Updated flora and vegetation of Te Haupa (Saddle) Island, Mahurangi, Hauraki Gulf

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Introduction

This article is based on four day trips by the author to the uninhabited Te Haupa (Saddle) Island (Fig. 1): with the Auckland Botanical Society (ABS) on 15 Feb 2014; by myself on 12 Mar 2014; with Jessica Beever on 29 Sep 2014 and 4 Nov 2014; and a comparison with observations recorded 2–3 decades earlier by Tennyson & Taylor (1999). The damage of a severe winter storm(s) was apparent during the Sep and Nov 2014 visits.

On a still clear morning 30 people gathered at Otarawao (Sullivans) Bay in Mahurangi Regional Park on 15 Feb 2014, as the charter boat from *Kawau Cruises* arrived at 9.30 am to collect us. With a high tide at 7:46 hrs a group of 41 bar-tailed godwits waited towards the southern end of the beach for the tide to retreat so that they could resume feeding. We were run the 2 km across the calm sea out to Te Haupa (Saddle) Island in two groups. The lack of a ladder meant that embarking / disembarking was rather slow (Fig. 2) and one member ended up having an involuntary dip. Fortunately it was a lovely day and he soon dried out. Once disembarked on the sandy beach on the western side of Te Haupa, Jamie MacKay gave a summary of his PhD work that he and others were involved with on the island in 2008, experimenting and ultimately eradicating the mice on the island. We then circumnavigated the island in a clockwise direction returning to the starting point about 1pm. Then we went up onto the island by the central saddle, into "The Grotto", up to the northern plateau, and finally worked back and along to the southern forested plateau, returning to the beach via the saddle area. Many cooled down by having a swim in the clear water, and by 16:35 hrs the second boatload left the island to head back to Otarawao Bay.

EKC returned to the island on 12 Mar 2014 for nearly 5 hours to further survey the forested parts of the island; this was repeated on 24 Sep 2014 and included circumnavigating the island and going up on to the southern plateau; and repeated on 4 Nov 2014, included circumnavigating the island and accessible open slopes on the western side.

Alan Tennyson and Graeme Taylor (1999) published an account on the history, fauna and flora of Te Haupa based on their 11 mainly winter visits to the island between 1987 and 1997. They were primarily surveying the island's seabirds (grey-faced petrels), exotic mammals and vascular plants. Te Haupa is managed by the Department of

Fig. 1. Location map of Te Haupa (Saddle) Island, east of Mahurangi Heads, Hauraki Gulf. From NZTopo50 maps, AZ31 (Warkworth) & AZ32 (Kawau), adapted by Joshua Salter. Scale: squares = 1 km^2.

Fig. 2. Bot Soc members disembarking on the western beach at Te Haupa. Photo: Philip Moll, 15 Feb 2014.

Fig. 3. The classic saddle-shape of Te Haupa (Saddle) Island (centre) when viewed from the west, with Motuora behind. Photo: from the top of Otarawao Bay, Philip Moll, 15 Feb 2014.

Conservation (DoC) as a Scenic Reserve (6 ha), it is 660 m long north to south, and 50–120 m across, with high points (the two forested plateaus) towards both ends reaching 33–35 m asl, and a low central saddle (Figs. 3, 4). Apart from the central-western section, most of the island's coast is cliffed, eroding and not climbable.

Similar to the adjacent mainland, Te Haupa is composed of well-bedded layers of early Miocene mudstone and sandstone of the Waitemata Formation dipping some 10° to the south-west. When viewed from the west the island looks idyllic with its prominent sandy beach backed by the green pohutukawa (*Metrosideros excelsa*) forest. However, the steep eroding cliffs along the eastern side (Fig. 5) are not evident from that angle. Sand appears to have blown up on to the island from the western sandy beach, creating a deep sand layer in the central area which is mostly vegetated. The largest open sand section is just north of the southern forested plateau and virtually runs from the coast up to the ridge line, c.15 m across (Fig. 6). Bruce Hayward (pers. comm.) has observed that there seems to be an excess of white quartz sand in some places in this part of Hauraki Gulf, including accumulating in the lee of Te Haupa. This sand is mostly derived from rhyolitic eruptions in the Taupo Volcanic Zone, and has probably been transported northwards by the ancestral Waikato River which once flowed down the Hauraki Plains and Firth of Thames and into the sea off Little Barrier Island, when the sea level was lower (pre-12,000 years ago). Tennyson and Taylor (1999) recorded that greater than two cables [= 370 m] of sand was removed from the seabed off Te Haupa by dredging in 1978.

Archaeological sites and observations on the island were discussed by Tennyson and Taylor (1999) and included: midden material, sub-fossil animal bones, apparent earthworks and oven stones. In 2014, midden shell was common, eroding out in several areas of the island, and included: pipi, cockle and queen scallop shells. The absence of any free water on the island would have limited any human occupation.

Vegetation

Forest

The diversity of woody species is rather poor – which is a reflection that the island is still recovering from being burnt in 1945, that it lacks any free water, and that some species are struggling to (re-) establish. The dominant current canopy is pohutukawa which is quite youthful (Tennyson & Taylor 1999). The largest trees are near the centre of the island (saddle area), with perhaps the tree with the largest trunk being the one which has fallen out on to the western beach by the saddle (Fig. 7). Pohutukawa by an illegal 'campsite' (saddle) area were up to c.15 m tall, were quite spaced out, all branched near their bases, and had (1–)3–5(–10) branches each of c.16 cm diameter (Fig. 8). This low spreading branching indicates that the trees established in the open in a non-dense fashion. However, on the higher forested slopes to the north the pohutukawa were generally single-trunked, erect and quite dense with variable branch diameters c.5–16 cm, and trees to 10 m tall. This stand is actively thinning with the skinnier stems dead to dying. The understorey of this general area is dominated by coastal karamu (*Coprosma macrocarpa*) 3–4 m tall, with occasional shrubs of karo (*Pittosporum crassifolium*) to 5 m, hangehange (*Geniostoma ligustrifolium*), *Coprosma rhamnoides*

Fig. 4. Te Haupa from the NNW with its dominant pohutukawa canopy. Photo: from Big Bay on Mahurangi Peninsula, EKC, 12 Mar 2014.

