s					
Pteridium esculentum	lc	c	c	lc	lc	lc	220221 Po
Pteris comans	l	s		#			220265 Po
Pteris macilenta				o			118389 Po
Pteris saxatilis				l	lc		299472 Pa
Pteris tremula	l	s		o	o		220296 Po
Pyrrosia eleagnifolia	a	o-lc	c	o	o-lc	lc	220321 P
Schizaea fistulosa				#			220345 Po
Tmesipteris elongata				l			220377 Po
Tmesipteris lanceolata				#			275678 Po
Tmesipteris sigmatifolia				l			295657 Po
Tmesipteris tannensis				#			220384 Po
Trichomanes elongatum				l			220399 Po
Trichomanes endlicherianum				l			
Trichomanes venosum				#			223160 Po

CONIFERS

Agathis australis				lc			151200 Po

*Araucaria heterophylla**		s+					297775	Ro
*Cupressus macrocarpa**		lc		l	lc		299538	Pa
Dacrycarpus dacrydioides				#				
Dacrydium cupressinum				#				
Libocedrus plumosa				x1				
Phyllocladus trichomanoides				lc			150585	Po
*Pinus nigra**				lc			221526	Po
*Pinus pinaster**		s						
*Pinus radiata**		c	s	lc	s	x1	299509	Pa
Podocarpus totara		o		x1			297778	Ro
Prumnopitys ferruginea				o				
Prumnopitys taxifolia				s			150587	Po
DICOTYLEDONS								
Acaena anserinifolia		MF		l				
Acaena novae-zelandiae		s		o	o-lc			
*Achillea millefolium**						lc		
*Ageratina adenophora**				l				
Alectryon excelsus		s		s				
Alseuosmia x*quercifolia*				o			228087	Po
Alseuosmia macrophylla				#			150572	Po
*Alternanthera sessilis**					l		299535	Pa
*Amaranthus deflexus**				l			247093	Po
*Amaranthus lividis**		s				s	295892	Pa
Anagallis arvensis var*. avensis**	o	c	c	o	o	o		
Anagallis arvensis var. *coerulea**	o	c		lc			297761	Ro
*Antirrhinum orontium**		s+					297796	Ro
*Aphanes inexspectata**	o	l		l				
Apium prostratum	o	s	l	l	lc		211731	Pa
*Araujia sericifera**		s		#	JM			
*Aster subulatus**	l	s			s	lc	299525	Pa
*Atriplex prostrata**		o	l	l	o	lc	150576	Po
Avicennia marina		o	s	lc	x2	x2	151193	Po
Beilschmiedia tarairi		s		lc	s		297949	Ro
Beilschmiedia tawa (incl. *B. tawaroa*)				o	l		151191	Po
*Bellis perennis**		o		o				
*Berberis glaucocarpa**		MF						
*Beta vulgaris**						AW		
*Bidens frondosa**				l		AW	159086	Ka
*Borago officinale**		s+						
Brachyglottis kirkii var. *angustior*				#				
Brachyglottis repanda		s		o	o			
*Brassica rapa**		MF			?s			
*Cakile edentula**						x1		
*Cakile maritima**		l				AW	159091	Ka
*Calendula officinalis**		l					297793	Ro
Callitriche muelleri				o				
*Callitriche stagnalis**		l		lc	l			
Calystegia sepium subsp. *roseata*		l		lc				
Calystegia silvatica (or hybrid)?*				o				
Calystegia soldanella	l	l	l		l	l		
Calystegia ? *soldanella* x *C. tuguriorum*		s			l	l	299399	Ka
Calystegia tuguriorum		s						
*Capsella bursa-pastoris**		l		l	l		299523	Pa
*Cardamine hirsuta**		l					297794	R
*Carduus nutans**				#				

