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Vascular flora (and some fauna) of islands/islets in the Hauraki Gulf

Ewen K. Cameron

This talk is partly based on a wider talk given to the Auckland Botanical Society (ABS) in 2006 on twelve small northern New Zealand islands (Cameron 2006). However, today's talk is confined to the Hauraki Gulf islands of which only three were included in the previous talk. Examples, mostly based on my personal experiences and ABS field trips, will be given of some special features, threats, progress, and I will finish with some conclusions (several examples and recent references have been added since the talk).

Based on the northern offshore island register (Taylor 1989), Lee (1999) recorded that there are 425 islets and islands in the Hauraki Gulf, ranging in size from 0.1 to 27,761 ha (Great Barrier Island), but most are < 1 ha. This is a remarkable biological resource at our doorstep, each with clearly defined boundaries making them ideal study areas. The biota of some is well known, but many are still undocumented. ABS has greatly assisted in the botanical recording with 29 Society trips to Gulf islands (Fig. 1) and 73 *Journal* articles on Gulf islands over the last two decades (1993–2012).

When landing for the first time on an island with little previous published information, a quick search can be made for 'good signs' that indicate whether the vegetation is in a healthy condition and whether the island is mammalian-pest-free, e.g. presence of special northern 'island' plants (defined below), copious invertebrates (under rocks and wood), and good lizard and nesting seabird numbers. These all indicate a lack of major disturbance and mammalian predators, e.g., rats, stoats, possums or cats. 'Bad signs' would include: rat caches of gnawed seeds, mammalian faeces, and environmental weed species.

Restorations and translocations galore

Rangitoto and Motutapu Islands *(mainly from the DoC website)*

Possums and rock wallabies were eradicated in the 1990s from the connected Rangitoto and Motutapu Islands. ABS supported the ambitious Department of Conservation (DoC) plan to eradicate the remaining mammalian pests on these two islands. Aerial baits were dropped in the winter of 2009 in combination with trapping and in August 2011 feral cats, rabbits, stoats, hedgehogs, Norway rats, ship rats and mice were declared gone, creating a 3800 ha mammal-pest-free island! Since the eradication, tui numbers have soared and three native birds have naturally established: bellbird, kakariki and pateke (brown teal). Other native fauna have since been introduced: takahe, saddleback/tieke, shore plover, whitehead, brown kiwi and freshwater species (red-finned bully and native crayfish/koura). Threatened plant species have been introduced to the Motutapu nursery and will be planted out once further weed control has been done. These include: *Euphorbia glauca*, pingao (*Ficinia spiralis*) and sand tussock (*Poa billardierei*). Regular surveys of native carrot (*Daucus glochidiatus*) on Rangitoto Island show that this plant is thriving since pests have been removed. ABS assisted recording the flora of these two islands by carrying out an initial weed survey of Motutapu (Cameron 1994) and producing the informative natural history book on Rangitoto Island (Wilcox 2007).

Hauraki Gulf

A map was shown that graphically illustrated 28 examples of successful bird translocations in the Hauraki Gulf, involving 11 species from 1903 to 2008 (Anon. 2010), and 18 islands/mainland islands where mammalian pests have been eradicated. Restoration plantings were often associated with these activities. Examples included Crown-owned islands like Tiritiri Matangi, Rangitoto-Motutapu, Hauturu (Little Barrier), Mokohinau, Motuora and Motuihe Islands; and private islands/land, e.g. Motukaikoura, Windy Ridge and Glenfern Sanctuaries of Great Barrier Island, and the recent transformation of Rotoroa Island. The coastal 'mainland islands' of Tawharanui, Wenderholm and Shakespear Regional Parks function partly as islands and mark the beginning of restoring Auckland's mainland. After mammalian pests were eradicated at Tawharanui in 2004, natural returns included bellbirds in 2005, and kaka and grey-faced petrels breeding there in 2008-09 (TOSSI website).

Another exciting development in the Gulf is special interest groups forming to look after the ecological welfare of particular islands or areas on larger islands. This began with the Supporters of Tiritiri Matangi – a large volunteer group founded in 1988 to further the aims of Tiritiri Matangi habitat restoration and species translocation projects (http://www.tiritirimatangi.org.nz/). Many other groups have followed and include: Motutapu Restoration Trust (http://www.motutapu.org.nz/); Motuora Restoration Society (http://motuora.org.nz/); Motuihe Trust (http://www.motuihe.org.nz/); Motukaikoura Trust (http://www.motukaikoura.org.nz/); and Rotoroa Island Trust (http://www.rotoroa.org.nz/).