Fig. 5. Eroding sandstone / mudstone cliffs along the eastern coast of Te Haupa. Photo: looking south, EKC, 15 Feb 2014.

Fig. 6. Open sandy slope towards the southern end of the western beach, Te Haupa. Main vegetation clumps of *Ficinia nodosa* and annuals, particularly grasses. *Pimelea urvilleana* on low cliff (arrow) (see Fig. 10). Photo: EKC, 12 Mar 2014.

Fig. 7. A multi-trunked pohutukawa, c.1m diam. at the top of the fallen trunk. Possibly the thickest-trunked pohutukawa on Te Haupa, escaping the 1945 fire by being fallen on the beach? Photo: middle of western beach, EKC, 12 Mar 2014.

Fig. 8. By the illegal campsite area the pohutukawa were up to c.15 m tall, not densely crowded, and all branched near their bases. Photo: EK, 12 Mar 2014.

Fig. 9. Actively eroding sandstone cliffs after recent severe winter storm(s) on the eastern side, near the southern end of the island. Photo: EKC, 24 Sep 2014.

Fig. 10. A healthy hanging mat of *Pimelea urvilleana* on 15 Feb 2014, SW coast (cf. Fig. 11) with inset of flowers and white fruit. Photo: EKC; inset Philip Moll, both 15 Feb 2014.

Fig. 11. Recent storm damage: the nearly dead mat of the same *Pimelea* as in Fig. 10. Photo: EKC, 24 Sep 2014.

Fig. 12. Storm damage: a leafless (many dead?) understory of coastal karamu from near shore line to virtually the ridge top, near the SW end of the island. Storm damage most pronounce at this locality. Note – none of the green leaves belong to karamu. Photo: EKC, 24 Sep 2014.

Fig. 13. Numerous spur valerian seedlings which germinated during the winter – these should be well established before the island dries out in the late summer-autumn. Inset: flowers. Photo: NW coastal slope, EKC, 24 Sep 2014; inset Philip Moll, 15 Feb 2014.

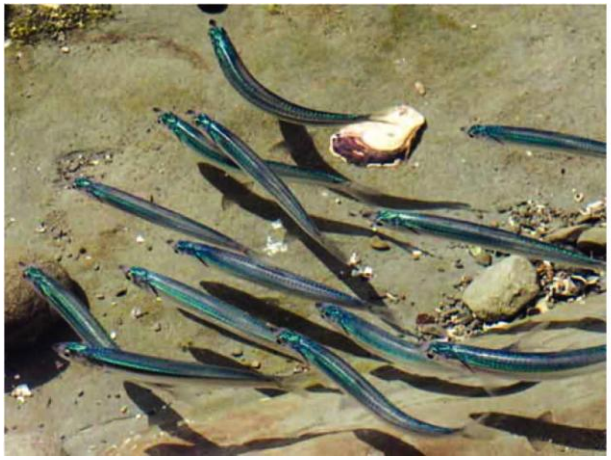

Fig. 14. Anchovies (*Engraulis australis*), 40-60 mm long, were common in the intertidal rock pools during the Bot Soc visit. Perhaps chased in by larger fish and the numerous seabirds? Photo: Philip Moll, 15 Feb 2014.

Fig. 15. Under a pohutukawa canopy houpara has really taken off on the island over the last two decades. Photo: near south end of west beach, EKC, 12 Mar 2014.

and occasional small totara (*Podocarpus totara*). Ground cover included: *Blechnum parrisiae*, *Polystichum* spp., *Microsorum pustulatum*, young houpara (*Pseudopanax lessonii*), *Dianella latissima* and *Carex* spp. (*C. breviculmis, C. flagellifera*). *Ficinia nodosa*, *Muehlenbeckia complexa* and flax (*Phormium tenax*) are also present here but are being actively shaded out.

Situated c.100 m south of the northern tip is a forested hollow, "The Grotto", which is a unique area on the island. It is c.40 m long x 20 m across and 5–7 m deep with steep sides and outcrops of Waitemata Formation exposed on the upper slopes. The canopy on The Grotto's outer margins is dominated by pohutukawa and karo, but the hollow itself is dominated by c. ten trees of mahoe (*Melicytus ramiflorus*) to 9 m tall with trunks to 16 cm diameter. The understorey is dominated by coastal karamu and the ground with *Blechnum parrisiae* and other fern species. With no apparent outflow, this area must be the dampest on the island, as shown by tree ferns (eight living ponga (*Cyathea dealbata*) and three young nikau (*Rhopalostylis sapida*), and it is the island stronghold for cabbage trees (*Cordyline australis*) and mahoe.

The southern plateau forest canopy is dominated by pohutukawa, 1–2 stemmed, erect and quite dense to c.10 m tall. There is a subcanopy to c.6 m tall dominated by coastal karamu, occasional karo and less commonly mahoe, houpara and at least one kohekohe (*Dysoxylum spectabile*). The lower shrub layer and ground cover contains *Coprosma rhamnoides*, houpara saplings, totara (2–3 m tall), hangehange (2–4 m), *Carmichaelia australis* (to 3 m), *Myrsine australis, Asplenium oblongifolium, Blechnum parrisiae, B. filiforme* (local), *Oplismenus hirtellus*, locally patches of *Gahnia lacera*, and leaf litter covers most of the ground. Near the cliff-tops karo becomes abundant, the houpara is taller, and they often occur here with bracken (*Pteridium esculentum*) and gorse (*Ulex europaeus*).