*Carduus pycnocephalus/tenuiflorus**		s	s	#		AW	159093	Ka
Carmichaelia australis	l	l	o	#			279314	Ro
*Carthamus lanatus**					AW,JM		159076	Pa
*Casuarina cunninghamiana**		s+						
*Centaurium erythraea**	l	o	o		o	o		
Centella uniflora				#				
*Cerastium fontanum**					l		295066	Pa
*Cerastium glomeratum**	lc	o	o	lc			300662	Ta
*Cerastium semidecandrum**				l			247094	Po
*Cerastium tomentosum**		s+						
*Chenopodium album**						AW	159071	Ka
*Chenopodium murale**		s						
*Chrysanthemoides monilifera**	o	l						
*Cichorium intybus**						c	299390	Ka
*Cirsium arvense**		l			JM			
*Cirsium vulgare**	GT	o	o	o	o	s		
Clematis cunninghamii		l					279315	Ro
Clematis paniculata		l	s	o	o		280012	Ru
*Conyza bonariensis**					l		299521	Pa
*Conyza sumatrensis**	l	o	o	#	o	o-lc	299421	Pa
Coprosma arborea				lc				
Coprosma grandifolia				#	IB			
Coprosma macrocarpa	o	l	lc	#	lc	o	299542	Pa
Coprosma macrocarpa x *C. robusta*		l				lc	299420	Ka
Coprosma repens	a	s	o	s	o		222792	Ta
Coprosma rhamnoides	lc	l	o	c	lc		150582	Po
Coprosma robusta		l		l		o		
Coprosma spathulata				s			295659	Po
Coriaria arborea		s		o	x2		299541	Pa
Corynocarpus laevigatus		MF		o-lc	l		150590	Po
*Cotoneaster glaucophyllus**		o					297822	Ro
*Cotoneaster lacteus**		l					297833	Ro
*Cotoneaster pannosus**		s						
Cotula australis	c	l	o	l			222784	Ta
Cotula coronopifolia	l	s		l	l			
Crassula colligata subsp*. colligata*		l						
*Crassula multicava**		l+						
Crassula sieberiana	lc	l	lc	l			222791	Ta
*Crataegus monogyna**				o	JM			
*Crepis capillaris**	o	o		o	c	o		
*Daucus carota**					l			
Dichondra repens	lc	lc	o	o	o	AW	222803	Ta
*Digitalis purpurea**		s						
*Diplotaxis muralis**						AW	159095	Ka
Disphyma australe	lc	s	o	l			150575	Po
*Dittrichia graveolens**						lc	299386	Ka
Dodonaea viscosa		l	lc	l	o	AW	279313	Ro
Drosera auriculata	c	s	lc	l			222813	Ta
Dysoxylum spectabile		s		o-lc	o		297950	Ro
Einadia triandra	lc	s	o				297829	Ro
Einadia trigonos	c		s				222785	Ta
Elaeocarpus dentatus				s			294107	Po
Entelea arborescens	l	s		l			151183	Po
Epilobium cinereum		s						
Epilobium nummularifolium		l+						
Epilobium pallidiflorum				l				

*Erica lusitanica**				l			
*Erigeron karvinskianus**				s			
*Erodium moschatum**		s		lc			297827 Ro
*Eschschoizia californica**						s	299418 Ka
*Eucalyptus saligna**		s					297760 R
Euchiton audax	o	s	l				
Euchiton collinus		RG	l	o	?		200585 Ru
Euchiton involucratus				o			
Euchiton sphaericus		s				l	295887 K a
*Euonymus japonicus**		l					
*Euphorbia lathyris**		s			s		279308 Ro
*Euphorbia peplus**	o	l		o	o	AW	
*Fatsia japonica**		s					
*Foeniculum vulgare**						lc	299404 Ka
Fuchsia excorticata				#			151199 Po
*Fumaria muralis**		l		#			297835 Ro
*Galium aparine**		o		l			
*Galium divaricatum**		?			l		295071 Pa
*Galium palustre**		MF					
Galium propinquum	o			l			
*Gamochaeta coarctata**				o	o		
*Gamochaeta simplicicaulis**				o	lc		
Geniostoma ligustrifolium	o	l	lc	l	s		151182 Po
*Geranium dissectum**		l		o			247084 Po
*Geranium gardneri**	o	l		o	lc	o	297785 Ro
Geranium homeanum				o			
*Geranium molle**	o	lc		lc	l		
*Geranium purpureum/robertianum**		s					
Geranium retrorsum	o		lc				222901 Ta
Geranium solanderi		l					297743 Ro
Gonocarpus incanus		l		l			
Griselinia lucida						AW	159085 Ka
*Hakea sericea**			l				
Haloragis erecta	o	l		o	o	AW	
Hebe x*affinis*		o	o				200601 Ru
Hebe macrocarpa		o	l				279311 Ro
Hebe pubescens subsp. *pubescens*		l			l		297747 Ro
Hebe pubescens x *H. stricta*					lc	lc	159074 Ka
Hebe stricta var. *stricta*	lc	RG	lc	#			222807 Ta
Hedycarya arborea		x1		o	o		150591 Po
*Helminthotheca echioides**		l			o		
*Homalanthus populifolius**		s					297742 Ro
Hydrocotyle heteromeria		s					
Hydrocotyle moschata	GT(?)	l		l			
*Hypericum humifusum**		?		l			
Hypericum japonicum				l			247092 Po
*Hypochaeris glabra**	l	o					
*Hypochaeris radicata**		o	o	o	o	o-lc	299406 Ka
Knightia excelsa				o	l		151184 Po
Kunzea aff. *ericoides* (b)		o-lc		a	lc	x1	297746 Ro
*Lactuca virosa**		l			lc		297823 Ro
Lagenifera pumila		l		l			
*Lapsana communis**		o					
Laurelia novae-zelandiae				#			
*Lavendula stoechas**		l+					277797 Ro
*Leontodon taraxacoides**		o		l		l	299400 Ka