Special 'northern island plants'

Many, but not all, of these special 'northern island plants' would have once been common on the mainland coast but have now been mainly confined/restricted? to island "refugia" because of various mainland pressures, e.g. from direct grazing, seed destruction, , pest pathogens, competition with weeds, lack of nutrients (guano), etc. Six of the eight examples below are Nationally Threatened (1) or Nationally At Risk (5) (de Lange et al. in press), one is Regionally Threatened (Stanley et al. 2005) and one is not threatened. The presence of any one of these species in the Gulf generally means you are visiting a special island. Some of the main special 'northern island plants' in the Hauraki Gulf include (unless otherwise stated distributions are based on specimens in AK herbarium, the virtual herbarium website, and pers. obs.):

Cook's scurvy grass (*Lepidium oleraceum*) (Threat status: Nationally Endangered) – Mahuki Island, on the mid-west coast of Great Barrier Island until recently had the best surviving population of Cook's scurvy grass for northern New Zealand growing in oozing gannet guano (Figs. 2 & 3). It prefers these open guano habitats ('ornithocoprophilous' species) but populations' boom and bust. These fluctuations appear to be related to many factors including the white rust disease *Albugo candida* which is a fungal-like pathogen, competition with weeds, and several crop viruses that have recently been recognised as present (Van Vianen et al. 2013). In the Gulf, Cook's scurvy grass has also been collected from at least another western Great Barrier islet, and Hauturu and Mokohinau Islands, and some western Coromandel islands. Our Society's Lucy Cranwell student grant recipient for 2012, Esther Dale, has helped uncover some of the secrets of this threatened species (Dale 2013).

Parapara (*Pisonia brunoniana*) (At Risk/Relict) – a clue as to why this plant is virtually restricted to islands occurred when the kiore were removed from Hauturu, resulting in "thousands of seedlings since kiore eradication" (Beever et al. 2012). Its natural New Zealand distribution is similar to coastal maire (below) except for its occurrence in the inner Hauraki Gulf. There are also plants on at least one western Coromandel island (Motuoruhi Island) and in the 1840s it was also recorded growing on the "shores of the Waitemata Harbour" (Stanley & de Lange 2005).

Fig. 1. Forty-seven Bot Soc members depart southern Ponui Island on a cattle barge after a great day's field trip. Photo: EC, 16 Oct 2005.

Fig, 2. Cook's scurvy grass habitat on Mahuki Island, below the gannet colony, western Great Barrier I., looking SW. Photo: EC, 20 Nov 2009.

Fig, 3. Cook's scurvy grass (note albugo – white patches on leaves) with *Senecio lautus* and *Sonchus oleraceus* on Mahuki. Photo: EC, 20 Nov 2009.

Fig. 4. *Carmichaelia williamsii* flowering. Photo: EC, Poor Knights Island, 8 Aug 1996.

Fig. 5. A mawhai vine on the coast of the private Motuhaku Island, western Great Barrier I. Photo: during a Bot Soc survey of the adjacent Motukaikoura, EC, 18 Dec 2006.

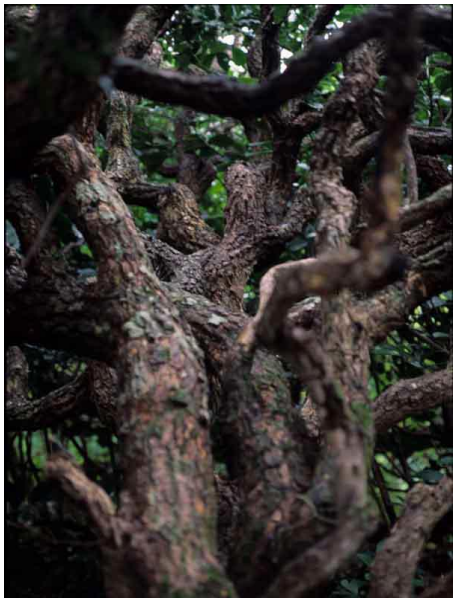

Fig. 6. Spreading branches of coastal maire trees, often much wider than tall, Fanal I. Photo: EC, Sep 1994.

Fig. 7. Coastal maire with green and ripening fruit, Fanal I. Photo: EC, Sep 1994.