There were signs of severe storm damage when EKC visited the island on 24 Sep and 4 Nov 2014: recent erosion all around the coast (Fig. 9); totara foliage severely burnt by salt spray (many >60% burnt); a large healthy *Pimelea urvilleana*, seen hanging down the bank on the SW coast during the two earlier visits, was now virtually dead (Figs. 10, 11); the kanuka (*Kunzea robusta*) near the top of the cliffs had lost much of its foliage; the thin-leaved coastal karamu in places had no leaves at all, and many appeared to be dead (Fig. 12) (the ones up on the S plateau seemed unaffected); and gorse on the exposed slopes looked dead. However, the adjacent karo, houpara, flax, *Ficinia nodosa* and pohutukawa showed no marked damage from the winter storm(s).

Coastal cliffs

These are actively eroding and predominantly bare on the eastern side (Figs. 5, 9). Pohutukawa, karo and gorse is present in places, but much of the cliff vegetation is of non-woody plants on the shallow ledges: mainly exotic grasses, herbaceous weeds, an occasional mat of *Pimelea urvilleana*, and clumps of mosses.

Sand and foot of coastal cliffs

The sandy vegetated slopes behind the western beach lie on top of the Waitemata Formation; some of this sandy area is still open with low vegetation (see Fig. 6): mainly *Ficinia nodosa*, exotic grasses, wild gladiolus (*Gladiolus undulatus*) and clumps of moss. The western sandy beach seemed to be scoured out at the back, ending in a c.1 m (or taller) bank. There is no continuum of the beach sand to the sand covering the slopes behind. Dune plants like *Calystegia soldanella, Atriplex prostrata, Cakile maritima* were generally not on the back of the beach, but locally on the steep bank behind. At least six previous records you'd expect to occur in this habitat were not seen in 2014: *Agave americana, Apium prostratum, Bromus arenarius, Cyperus ustulatus, Lobelia anceps, Raphanus raphanistrum,* and *Symphyotrichum subulatum*. This indicates that this habitat is subject to change (storms, wave surges, eroding cliffs) and consequently so is its flora.

Flora

Tennyson and Taylor (1999) listed 122 [121 accepted here] wild vascular plants (59% native), five lichens and 11 bryophytes for the island. Jessica Beever surveyed the mosses during the ABS trip and two follow up trips – they are recorded separately (Beever 2014). Three additional liverworts were added to the list: a *Fossombronia* species (AK 354554); *Chiloscyphus subporosus* s.str. (AK 355270); ?*C. calcareus* (AK 355271); and small clumps of the previously recorded thalloid liverwort, *Lunularia cruciata*, were widespread on open slopes and upper slopes in forest. All vascular plants seen on the island in 2014 appeared to have been wild.

There was no evidence of the previously reported two planted species, *Aeonium haworthii* and *Kalanchoe* cv., which were removed in 1997. However, an old planter bag with the base of a dead plant in The Grotto looked suspiciously like a last season's marijuana (*Cannabis sativa*) planting. Marijuana was recorded planted on the island in the 1990s (Tennyson & Taylor 1999). The vascular plant surveys in 2014 added 35 new species (46% native): 5 ferns (100% native); 11 dicots (36% native); and 19 monocots (37% native) – see Appendix. This brings the combined recorded wild vascular flora to 156 species (55% native). The total number recorded in 2014 was 129 species, which was eight more than the previous survey. More than half the new additions were monocots (54%) which is higher than would be expected in a normal ratio of dicots to monocots. Some of these won't be new to the island but they would have been missed in the previous surveys that were mainly carried out in the winter when the grasses (40% of the additions) would not have been flowering. Unrecorded during 2014 were 27 species (56% native): 1 fern (native); 23 dicots (52% native); and 3 monocots (67% native).

Weeds

Spur valerian (*Centranthus ruber*), cotoneaster (*Cotoneaster glaucophyllus*), climbing asparagus (*Asparagus scandens*), pampas grass (*Cortaderia selloana*) and purple pampas grass (*C. jubata*) are environmental weeds that are likely to increase their abundance on the island and therefore should be controlled. Only the pampas grass was recorded in the previous survey. These weed species all exist on the adjacent mainland (pers. obs.) and have presumably reached the island by wind-blown seed or fleshy fruit being ingested by frugivorous birds. The establishment and rapid spread of spur valerian on the island in <17 years is concerning. It has wind-blown seed and reproduces rapidly on these dry, open sites (Fig. 13) and will supress native species establishing. A wild flowering Australian ngaio (*Myoporum insulare*) was at the foot of the cliffs on the SW coast – perhaps slid down from the eroding slope above? Unfortunately Australian ngaio is still mistakenly planted for the native ngaio (*M. laetum*). There was no evidence of any weed control on the island.

Fauna (passively recorded)

Lizards

None seen in 2014 and they were unrecorded for the island by Tennyson and Taylor (1999).

Birds

Birds seen during our ABS visit: hundreds of fluttering shearwaters were actively feeding in rafts close to the reef edge – possibly chasing the numerous anchovies that we observed (Fig. 14); grey-faced petrel – a few small groups of burrows seen along the west and east coast cliff-tops were assumed to be made by this species; blue penguin – many seen in the calm sea from the boat, a couple of largish burrows on the island were assumed to be this species; Australasian gannet – several diving close to the reef edge; pied shag – a few single birds roosting and fishing by the outer reef edge; Australasian harrier – single bird gliding over island when we arrived; variable oystercatcher – at least 3 pairs around the island with 1–2 semi-adult chicks, these chicks may have been raised elsewhere and later flown to the island (Matt Williams, pers. comm.); NZ dotterel – a single group of 3 adult(?) birds on E side reef; black-backed gull – a few adult birds on the intertidal reef, 1 pair with a half-grown chick; red-billed gull – a few adults on the intertidal reef; white-fronted tern – flocks of >40 birds fishing near the reef edge and resting on the outer reef; kingfisher – row of nest holes present on E cliff tops, no birds seen; and grey warbler was the only land bird seen or heard in the forest.