*Lepidium didymum**		l		l		s	295894	Ka
Leptecophylla juniperina		o	lc	lc	o	s	159084	Ka
Leptospermum scoparium	o-lc	o	o	lc	lc		299514	Pa
Leucopogon fasciculatus	lc	o	o	lc	la	o	222806	Ta
Leucopogon fraseri		l						
*Ligustrum lucidum**		s						
*Ligustrum sinense**		l			x1			
*Linum bienne**		o		o				
Linum monogynum	o	l	l				297769	Ro
*Linum trigynum**	o	lc	c	lc	la	c	159098	Ka
*Liquidambar styraciflua**		s+					297800	Ro
Litsea calicaris		x1			l			
Lobelia anceps		l			l			
*Lobularia maritima**		l+					297790	Ro
*Lonicera japonica**		MF						
*Lotus angustissimus**		l		l	lc	l		
*Lotus pedunculatus**		l	l	lc	lc	lc		
*Lotus suaveolens**	o	o	o	lc	o	o		
*Ludwigia palustris**		l		lc	lc			
*Lycium ferocissimum**	l	o-lc	o-lc	l	JM	AW	222906	Ta
*Lythrum hyssopifolia**		l						
Macropiper excelsum	l	l		o	o		297831	Ro
*Malva neglecta**		lc			o		297826	Ro
*Malva parvifolia**				l			242612	Po
*Matricaria discoidea**		s						
*Medicago arabica**		l						
*Medicago lupulina**		o		l		AW	242614	Po
*Medicago nigra**		o-lc			JM	l	295895	Ka
Melicope ternata	c			o	?		222805	Ta
Melicytus novae-zelandiae	o-lc	x1	c				297780	Ro
Melicytus ramiflorus	GT	l	s	o	lc			
*Melilotus indicus**	c	o				lc	299388	Ka
*Mentha pulegium**		l		l				
*Mercuralis annua**	lc						222815	Ta
Metrosideros carminea				l			294129	Po
Metrosideros diffusa				o			275675	Po
Metrosideros excelsa	c	lc	c	lc	c	o	280370	Po
Metrosideros excelsa x *M. robusta*				s				
Metrosideros fulgens				o				
Metrosideros perforata		s		lc				
Metrosideros robusta				s			295658	Po
Mida salicifolia				l			150578	Po
*Modiola caroliniana**		o		l	o	AW		
Muehlenbeckia australis		l						
Muehlenbeckia complexa	c	l	l	o	o	o-lc	222793	Ta
Myoporum laetum			s	#			200580	Ru
*Myosotis discolor**		l		l			297830	Ro
*Myosotis laxa**				lc				
*Myosotis sylvatica**		l		lc				
Myrsine australis	o	lc	lc	lc	o	AW	151181	Po
*Nasturtium officinale**		l		l				
Nestegis lanceolata				o	o			
*Nigella damascena**		s+					297801	Ro
Nothofagus truncata				#			150576	Po
Olearia albida		s		s			295655	Po
Olearia furfuracea	o	lc	o-lc	lc	o	l	222819	Ta