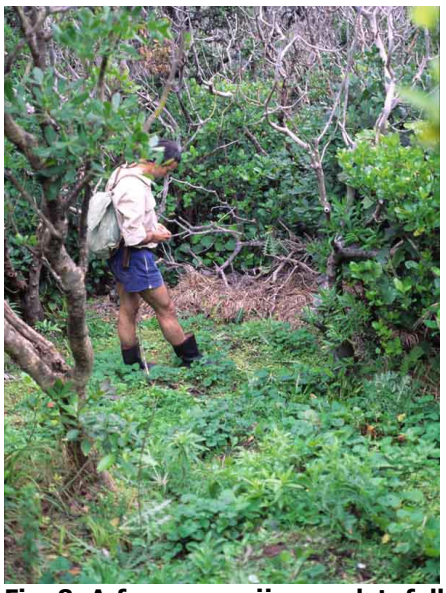

Fig. 8. A former marijuana plot, full of weeds. Photo: EC, Fanal Island, Sep 1994.

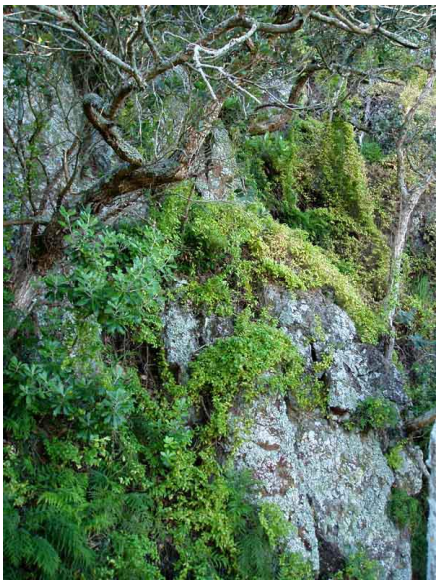

Fig. 9. *Asparagus asparagoides* yellowed by the rust infection, Tarahiki I. Photo: EC, 27 Sep 2007.

Fig. 11. A small stand of coastal mahoe (a special "island species") in full flower (this one male), on the summit of Tatapihi I. (3ha) of the Mokohinau Islands. Photo: EC, 13 Sep 1994.

Fig. 12. The nationally At Risk *Geranium solanderi*. Photo: EC, Motukaha, western Waiheke I., 20 Aug 2009.

Fig. 13. Tall rhamnus forest converted to wood piles, by the Auckland Council Biosecurity team. Photo: EC, Motukaha, Waiheke I., 20 Aug 2009.

Giant-flowered broom (*Carmichaelia williamsonii*) (At Risk/Relict) – it is generally limited to kiore-free islands; in the Hauraki Gulf it survives on Hauturu and on a few western Coromandel islands. However, the best populations are on the Poor Knights (Fig. 4) and the Aldermen Islands which have never had kiore.

Milk-tree (*Streblus banksii*) (At Risk/Relict) – present on several of the Gulf islands and on Auckland's NE mainland (Young 2006), its regional stronghold is Great Barrier and associated islands. There's an interesting local occurrence in the inner Gulf on NE Waiheke, Rotoroa and Tarahiki Islands – otherwise it is absent in the inner Gulf. Nationally it is doing best on the rat-free islands with good seabird populations. The form occurring on Auckland's NE mainland, e.g., Tawharanui Regional Park, generally have smaller leaves than the outer Gulf island plants – hybrids?

Mawhai (*Sicyos mawhai*) (At Risk/Relict) – an endemic vine occurring from the Kermadec and Three Kings Islands south to the Bay of Plenty, and historically south to the Marlborough Sounds (Telford et al. 2012). In the Auckland region its stronghold is the northern Gulf islands (Barrier and Mokohinau Islands, Fig. 5). It used to also occur on the mainland and some of the inner Gulf islands but its susceptibility to Cucumber mosaic virus appears to have caused a dramatic decline (Delmiglio & Pearson 2006) and it is now restricted to the more remote islands.

Coastal maire (*Nestegis apetala*) (At Risk/Nationally Uncommon) – occurs in the Auckland region only on the outer islands: Great Barrier Island group, Fanal Island (Figs. 6 & 7). This species is unusual because no historical records appear to exist of it occurring in the inner Gulf or on the Auckland mainland, hence the Nationally Uncommon threat ranking. In New Zealand it extends from the Three Kings Islands along the outer east coast of Northland south to Whangamata. A surprising discovery on the ABS Mangawhai Walkway field trip in 2011 was a single coastal maire on the mainland (Cameron 2012a). Two other "island" species grew close by: parapara and tawapou (*Planchonella costata*).