On 13 Mar 2014 forest birds were more obvious than during the ABS visit: silvereyes were quite common and feeding on the coastal karamu fruit; a blackbird was present in the N forest, and another heard in the S forest; grey warblers heard throughout; and a fantail was present in the S forest. A Caspian tern was resting on the reef at the S end of the western beach.

On 24 Sep 2014 forest birds were quite prevalent: grey warblers throughout; blackbirds frequent – old nest on S plateau; fantail – several; kingfisher – one on the E reef, and one hawking out on the reef from a low branch at N end of island; tui – 1 visiting flowering karo; goldfinch, small group; welcome swallows – locally common and noisy just above the bush. On the reef: a chaffinch (E side); NZ dotterel – 1 pair E side; variable oystercatchers – at least 4; pied shags – 2 on edge of reef at N end; gannets flying close; black-backed gull and red-billed gull – a few on edge of reef and flying past; white-fronted terns – small group flying past.

On 4 Nov 2014 forest birds were noisy and obvious: grey warblers; blackbirds; fantails; groups

of silvereyes; active noisy groups of goldfinches; welcome swallows occasional; morepork, 1 in The Grotto. On the beaches and reefs: black-backed gulls, 4 on main beach; red-billed gulls, 3 on main beach when we were eating our lunch; kingfishers, 2 near SW corner of reef; variable oystercatchers, 3 pairs, 1 pair had a nest with 3 eggs, S end of W beach; NZ dotterel, 2 pair – 1 pair had 2 small chicks (S end of main W beach), the other pair had 3 eggs (mid E beach); pied shag, 2 on reef edge S end, E & W side; heron (white-faced?) 1 on reef edge E side; gannets diving off the E reef.

The only additions to Tennyson's and Taylor's (1999) bird observations were three seabirds: fluttering shearwater, Australasian gannet and Caspian tern – only the latter was actually landed on the reef. (Note – they did not record birds only seen flying well offshore).

Mammals

After Norway rats were eradicated in 1989 mice were observed for the first time (Tennyson & Taylor 1999). The mice were eradicated in 2008 (MacKay et al. 2011, Nathan et al. 2013) making the island mammalian-free since that date.

Invertebrates

Dead shells of the common garden snail (*Cantareus aspersus*) were frequent and widespread; living animals were also seen. During the ABS visit Karl pointed out a native scale insect producing honey dew on karo trunks; and we also observed tiger beetles, a grass grub beetle and Asian paper wasps.

Seaweeds at Te Haupa Island

Mike Wilcox

During the ABS trip the outgoing tide revealed a broad sandstone platform surrounding the northern, eastern and south western parts of the island. There is no freshwater on the island, and no damp seeps at the base of cliffs, so high intertidal algae were absent. *Hormosira banksii* is by far the most prominent intertidal seaweed, with the flat rocks being otherwise rather bare save for the dominant sessile animals, the plicate barnacle (*Epopella plicata*) and the rock oyster (*Crassostrea glomerata*). Two blue-green algae (cyanobacteria) were very prominent and highly noteworthy. The dark, hair-like *Lyngbya majuscula* was abundant in the pools and runnels, smothering *Hormosira*, while the saccate, emerald green *Rivularia bullata* grew in rubbery colonies on the open rock. Filamentous brown algae were conspicuous in pools and puddles (mainly *Bachelotia antillarum*) and also epiphytically on *Hormosira* (mainly *Ectocarpus siliculosus*). The orange-coloured crust *Ralfsia verrucosa* and the convoluted *Leathesia marina*, and occasional stunted *Scytothamnus australis* were the only other brown algae present on the platforms of gritty sandstone. At the edge of the reef (and also in the deeper rock pools) was an assemblage of large brown seaweeds, the dominant ones in sequence down the shore being *Cystophora torulosa, Sargassum sinclairii, Carpophyllum plumosum, Carpophyllum maschalocarpum,* and *Ecklonia radiata*.

Green algae recorded were *Rhizoclonium riparium* (on *Hormosira* in pools), *Codium fragile* subsp. *fragile*, and *Microdictyon mutabile*. Save for a turf of *Corallina officinalis*, red algae were very poorly represented. *Capreolia implexa* was found locally at the shaded base on high tidal boulders, *Liagora harveyi* was locally present in runnels, *Jania verrucosa* fringed some of the low-tidal rock pools, and *Laurencia gracilis* grew abundantly in lower intertidal runnels at the southern end of the island.

There is a good sandy beach on the western side of the island, below which are healthy subtidal beds of eelgrass (*Zostera muelleri*).

In May 1985 a detailed survey was carried out on the marine environment around the island by a team from the University of Auckland's Leigh Marine Laboratory. This was in response to an application (subsequently declined) to set up mussel farms adjacent to the island (Battersill et al. 1985). The survey revealed extensive subtidal forests of brown algae – *Ecklonia radiata* and *Carpophyllum flexuosum* – down to 7 m on submerged reefs up to 100 m off the eastern coast. Beneath the brown algal canopy the only red alga reported was pink coralline paint (*Lithothamnion*). Other brown algae mentioned were *Sargassum sinclairii, Carpophyllum maschalocarpum*, and *Cystophora* spp. The only intertidal rock platform algae recorded were abundant *Corallina officinalis* and *Hormosira banksii*.