Olearia rani				o			
*Orobanche minor**	GT	s			o	AW	
*Osteospermum fruticosum**		s					
*Oxalis corniculata**		l		l			297755 Ro
Oxalis exilis	o	l		o	o		299537 Pa
*Oxalis incarnata**		l					
*Oxalis pes-caprae**		l	l			l	297340 Ka
Oxalis rubens		l	o		o	AW	297782 Ro
*Oxalis thompsoniae**		s				o	297754 Ro
Parietaria debilis	lc		l				222795 Ta
*Pariserianthes lophantha**		l					
Parsonsia ? *heterophylla*				o	s		
Peperomia urvilleana	lc	l	o	l	o-lc		222788 Ta
Pericallis x*hybrida**		l		l			297779 Ro
*Persicaria capitata**		l+					
Persicaria decipiens		s		lc	l	l	299533 Pa
*Physalis peruviana**		s					
*Phytolacca octandra**	s	s	s	o	o	lc	150573 Po
Pimelea aff. *urvilleana*			c				200579 Ru
Pimelea tomentosa				#			151196 Po
Pittosporum ? hybrid				#			275674 Po
Pittosporum cornifolium				s			
Pittosporum crassifolium	a	c	a	o	o-lc	l	222804 Ta
Pittosporum umbellatum		s					297767 Ro
Plagianthus divaricatus		s					
Planchonella costata	l	MF		s	lc		299528 Pa
*Plantago coronopus**		l		l			
*Plantago lanceolata**		o	lc	lc	o-lc	a	
*Plantago major**		l		o			
Plantago raoulii				#			151197 Po
*Polycarpon tetraphyllum**	GT	l	c	l	l	l	
*Polygala myrtifolia**			o				
*Polygonum aviculare**		l		l			
Pomaderris amoena		l		#	s	AW	160753 Po
Pomaderris rugosa		lc	l	#	lc	AW	255467 Ro
*Portulacca oleracea**				l	l		
*Potentilla reptans**		l					
*Prunella vulgaris**		o		o	o		
*Prunus persicaria**		s		s	s		297799 Ro
Pseudognaphalium luteoalbum agg.	o	s		o		o	
Pseudopanax arboreus		s		s			
Pseudopanax crassifolius		s		o	s		151176 Po
Pseudopanax crassifolius x *P. lessonii*	s	s		s	s		WELT 85985 Ta
Pseudopanax lessonii	a	l	c	o	lc		279316 Ro
*Psidium cattleianum**		s					297768 Ro
*Quercus robur**		s					
Quintinia serrata				#			
*Ranunculus muricatus**		l					
*Ranunculus parviflorus**		lc		lc			
Ranunculus reflexus		s		l	o		
*Ranunculus repens**				lc	l		
*Ranunculus sardous**		lc		o			
*Ranunculus sceleratus**		MF		l	l		279310 Ro
*Raphanus raphanistrum**		l				AW	
*Rapistrum rugosum**		s					297788 Ro
*Rhamnus alerternus**							