Trisetum arduanum (Regionally threatened) – this indigenous coastal grass occurs in New Zealand from the Three Kings Islands south to Marlborough in the South Island. In the Auckland region its stronghold is the northern Gulf islands (Barrier and Mokohinau Islands). However, it also occurs on at least four islands in the inner Gulf (Rotoroa, Ruthe, Casnell and Pudding), and locally on the Waitakere coast as well. In the nineteenth century it was also collected on Motutapu Island and the Orakei foreshore. Loss of habitat and competition with weeds are presumed the main threats.

Coastal mahoe (*Melicytus novae-zelandiae*) (not threatened) – an almost exclusive island species, this variable-sized shrub occurs from the Three Kings Islands, down the east coast south to the Bay of Plenty. It occurs on most of the better quality Hauraki Gulf islands as far into the Gulf as Motuihe and Noises Islands and is absent from the Auckland mainland (except for one dubious record, AK 261891). Limiting factor is perhaps rat predation on seed?

Weeds

Most of the aggressive northern New Zealand environmental weeds are present on at least some of the Gulf islands. These island weeds include: rhamnus (*Rhamnus alaternus*), mile-a-minute (*Dipogon lignosus*), bone-seed (*Chrysanthemoides monilifera*), smilax (*Asparagus asparagoides*), mist flower (*Ageratina riparia*), pampas grasses (*Cortaderia jubata* and *C. selloana*), sweet pea shrub (*Polygala myrtifolia*), veldt grass (*Ehrharta erecta*), and kikuyu grass (*Cenchrus clandestinus*). Weed management has been intense on some of the important conservation islands, e.g. Hauturu, Tiritiri Matangi and Motukaikoura Islands. However, compared with exotic mammalian pests, weeds are much harder to eradicate and reinvasion is more likely because of the often large adjacent populations, good dispersal methods of many species, and for most the establishment of a single individual is enough to begin a new invasion. The illegal planting of marijuana (*Cannabis sativa*) occurs on remote islands (Fig. 8) and threatens the natural biota because of what might be accidently transported with the plants and their planters, e.g. weeds, exotic invertebrates and exotic pathogens.

Carefully screened introduced biological control agents (biocontols) offer hope for assisting future control for many of the well-established weeds. Most of these biocontrol introductions have been funded by a successful national collective of regional councils and DoC. Some examples of biocontrols affecting Gulf island weeds include: white smut fungus for mistflower (*Ageratina riparia*) was introduced in 1998 and a gall fly in 2000 (references mostly from Landcare website); a rust for smilax appeared to be self-introduced from Australia in 2005 (Landcare 2006) – it is a wonderful experience to visit a remote island and see, without direct management, smilax being devastated by this rust (Fig. 9); a leaf roller for bone-seed (*Chrysanthemoides monilifera*), first released in 2007; a lace bug for woolly nightshade (*Solanum mauritianum*), released in 2010; three beetle species for wandering Jew (*Tradescantia fluminensis*) released 2011-13, and yellow leaf spot fungus was approved for release in January 2013; a beetle for moth plant (*Araujia hortorum*), approved for release in 2011 (yet to be released). A smut and a fly that damage purple pampas grass (*Cortaderia jubata*) flowerheads were recently located in Ecuador (Landcare 2012) – the battle continues.

An example of weed species establishing over time on the remote uninhabited Poor Knights Islands Nature Reserve (Fig. 10) shows that, despite being 20 km off the eastern coast of Northland, and where access is tightly controlled by DoC, weeds still establish. Fortunately, since 1994 DoC has been managing the four worst environmental weeds to reach the Poor Knights: Mexican devil (*Ageratina adenophora*) (first recorded there in 1970), mist flower (1984), pampas grass (*Cortaderia selloana*) (1984), and moth plant (1993) (de Lange & Cameron 1999) – all four have wind-dispersed seed.

On the popularly visited Tiritiri Matangi Island reserve in the Hauraki Gulf, Cameron & Davies (in press) estimated that 42% of the 84 new vascular weeds found there during 1978–2010 had been assisted to the island by humans.