Discussion

Vascular flora comparisons: 2014 vs 1987–1997

The regeneration of the forest on the island is reflected by several of the light-demanding species being shaded out. These include: bracken, flax, *Ficinia nodosa* and gorse. Two native species that have really taken off since the previous survey are

totara and houpara (Fig. 15), particularly the latter (see Appendix). It is unusual for podocarps to be common on small Hauraki Gulf islands (Bellingham et al. 2010, pers. obs.) such as this one. Presumably it's taking advantage of the present depauperate nature of the shade-tolerant woody flora, although the severe wind-burn seen on the totara in September explains why it is never common on small exposed islands. Could the marked increase in houpara be related to the eradication of the rodents or is this just a coincident? Although 15 native species are newly recorded for the island, most are present only in low numbers and some of these may have been missed by the earlier survey. Some species which were previously recorded as present in low numbers are still present in low numbers, e.g. mamaku (*Cyathea medullaris*) – the island with its summer-autumn droughts would be marginal for this species.

Apparent vascular plant extinctions on the island

Tennyson & Taylor (1999) saw fewer than five individuals ("scarce") for 21 of the 27 records not seen in 2014. The remainder were "occasional" or "local". I was surprised not to see two of the previous "scarce" records: taupata (*Coprosma repens*) which should do well on the island, and the threatened native grass *Bromus arenaris* which was collected on the island on a 'sand flat' in October 1988 and should have been evident (flowering) during the September and November 2014 visits.

These overall observations and comparisons with the earlier survey clearly demonstrate how dynamic these island floras are, with new species apparently establishing (including several aggressive weeds), species apparently being lost, and the island being vulnerable to storm events.

Bird movements

Forest bird movement must be low between the island and the mainland because the coastal karamu was 'dripping' with ripe fruit during the ABS February visit (Fig. 16) and most of the fruit were still present nearly a month later. Presumably the frugivorous bird population resident on the island is too low to have much impact, and the fruit present on the island is too infrequent to support a larger resident bird fauna or to entice regular visitors from the mainland. For example, a flock of starlings, which Cone (1943) recorded cleaning up the fruit on her taupata bush in a single hit in her Wellington garden, does not appear to occur on Te Haupa. Matt Williams (pers. comm.) comments that coastal karamu fruit at Otarawao Bay on the Mahurangi mainland lasts at least a month on the plants. Perhaps frugivorous bird numbers are low in the general area.

Comparisons – Adjacent islands – and Missing plants

Several other nearby islands have been surveyed for their vascular floras: Pudding Island (Cameron & Taylor 1991); Maunganui (Casnell) Island (de Lange & Crowcroft 1996); Motuora Island (Heiss-Dunlop & Fillery 2006, Cameron et al. 2011); Moturekareka group (Tennyson et al. 1997, Cameron 1999). However, because of their different sizes, varying degrees of exposure, and histories, direct comparisons with Te Haupa would be rather pointless, except for the closest much smaller (0.1 ha) Pudding Island 1.4 km distant (Fig. 1), SE of Otarawao Bay. This island would be more protected from the prevailing southwest wind. There was a single native recorded here that was apparently absent from Te Haupa: tutu (*Coriaria arborea*) ("single plant"). Tutu is an unusual occurrence on any Hauraki Gulf Island less than 100 ha (pers. obs.) – Otata Island (15 ha) of The Noises being another exception. On Te Haupa, some plant species that you would expect to find on a semi-exposed island of this size, in the Hauraki Gulf, are missing (pers. obs.). These would include: kawakawa (*Piper excelsum*), wharangi (*Melicope ternata*), ngaio, *Astelia banksii,* rengarenga (*Arthropodium cirratum*) and *Leucopogon fraseri*. Perhaps the abundance of garden snails prohibits the establishment of rengarenga on the island. The apparent loss of taupata, inkweed (*Phytolacca octandra*) and the two nightshades (*Solanum nigrum* and *S. nodiflorum*) is a mystery. These species are usually ubiquitous on the Hauraki Gulf islands.

Fig. 16. The dominant understory shrub, coastal karamu, with copious ripe fruit. Photo: near middle of the island, EKC, 15 Feb 2014.

Threats

The biggest treats to Te Haupa's natural values are aggressive weeds, exotic mammals re-invading (though it's beyond the normal swimming range of rodents), fire and visitors with dogs. Dogs threaten the established burrowing seabirds (grey-faced petrels and blue penguins), and probably would have an impact on oystercatchers and dotterel nesting on the island.

ASB field trip participants on 15 Feb 2014

Karl Beaufort, Jessica Beever, Peter Bellingham (visiting from Christchurch), Jan Butcher, Ewen Cameron (leader), Janeen Collings, Claire de Luen, Frances Duff, Alan Foubister, Sharen Graham, Petr Jansta (entomologist from the Czech Republic), Eliane Lagnaz, David Lourie, Jamie MacKay (biologist involved with the mouse eradication from Te Haupa), Carol & Garry McSweeney, John Millet, Philip Moll, Marian O'Brien, Harry Pakenham (grandson of Maureen), Dhahara Ranatunga, Juliet Richmond, Joshua Salter, Vijay Soma, Claire Stevens, Cheryl Taylor, Val Tomlinson, Alison Wesley, Mike Wilcox, Maureen Young.

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Appendix. Vascular plant list for Te Haupa (Saddle) Island for the two survey periods.

Key: a = abundant**;** c = common**;** l = local**;** o = occasional**;** s = scarce (<5 individuals seen)**;** P = planted**;** T&T = Tennyson & Taylor (1999); * = naturalised species; [ ] = most likely identification when different from original by Tennyson & Taylor (1999).