*Rhapiolepis umbellata**		l					297772 Ro
*Robinia pseudoacacia**		s+					
*Rosa rubiginosa**		l		o	o-lc		247072 Po
Rubus cissoides		s		o	x1		151203 Po
Rubus fruticosus agg.*		l		#	lc		
*Rumex acetosella**		s			lc	l	
*Rumex brownii**				#	l		
*Rumex conglomeratus**		l			o		
*Rumex crispus**		s		l		o	299408 Ka
*Rumex obtusifolius**				o		l	
*Rumex pulcher**		o		o	l		
*Sagina apetala**	o	l					
*Sagina procumbens**	lc	l					
*Salix cinerea**		l		lc			293952 Po
Samolus repens	o	l		lc			
Sarcocornea quinqueflora	o	l	o-lc	#	o		
Schefflera digitata				o			
Scleranthus biflorus		lc		#	LM		297744 Ro
Selliera radicans		l			l		
*Senecio bipinnatisectus**		s		o	o	AW	
*Senecio esleri**					l		
Senecio glomeratus		s	s	s			200589 Ru
Senecio glomeratus x *S. hispidulus*			s				200587 Ru
Senecio hispidulus	c	lc	c	o	l	c	222903 Ta
Senecio hispidulus x *S. scaberulus*		l					297787 Ro
*Senecio jacobaea**		l		o			
Senecio lautus	c	lc	o	lc	o		
Senecio minimus				s			
Senecio scaberulus		s		l			297745 Ro
*Senecio skirrhodon**		s			x1	o-lc	299389 Ka
*Senecio vulgaris**		s			l		
*Sherardia arvensis**		o		o			
*Silene gallica**		o				o	295893 Ka
*Sisymbrium officinale**		o		s		l	
*Sisymbrium orientale**						s	
Solanum americanum	c	l	o	o			222900 Ta
Solanum aviculare s.str.				x1	x1		299470 Pa
*Solanum esculentum**		s					
*Solanum linnaeanum**		s		#	o		
*Solanum mauritianum**				#	lc		
*Solanum nigrum**	lc	o	s	o	s	l	222902 Ta
*Soliva sessilis**		l		l	s	s	
*Sonchus asper**	l	l		s	o	o	222904 Ta
*Sonchus oleraceus**	lc	o	c	o	o	o	151178 Po
Sophora chathamica		l	lc	#	s		151192 Po
*Spergularia rubra**		l			l		
Sperularia media	l	s		l			297770 Ro
*Stachys sylvatica**		l					
*Stachys arvensis**	l	l					222894 Ta
*Stachys byzantina**		l+					297802 Ro
*Stellaria media**		s		l			
Stellaria parviflora		s					
Streblus banksii	l	MF					279309 Ro
Syzygium maire				l			242616 Po
*Taraxicum officinale**		o		l			
Tetragonia implexicoma	c	s	lc				222810 Ta

*Trifolium campestre**		s					
*Trifolium dubium**		o	c	o			200594 Ru
*Trifolium glomeratum**				l			
*Trifolium pratense**		s		o	JM	c	299387 Ka
*Trifolium repens**		o-lc		lc	o	l	
*Trifolium subterraneum**		o-la	o	lc			
*Tropaeolum majus**		l					
*Ulex europaeus**		o-lc	lc	o	lc	o-lc	
*Urtica urens**		l					297825 Ro
*Verbascum thapsus**					o-lc		
*Veronica arvensis**		o		l			
*Veronica persicaria**		o					
Veronica plebeia	o	l		o			297774 Ro
*Veronica serpyllifolia**		o		l			247082 Po
*Vicia tetrasperma**		o		s	o		299471 Pa
*Vicia villosa**						s	295896 Ka
*Vinca major**		l		l			
*Viola odorata**		s+					297789 Ro
Viola x*wittrockiana**		l+					299791 Ro
Vitex lucens		s		o	l		297773 Ro
Wahlenbergia littoricola	o			l	o		294119 Po
Wahlenbergia violacea		s	o	l			200593 Pa
Weinmannia silvicola		s	s	l			297834 Ro
*Xanthium spinosum**				#			

MONOCOTYLEDONS

Acianthus sinclairii	lc		lc	l			300667 Ta
*Agapanthus praecox**		lc					
*Agave americana**		l					297740 Ro
*Agrostis capillaris**		l		#	lc	lc	299394 Ka
Aira caryophyllea s.str. *		lc	la	lc	lc	lc	279307 Ro
*Allium triquetrum**		l					
*Aloe maculata**		l					
*Anthoxanthum odoratum**		c	o	o	o	o	
Apodasmia similis				#			150594 Po
*Aristea ecklonii**		s+					
Arthropodium bifurcatum		s					297776 Ro
Arthropodium cirratum	o	lc	lc	l	lc		297817 Ro
*Arum italicum**		la		l			297741 Ro
*Asparagis asparagoides**	a	lc					297762 Ro
Asparagus aethiopicus 'Sprengeri'*		x1+					
*Asphodelus fistulosa**						AW	159090 Ka
Astelia banksii	c	o	a	l	o	x1	300665 Ta
Astelia solandri		MF		o	s		
Astelia trinervia		s		s			293980 Po
Austrostipa stipoides	l	lc		#	lc	l	159100 Ka
*Avena barbata**	o	c	c	l	o	l	222794 Ta
Baumea juncea				#			
Baumea rubiginosa				lc			
Baumea teretifolia				l			
Bolboschoenus fluviatilis		MF					
Bolboschoenus medianus				l	s(?)		
*Briza maxima**						s	
*Briza minor**	l	l		l			301114 Ta
Bromus arenarius	s		lc	s			222812 Ta
*Bromus diandrus**	lc	c	c		o		222899 Ta