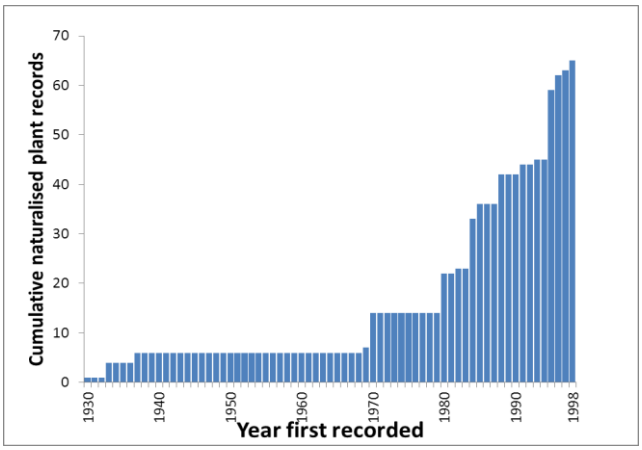

Fig. 10. Cumulative naturalised plant records for the Poor Knights Islands 1930–1998 (based on fig. 5 of de Lange & Cameron 1999 with additions from Cameron 2002).

Some Hauraki Gulf island examples

The Noises Islands

Based on two ABS trips in Mar 1993 and Mar 1998 (Cameron 1998)

The group is privately owned and the survey covered the two main islands: Motuhoropapa (8.1ha) and Otata (15 ha). These islands have some of the best indigenous forest cover of any island in the inner Gulf, with a flora consisting of plants typical of both inner and outer gulf islands. Special 'island species' present included: *Pteris comans*, coastal mahoe, and tawapou. Environmental weeds included phoenix palm (*Phoenix canariensis*), moth plant, pampas grass and rhamnus.

A chain of seven islands SE of Waiheke Island

Based on many trips, including 5 by ABS during 1999–2009 (Cameron et al. 2007, Cameron 2010b)

This chain of islands consists of: Tarahiki, Pakatoa, Rotoroa, 'Ruthe', Ponui, Pakihi, and Karamuramu Islands. The majority are privately owned and like most of the Hauraki Gulf islands they have all been modified at some time by fire, land clearance, and the impacts of exotic fauna and flora. Four of the islands have been farmed and one is an active chert mine. Until recently, apart from Ponui Island, the botany of this chain was undocumented. ABS members assisted with the field surveys on Ponui in 1999 and 2005 (Cameron 2000, Cameron & de Lange 2006, Fig. 1), Rotoroa in 2006 (Cameron 2007), Pakihi in 2008 (Cameron 2009), and Pakatoa in 2009 (Cameron 2010a). The combined vascular flora for the chain is currently 660 taxa with 52% of them being native (Cameron et al. 2007, Cameron 2010b, plus eight additions from Peter de Lange).

An interesting native shrub of this chain is *Pomaderris rugosa*, a Nationally Uncommon Species (de Lange et al. in press), which occurs on five of the seven islands. Its stronghold is the Coromandel Peninsula and it extends west to this chain of islands, Waiheke Island and the mainland adjacent to the south of the chain (Kawakawa Bay area). Naturalising from considerable plantings, young spiny phoenix palms were quite a problem on Pakatoa and Rotoroa Islands. Many of the weeds and animal pests can island-hop along the chain so it is important for pest management to consider the chain as a single unit.

Rotoroa Island has been transformed since the ABS 2006 survey of the island. Philanthropists Neal and Annette Plowman have funded a 99-year lease of Rotoroa Island from the Salvation Army and formed a trust to create a conservation park and restore historical features (*NZ Herald*, 20 Feb 2010). The many pine plantation (*Pinus radiata*) blocks were felled and mulched and some 450,000 natives were planted out. The island opened to the public on 27 February 2011. More recently Peter de Lange (pers. comm.) visited Rotoroa Island (31 Jan 2013) and added at least eight new wild vascular plants to the species list (most vouchered in AK): *Centipeda minima* subsp. *minima, Chenopodium ambiguum, Epilobium ciliatum, E. hirtigerum, E. tetragonum, Lagunaria patersonsia, Muehlenbeckia australis* × *M. complexa* and *Tripleurospermum inodorum* – he suspected that some were accidental introductions from the recent nursery plantings.

Tatapihi (Groper Island), Mokohinau Islands

Based on a visit by Peter de Lange and myself in Sep 1994 (de Lange et al. 1995)

The most remote island in the Auckland region is an important seabird island and the region's largest island (3.0 ha) totally lacking any naturalised plants. The island supported a vascular flora of 20 species, including: a stand of coastal mahoe (Fig. 11), abundant taupata (*Coprosma repens*), and also NZ ice-plant (*Disphyma australe*); *Parietaria debilis*, *Einadia trigonos* and *Asplenium haurakiense*.