Species	1987-1997	2014	Comments (all related to the 2014 visits unless stated otherwise) and herbarium vouchers
Ferns (18 + 0) (= native + naturalised totals)			
Adiantum cunninghamii	lc	o	maidenhair. Forest on S plateau
Adiantum hispidulum		s	rosy maidenhair. Single plant in N forest
Asplenium flaccidum		s	hanging spleenwort. Several as low epiphytes in N forest
Asplenium haurakiense	s	s	Semi-open sites
Asplenium oblongifolium	o	o-lc	shining spleenwort. Throughout in shaded localities, some individuals quite luxuriant, especially on S plateau
Asplenium polyodon		s	sickle spleenwort. Single plant on pohutukawa base in N forest
Blechnum filiforme	o	l	thread fern. Forest on south end of S plateau, single terrestrial patch c.8 x 10m, a few climbing to 1.5m, some climbing stems have died back
Blechnum parrisiae	la	la	doodia. In places forming a nearly pure ground cover under rather open pohutukawa canopy. Previously recorded as *Doodia australis*
Cyathea dealbata	s	l	ponga. Eight living plants in or near forested Grotto, three with trunks (1.5, 0.5, 0.5m tall), and 2 recent dead ones (1 & 3m tall trunks); single living trunkless one on S plateau with fronds 1.5m long
Cyathea medullaris	s	s	mamaku. Only 2 old dead small trunks (0.5m) in forest: 1 in The Grotto; 1 near S end of island
Pellaea rotundifolia	s		
Microsorum pustulatum	la	la	hound's tongue. Groundcover throughout, fronds spread out on rhizome
Polystichum neozelandicum	[o]	o	shield fern. Forest, some plants quite large. Previously recorded as *P. richardii*? AK 349527
Polystichum wawranum		o	shield fern. Forest. AK 349525
Psilotum nudum		s	Single branching plant, base of pohutukawa, in plateau forest near N end. AK 348744
Pteridium esculentum	c	lc	bracken. Scattered patches, forest margins, much of it being shaded out
Pteris tremula	l	o	shaking brake. Throughout in forest, most plants with few fronds in February
Pyrrosia eleagnifolia	c	a	leather fern. In places as forest groundcover and cliff tops; also as a low epiphyte mainly on pohutukawa

Gymnosperms (1 + 0)			
Podocarpus totara	o	lc	totara. In forest throughout, tallest 6m, most <2m tall, especially common in N forest; some displaying salt-burnt foliage in Sep 2014
Dicotyledons (43 + 44) (plantings excluded from totals)			
Aeonium haworthii *	P		[1 small patch removed in 1997]
Anagallis arvensis var. *arvensis* *	o	o-lc	scarlet pimpernel. Open slopes throughout, most as dried up plants in February
Anagallis arvensis var. *caerulea* *		lc	blue pimpernel. Open slopes mainly towards N end of island on both coasts. AK 355352
Apium prostratum	s		NZ celery
Atriplex prostrata *	o	o-lc	orache. Scattered throughout along the strandline and lower coastal slopes
Avicennia marina		o	mangrove. At least 6 small plants, scattered along upper intertidal reef
Brachyglottis repanda	s		Rangiora. Single dead leaf near saddle area on 4 Nov 2014, 2m asl. Origin?
Cakile maritima *	lc	o	sea rocket. Scattered along the strandline and lower coastal slopes
Calystegia soldanella	s	o	shore bindweed. Most colonies on the lower sandy coastal slopes, W and E sides of the island to 4m asl
Cannabis sativa *	P	P	marijuana. Single old planter bag by The Grotto in Feb 2014 with base of dead plant - suspected to be this species
Carmichaelia australis	o	o	North Island broom. Many as small plants throughout the forest areas; to 3m tall in S forest. AK 233754
Centaurium erythraea *	o	o	centaury. Semi-open sites
Centranthus ruber *		lc	spur valerian. Patches at N tip of island on both E & W steep coastal slopes. The E coast colony scattered along that coast for c.200m; and there is an isolated patch on the W coast c.100m from the N tip (Fig. 13). Full flower in Nov 2014. AK 348649
Cerastium glomeratum *	o	o	annual mouse-ear chickweed. Open sites near centre of island
Chrysanthemoides monilifera *	s	s	bone-seed. Three plants seen (all <60cm), N point (flowering in Sept), mid-E side (uprooted), W side near S end
Cirsium vulgare *	o	o	Scotch thistle. Semi-open sites
Clematis paniculata	s	o	clematis. Small vines in forest. AK 233753
Conyza sumatrensis *	c	o	fleabane. Open sites throughout
Coprosma areolata	s	l	thin-leaved coprosma. A few plants in The Grotto, up to 4m tall, and a few smaller plants in S plateau forest
Coprosma macrocarpa	a	a	coastal karamu. Main understorey plant, frequently forming a continuous sub-canopy. In February female plants dripping with ripe orange fruit (Fig. 16); by March fruit still present but had decreased
Coprosma macrocarpa × *C. propinqua*	s		hybrid coprosma
Coprosma macrocarpa × *C. robusta*	c	l	hybrid coprosma. Present on lower slopes of W coast