*Bromus hordeaceus**	a	c	o	s			210576 Ro
*Bromus lithobius**		o	lc	l			228088 Ru
*Bromus willdenowii**	a	o		o		s	
Carex "raotest"				o			
Carex aff. *geminata*				o			299527 Pa
Carex breviculmis	o	l	o-lc		o		200591 Ru
Carex dissita		MF		o			247090 Po
*Carex divisa**		l		l			297824 Ro
*Carex divulsa**		c		l			
Carex flagellifera	o	l			lc		
Carex inversa		l		l		AW	
Carex lambertiana		l		o	o		247097 Po
Carex lessoniana				l	l (?)		
Carex maorica				l			
Carex ochrossacus				l			
Carex pumila		l					
Carex secta				l			293945 Po
Carex solandri				o			
Carex spinirostris		s		l			
Carex testacea					lc		295058 Pa
Carex virgata				o	l		131190 Po
*Catapodium rigidum**				l		lc	159101 Ka
Collospermum hastatum	a	s		lc	l		222818 Ta
Cordyline australis		s		o	s		
Cordyline pumilio				s			
*Cortaderia jubata**		o			l?	lc	299391 Ka
*Cortaderia selloana**		lc		lc	l?	a	299397 Ka
Corybas cheesemanii				s			
*Critesion murinum**	lc	lc		l	l		297828 Ro
*Crocosmia ×crocosmiiflora**		l					
*Cynodon dactylon**		o		l	lc		
*Cyperus brevifolius**				l	l		299532 Pa
*Cyperus congestus**						l	299405 Ka
Cyperus insularis	s						301115 Ta
Cyperus ustulatus	lc	l		o	l		299559 Pa
Cyrtostylis oblonga				#			275662 Po
*Dactylis glomerata**	o	o		o	o-lc	a	
Deyeuxia avenoides				l			
Dianella latissima				l	s		286151 Pa
Dianella nigra	GT	l	s	o	o		295554 Pa
Dichelachne crinita	o	lc	o	o	o-lc	o-lc	
*Dichelachne rara**		lc		l			297763 Ro
*Digitalia sanguinalis**		l+					
Diplodium alobulum	o-lc			#			228085 Ta
Diplodium brumalum				#			
Diplodium trullifolium				#			275665 Po
Drymoanthus adversus				l			275659 Po
Earina autumnalis					l		
Earina mucronata		x1		lc	l		297951 Ro
Echinopogon ovatus	GT			#	l		278182 Ta
*Ehrharta erecta**	o	lc+					297792 Ro
Eleocharia gracilis					l		
Eleocharis acuta				lc	l		
*Eleusine indica**					l		299517 Pa
Elymus multiflorus	l	l			l	s	299772 Ro
Ficinia nodosa	o	o	c	#	o	l	300664 Ta

*Freesia refracta**		l						
Freycinetia banksii				lc				
Gahnia lacera	o	o		o	o		150584	Po
Gahnia setifolia				#			151189	Po
*Gladiolus undulatus**		x1						
*Glyceria declinata**		l		l			247085	Po
*Glyceria maxima**		l		lc				
*Hedichyum gardnerianum**		s						
*Holcus lanatus**		l		o	o	o		
Hordeum vulgare subsp. *distichon**	l						228081	Ta
Ichthyostomum pygmaeum				l			275656	Po
*Iris foetodissima**		l						
Isachne globosa				lc	lc		299673	Pa
Isolepis cernua	o			o				
Isolepis inundatus				l				
*Isolepis levynsiana**				l			295661	Pa
Isolepis prolifera				lc			295652	Po
Isolepis reticularis				o				
*Isolepis sepulcralis**		l		o	lc		295660	Po
*Juncus acuminatus**				o	o		299552	Pa
*Juncus articulatus**				l				
Juncus australis		o		o	o			
Juncus bufonius var. *congestus**		l		l			297798	Ro
*Juncus dichotomus**				l			247081	Po
Juncus edgariae		l		l	o		131186	Po
*Juncus effusus**		l		o	o-lc		131006	Po
*Juncus flavidus**				o	o-lc		295073	Pa
Juncus kraussii				l			131007	Po
Juncus pallidus				o				
Juncus planifolius					l		299526	Pa
Juncus sarophorus		MF		o	l			
*Juncus tenuis**		l		l				
Juncus usitatus				o				
Lachnagrostis billardierei	o	o	o	#				
Lachnagrostis filiformis		l						
Lachnagrostis littoralis	o	l	o				297771	Ro
*Lagurus ovatus**	l	o						
Lemna minor		l		lc	lc		295654	Po
Lepidosperma australe				l			151190	Po
*Leucojum aestivum**		l						
*Lolium multiflorum**		l						
*Lolium perenne**		a		la	o-lc	AW		
*Lolium rigidum**	o-lc	l	c	o	l	o	222811	Ta
*Luzula congesta**				l			247087	Po
Microlaena stipoides		la	l	la	o-lc	l		
Microtis unifolia		l		l				
Morelotia affinis				#			150593	Po
Narcissus sp.*		MF						
Nematoceras triloba				l				
Oplismenus hirtellus		l	o	o	o			
*Parapholis incurva**	GT	l	o	l		AW	278567	Ru
*Paspalum dilatatum**		l	o		o-lc	o		
*Paspalum distichum**		l		lc	lc	s	299415	Ka
Paspalum orbiculare		s					299872	Ro
*Paspalum urvillei**		MF				AW		
*Paspalum vaginatum**		l						