Watchman Island, Waitemata Harbour, just west of the harbour bridge

Based on two visits in Nov 1987 and Sep 2006 (Cameron 1988, 2006)

It has a flat sward of exotic herbs over the top (6 m asl). The islet (0.1 ha), which is actively eroding into the sea, supports a vascular flora of 27 species (30% native). Rather surprisingly this includes the threatened (Nationally Vulnerable) *Geranium retrorsum* hanging on precariously to the edge of the exotic herb mat.

Motukaha, Church Bay, western Waiheke Island

Based on three visits: by boat in Aug 2009 (a small ABS team), and wading across the 240 m gap in Jan and Dec 2010 (unpublished).

The island (0.4 ha, 16 m asl) supports a vascular flora of 27 species (42% native) including the nationally At Risk/Declining *Geranium solanderi* (de Lange et al. in press) (Fig. 12) and many well-known Hauraki Gulf weed species: rhamnus, mile-a-minute, bone-seed and smilax. The Auckland Regional Council Biosecurity team is to be congratulated for the weed control work that they have done so far on the island (Fig. 13).

Mathesons Bay islet, Mathesons Bay near Leigh

Based on a short visit in Sep 2012 (Cameron 2012b)

I was surprised to find on this small islet (0.04 ha, c.10 m asl) another island population of the threatened *Geranium retrorsum*, this time next to active grey-faced petrel burrows. The total flora numbered 29 species (45% native) and included well-established freesias (*Freesia refracta*) – an unusual sight on uninhabited islands. However, they have also been observed in the Gulf flourishing on Crusoe Island (between Motuihe and Waiheke I.) (pers. obs., Sep 2009).

Conclusions

The above examples show that:

- small islets often have high conservation values;
- weeds have to be controlled throughout their total distribution if we are ever to achieve and maintain weed-free islands;
- many Gulf islands now have their own supporter group managing the ecological and conservation values;
- humans (often accidently) are one of the main vectors for weeds reaching islands;
- although there are many examples of successful threatened fauna translocations in the Gulf, there are few examples of successful threatened flora translocations;
- we still lack baseline flora information for many of the Gulf islands and islets;
- these island floras are dynamic with local extinctions and new arrivals continually occurring, and therefore species lists need to be updated regularly.

It is exciting that for the first time since human visitation the biological degradation of many of the Gulf islands is being turned around and their native biota and ecosystems are in a much better condition now than a few decades ago. If desired, within a few decades mammalian pests on all the Gulf islands could now be totally eradicated. Control of weeds is not so easy, but targeted weed eradication continues in sensitive conservation areas and new introductions of biocontrol agents promise to give widespread control to some of the more aggressive environmental weed species. But don't forget that many of these weed species begin their naturalisation in our own urban gardens – so we also have an important role to play here to limit their establishment and spread.

Because mammalian pests can now be relatively easily removed from islands, and many weeds can be controlled and native biota re-introduced, islands offer 'show case' examples of what can be achieved in terms of re-establishing good functioning native ecosystems. This type of management is spreading onto the mainland and it won't be long before bellbirds re-establish in urban Auckland – in fact one kokako, 'Duncan', has already tried (*NZ Herald*, 14 May 2013). The future looks hopeful, but there is still much work to do to eradicate mammalian pests (straight forward), control our worst environmental weeds (more challenging), and save the threatened 'island plants' (most challenging) on our outstanding Hauraki Gulf islands. ABS should continue to actively document their changing flora.

Acknowledgements

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Adventures on Hauturu (Little Barrier Island)

Maureen Young

William Maxwell Hamilton (1909-1992), Director General of the Department of Scientific and Industrial Research (DSIR) from 1953-1971, explored Hauturu extensively as a young man working on the family farm on the Mahurangi River. He continued these explorations as a student at Massey Agricultural College and as an employee of the DSIR. He authored two DSIR Bulletins on the island, one in 1937 (Hamilton 1937) and one, with seven other authors, in 1961 (Hamilton 1961). Dr. Hamilton's daughter, Lyn Wade, has continued with the family interest in the island, and is a trustee for the Friends of Hauturu. When Lyn asked for help to identify some herbarium specimens found in the ranger's office, I expressed a long-held dream of making a herbarium of the plants growing on the island for the use of staff and scientists. Lyn then organised permits and transport to allow this to happen. When Landcare Research scientist, Dr. Ross Beever, heard of this scheme, he suggested that I also update the