Coprosma repens	s		taupata
Coprosma rhamnoides	o	o	In all forest areas usually as small plants to 0.5m tall
Coprosma robusta	s	l	karamu. Present on lower slopes of W coast
Cotoneaster glaucophyllus *		s	cotoneaster. Two seedlings near centre of island, both uprooted. AK 348748
Crepis capillaris *	o	o	hawksbeard. Widespread, partially open areas. AK 233750
Dichondra repens	s	s	Mercury Bay weed. By The Grotto in forest
Disphyma australe	c	o	NZ iceplant. Small patches, coastal slopes E side only
Dodonaea viscosa		s	akeake. Single shrub 0.8m tall, N tip of island on E side, below open plateau margin. AK 349526
Dysoxylum spectabile	s	l	kohekohe. Three saplings: to 1.2m tall at N end of The Grotto. At least 1 tree and 3 saplings: c.6m, 1m, 80cm & 40cm tall in S plateau forest
Entelea arborescens	s		whau
Eriobotrya japonica *	s		loquat [1 plant during 1987-1988]
Euphorbia peplus *	o	o-lc	milkweed. Open coastal slopes, especially along W coast
Fumaria muralis *	s		scrambling fumitory [Single plant in the open in 1997]. AK 233751
Galium aparine *	o		cleavers [above western beach during 1987-1997]
Geniostoma ligustrifolium	o	o	hangehange. Understorey shrub throughout, largest 4m tall on edge of S plateau forest
Geranium gardneri *	[o]	l	Open W slopes. Previously recorded as *G. solanderi*
Haloragis erecta	o		toatoa
Hebe stricta var. *stricta*	o	s	koromiko. Single flowering plant in forest just S of The Grotto. Flowering spikes short (<4cm). AK 233749 & 348751
Helminthotheca echioides *	o	o	oxtongue. Open areas, mainly along W coast
Hypochaeris radicata *	s	o	catsear. Rather open slopes
Kalanchoe (cultivar) *	P		[2 plants removed in 1997]
Kunzea robusta		s	kanuka. Two plants, c.2.5m tall on SW edge of S plateau forest; 1 other near centre of island (Maureen Young pers. comm.)
Leontodon saxatilis *	c	c	hawkbit. Widespread on open areas. AK 348648 [previously as *L. taraxacoides*]
Leucopogon fasciculatus	c	o	mingimingi. Widespread, but nowhere common
Ligustrum sinense *	s	s	Chinese privet. Single twiggy plant, almost dead (very few leaves), N end, <2m tall in Feb 2014

Linum bienne *	o	o-lc	Australian flax. On dry, open coastal slopes, most plants completely dried up (Febr.). AK 349401
Linum trigynum *		lc	yellow flax. On dry, open coastal slopes, on NW coast, all plants completely dried up (Febr.). AK 349505
Litsea calicaris	s	s	mangeao. One 1.5m tall at N end, upper-half dead [was 3m in 1997]
Lobelia anceps	s		shore lobelia
Lotus suaveolens *	a	lc	lotus. Open areas throughout
Medicago nigra *	c	lc	bur medick. Open areas throughout
Melicytus ramiflorus	o	o	mahoe. Tallest plants 9m tall in The Grotto and S plateau
Melilotus indicus *	lc	la	King Island melilot. In all open coastal sites
Metrosideros excelsa	a	a	pohutukawa. Most are youthful looking trees, <20cm dbh, and 10–15(–18)m tall; a few larger trees on coast on W side
Muehlenbeckia complexa	la	lc	pohuehue. Open sites, especially in sandy areas, locally forming tangles
Myoporum insulare *		s	Australian ngaio. Single plant 2.2m tall, not planted, W side at foot of coastal cliffs, S end – possibly eroded out from bank above. AK 348750
Myrsine australis	s	o	mapou. Small plants in forest, scattered throughout
Olearia furfuracea		s	akepiro. Single plant 1.6m tall, N plateau forest on W side of The Grotto
Orobanche minor *	o	lc	broomrape. Throughout, quite dense in places; even in forest where there was no obvious host. AK 355351
Oxalis rubens	s	l	shore oxalis. Sandy open areas on W side, especially in sandy areas
Parsonsia heterophylla	s	s	NZ jasmine. A few juvenile vines in forest in The Grotto and S plateau presumed to be this species
Passiflora sp.*	s		passionfruit
Phytolacca octandra *	o		inkweed
Pimelea urvilleana	lc	o	As small mats (<1m across), often pendant on bare sandstone, right around the island mainly 2–5m asl (Fig. 10). AK 346746, 355371
Pittosporum crassifolium	a	a	karo. Especially on outer edge of pohutukawa forest and scattered as a small understorey tree; in full flower in Sep 2014
Pittosporum tenuifolium	s		kohuhu
Plantago lanceolata *	c	c	narrow-leaved plantain. Open sites throughout
Polycarpon tetraphyllum *	o	o-lc	allseed. Open sites
Pseudopanax arboreus	s	s	whauwhaupaku. Single tree on S plateau
Pseudopanax crassifolius	s		horoeka
Pseudopanax lessonii	s	lc	houpara. Mainly as saplings, especially on the forest margins (Fig. 15). Greatly expanded since T&T

Ranunculus reflexus	s		hairy buttercup
Raphanus raphanistrum *	s		sea radish
Rumex sp. *	s		dock
Sagina apetala *		l	Small numbers on open E slopes near centre of island on stable ground. AK 354531
Senecio bipinnatisectus *	o		Australian fireweed
Senecio glomeratus	s		fireweed
Senecio hispidulus	s	l	fireweed. Partially open sites, especially S end ridgetop. AK 233752
Senecio lautus	o	o	shore groundsel. Open coastal sites
Solanum nigrum *	o		black nightshade
Solanum nodiflorum	s		small-flowered nightshade
Sonchus oleraceus *	o	c	puha. Open sites throughout
Symphyotrichum subulatum *	s		sea aster [previously as *Aster subulata*]
Trifolium dubium *	o		suckling clover
Ulex europaeus *	c	c	gorse. Open slopes, often being shaded out
Vicia hirsuta *	[c]	lc	hairy vetch. Open W-facing slopes, especially on sandy soils. "Small-leafed sp." recorded by T&T? AK 355354
Vicia sativa *	c	o	vetch. Grassy open areas by middle of the island
Vicia tetrasperma *		o	four-seeded vetch. Mainly along open ridge-tops;
Monocotyledons (24 + 26)			
Agave americana *	s		century plant
Aira praecox *	l	l	early hair grass. E cliff-top near centre of island on stable ground. AK 278590, 355372
Anthosachne multiflora		l	blue wheatgrass. Coastal slopes on SW side
Asparagus scandens *		l	climbing asparagus. Small patches, some fruiting, in and near The Grotto
Anthoxanthum odoratum *	c	o	sweet vernal. Open sites throughout
Austrostipa stipoides	s	l	needle tussock. >15 plants on sandstone ledges on steep slope over c.50m on W side near S point
Avena barbata *		o	slender oat. Open slopes throughout. AK 355353