*Pennisetum clandestinum**		c		l	JM	l	
Petalochilus chlorostylus				l			247091 Po
*Phalaris aquatica**				l			
*Phoenix canariensis**		o-la					297738 Ro
Phormium cookianum				l			
Phormium tenax	s	l		l	Pl	Pl	
Poa anceps	l	o	c	l	la		
*Poa annua**	lc	l	o	lc			222809 Ta
*Poa pratensis**		o					
*Poa trivialis**		lc		o			
*Polypogon fugax**		s				l	299419 Ka
*Polypogon monspeliensis**		l		l			
Potamogeton cheesemanii		lc					279312 Ro
Pterostylis banksii				l			
Rhopalostylis sapida		MF		lc	l		275672 Po
Ripogonum scandens				o			294115 Po
*Romulea rosea**		l+					
Rytidosperma biannulare	lc	l					
*Rytidosperma penicillatum**					lc		
*Rytidosperma pilosum**		MF/RG		o	l		299773 Ro
*Rytidosperma racemosum**	c	lc	c	o	lc	o	278563 Ru
Rytidosperma unarede		l		lc			282804 Po
*Schedonorus phoenix**						AW	
Schoenoplectus tabernaemontani				l			
Schoenus maschalinus				l			
Schoenus tendo				l			
Spinifex sericeus		lc					
*Sporobolus africanus**	o	l	o	lc	o	o	299416 Ka
*Stenotaphrum secundatum**		l		l			
Thelymitra colensoi	o			l			222814 Ta
Thelymitra longifolia (autogamous)	o	lc	o	o	l		
Thelymitra longifolia (entomophilous)		o					
Thelymitra pauciflora	l	s	l				222874 Ta
Triglochin striata		RG					
Trisetum arduanum		s	o				299176 Ro
Typha orientalis		MF		la	lc		
Uncinia banksii				o			
Uncinia uncinata		l		o	lc		
*Vulpia bromoides**		lc	a	o	lc	lc	200603 Ru
*Vulpia myuros**	a	l	c			l	278564 Ru
Winika cunninghamii				#	s		
*Zantedeschia aethiopica**		l		l			
Zostera muelleri				#			

Oakleigh Saltmarsh Island, southwest Whangarei Harbour

Maureen Young

On my many trips north I have noted a raised area of saltmarsh vegetation on the mangrove flats opposite and a little south of the Oakleigh Caltex Service Station, c. 15 km south of Whangarei (NZMS 260 Q07 308952). On 13 August 2007, with the ever-obliging John Kendrick as companion, and with gumboots on feet, we circumnavigated this small "island" (c. 300 x 100 m). An island it may be on occasion when there is an extra high tide, but most of the time it sits in a "sea" of soggy sandy mud, showing beautifully the zonation of plants according to how much salt they can tolerate.

Among the fringing plants of glasswort (*Sarcocornia quinqueflora*) and sea primrose (*Samolus repens*), grow some small mangroves, but they do not attain