Briza minor *		lc	shivery grass. Open cliff tops, grassy slopes and ledges throughout
Bromus arenarius	s		[In the open on sand flat amongst exotic grasses in Oct 1988]. AK 277556
Bromus diandrus *	c	lc	ripgut brome. Open slopes throughout. AK 355357
Bromus hordeaceus *	o	c	soft brome. Grassy slopes and ledges throughout
Bromus willdenowii *	o	o	pairie grass. Open sites, W side
Carex breviculmis	o	o	grassland sedge. Throughout in partial shade
Carex flagellifera	o	o	Glen Murray tussock. Forest edge and steep slopes in forest
Carex longebrachiata *		s	Australian sedge. Single large tussock, S plateau forest. AK 348747
Carex testacea		l	speckled sedge. Partially open slope mid-W side. AK 348635
Catapodium rigidum *		lc	hard grass. Widespread, on most open slopes where there is soil or sand. AK 354529
Collospermum hastatum		s	kahakaha. Single small low epiphyte near S end
Cordyline australis	s[o]	o	cabbage tree. Approx. 10 plants, most with narrow leaves with trunks <50cm tall, in or near The Grotto, and also at least 5 on S plateau. Only 2 reached the canopy: a 10m-tall 18cm-diam. trunk in The Grotto, and a 9m-tall 7cm-diam. trunk on S plateau. T&T also recorded "*Cordyline pumilio* (*C.* ?*pumilio* × *C. australis*)" - we saw similar plants but felt that they were more likely to be just juvenile *C. australis*.
Cortaderia jubata *		lc	purple pampas grass. Quite well established on steep coastal slopes throughout. AK 349506
Cortaderia selloana *	s	o	pampas grass. Only clumps on W side identified as this species, but probably more widespread on island
Cyperus ustulatus	s		coastal cutty grass
Dactylis glomerata *	a	c	cocksfoot. Open sites throughout
Dianella latissima	[s]	o	turutu. Small tussocks in forest. Recorded as *D. nigra* by T&T
Dichelachne crinita		o	plume grass. Cliff tops and open ledges
Ficinia nodosa	a	lc	knobby sedge. Open coastal slopes, some being shaded out by the expanding forest
Gahnia lacera	o	lc	bamboo sedge. Some large clumps, especially in S plateau forest and younger plants on the W slopes. AK 349722
Gladiolus undulatus *	lc	la	wild gladiolus. Frequent around splash zone on W side; abundant in sandy areas towards the centre of island from coast to ridge-top
Lachnagrostis billardierei	s	o-lc	sand wind grass. Lower coastal fringe and along cliff tops
Lachnagrostis littoralis	[c]	l	NZ wind grass. On E coast amongst *Senecio lautus*. Starting to flower on 4 Nov 20114. Previously recorded as *L. filiformis*? AK 355358
Lagurus ovatus *	lc	lc	hare's-tail. Open coastal slopes, especially on the sand on the W side

Lolium rigidum *		o	annual ryegrass. Open ledges along W side. AK 348742
Microlaena stipoides	c	o	microlaena. In forest throughout, usually not sward-forming
Oplismenus hirtellus	la	o	basketgrass. Small patches in forest
Parapholis incurva *		l	sickle grass. On bare soil, 1m asl, E coast near saddle area; plants young (Nov 2014) possibly more widespread
Paspalum dilatatum *		lc	paspalum. Open ledges both sides of island
Paspalum vaginatum *		s	saltwater paspalum. Single narrow patch 9m long at foot of bank, back of W coast beach. AK 348749
Phormium tenax	c	o	flax. Small scattered plants throughout the island, many in shaded localities and these ones failed to flower
Poa anceps	o	o	coastal poa. Coastal flanks and forest gaps. AK 348743
Poa annua *		l	annual poa. Small patch on open E cliff-top near centre of island on stable ground. AK 354530
Poa pusilla	o	lc	Margin of S plateau forest and W coastal slopes; plants very fine. AK 277234
Rhopalostylis sapida	s	s	nikau. In forest, 4 trunkless plants with fronds to 0.5, 1.0 and 1.6m long (all in The Grotto); and 1 in S plateau with 0.5m fronds
Rytidosperma caespitosum *		lc	danthonia. On open grassy ledges. AK 348745
Rytidosperma racemosum *	[c]	c	danthonia. Throughout in open sites. Previously as *R.* sp. by T&T?
Rytidosperma unarede		lc	danthonia. On open grassy ledges and cliff tops
Schedonorus arundinaceus *	o	lc	tall fescue. Especially at foot of cliffs along the E side; 1 rather tatty specimen may have been ×*S. holmbergii*
Sporobolus africanus *	c	c	ratstail. Throughout in open sites
Trisetum arduanum		l	E coast, S end; starting to flower, Nov 2014; may be more obvious in summer. AK 355355
Vulpia bromoides *	o	o	vulpia hair grass. Open coastal slopes. AK 355359
Zostera muelleri		lc	eelgrass. Mainly sub-tidal W side