Early colonisation of slips on Hinewai Reserve, Banks Peninsula

Hugh Wilson

Hinewai Reserve, 632 Long Bay Road, RD3 Akaroa 7583

Hinewai is a nature reserve in the southeast corner of Banks Peninsula, "owned" and "managed"[1] by the Maurice White Native Forest Trust for the protection and restoration of native vegetation and wildlife. Initiated in 1987 with the "purchase" of 109 hectares, the project now embraces more than 1,350 hectares, ranging from the subalpine summit of Taraterehu / Stony Bay Peak (806 m) down to the sea at Ōpātuti / Stony Bay.

Banks Peninsula was once forested from side to side and from top to bottom, but was comprehensively deforested by two tsunamis of human settlement, first the Polynesians, arriving some 800 years ago, then the Europeans, colonising Aotearoa from some 250 years ago.

Before this, land that is now Hinewai was almost entirely clothed in old-growth forest, except for a few vertical rock faces and, temporarily, a few surfaces bared by occasional landslides or by rare fires, sparked by lightning.

When the English ship *Endeavour* sailed close to Hinewai in February 1770, both Captain James Cook and botanist Joseph Banks described the landscape: the valleys were heavily wooded, but the headlands, ridges and summits were bare. The cover on this "bare" land would have been tussock grasses, shrubland and bracken fern resulting from Māori burning, and some sparse vegetation on rock outcrops. So far as I can judge, perhaps 7 or 8 percent of what is now Hinewai was unforested at this time.

The following 150 years saw most of this forest vanish, nearly all of it burned, much on purpose, some by accident. The Pākehā colonists were mostly farmers. What they wanted was grassland for their cattle and sheep. Hinewai is steep marginal hill-country however, and maintenance of pasture was by no means easy. Native bracken and kānuka recolonised the open ground, initiating a strong trend back to forest. These natives were soon joined by the exotic leguminous shrubs gorse and broom, intentionally introduced by the Pākehā for fencing (and fodder).

Hinewai Reserve

When our Trust bought the first 109 hectares in 1987, the 1,350 farmed hectares that would become Hinewai supported about 30% native forest cover (Wilson 1994). The 4% of surviving old-growth forest had been augmented by regenerating native trees, especially in the steeper gullies and along the main streams. Nearly 70% was pasture and ever-encroaching gorse, and about 1% was exotic *Pinus radiata* plantation.

Our plan was to reduce as much as possible those human-caused factors (herbivorous mammals, hugely increased frequency of fire, herbicides, etc.) that slowed down this relentless trend back to trees. The strategy was to be natural regeneration under a policy of minimum interference management. So we removed farm stock and feral goats, hammered the possum population to low levels, targeted a handful of exotic "weeds" we judged to be seriously deleterious to native regeneration, and tried to pre-empt wildfires.

[1] To me, the notion of "owning" land as if it were a commodity, is an extreme example of ridiculous human hubris and self-importance, hence the inverted commas.

Thirty-five years later much of Hinewai is reforested. There has indeed been a vigorous trend to tree cover, though not a smooth one, rather one punctuated and perturbed by what seem at the time like setbacks – droughts, floods, landslides, heavy snowfalls, unusual winter cold, earthquakes, misguided Regional Council weed regulations, and fire. To a botanist, of course, the response of the vegetation to these blips is fascinating. After a few decades of watching and recording, one tends to drop any pretence of a smooth progression back to mature stable forest, and to think instead that vegetation might usually be, more or less, in a state of adjustment to the latest disturbance, great or small. Indeed, it becomes obvious that many Banks Peninsula plant species owe their continuing existence to such dynamic environments.

Landslides

A severe weather event in mid-December 2021 focussed our minds on one of these perturbations: landslides. By morning on the 17th of December the 4-day rainfall total at Hinewai weather station was 304.2 mm, of which at least 200 mm fell on one prodigiously wet day on the 15th. This triggered unexpectedly huge landslides that carried earth, rocks and trees into what were until then canopied stream courses, gouging out wide swathes many kilometres long and 50 or more metres wide (Fig. 1 below and Fig. 2, p. 18), disgorging across valley flats and out to sea, cutting roads, tracks, power and phones, sweeping away mature trees, bridges and small buildings, threatening homes, and obliterating fences. The mayhem was restricted to the extreme eastern fringe

Figure 1. Hinewai Reserve, looking northeast from Waterfalls Track in late December 2021. The slip in the foreground is 90 metres across and shaped like a trident that formed when three separate slips merged. It is edged with kānuka and other low forest trees. Multiple slips are evident on the opposing hills. Photo by Paul Newport.

of Banks Peninsula, with Hinewai right in the middle. Townsfolk in nearby Akaroa, only a few kilometres further west, were unaware of anything amiss.

Figure 2. The multiple-pronged landslide pictured in Figure 1 (nick-named "The Moa Scratch") in the Ōtānerito Valley, Hinewai Reserve, starting to green over at the edges, 23 April 2022, 128 days after the December deluge. Photo by Hugh Wilson.

Generous geospatial analyst Peter Pletnyakov provided us with extraordinary satellite imagery of the denudation. From the digital data Peter estimated that at least 63 hectares of Hinewai's surface area were laid bare. The figure could be higher, perhaps closer to 70 hectares; nearly 100 individual, but coalescing, slips were evident on the digital map, but where the width of destroyed canopy narrowed along some stretches of stream, the actually continuous slip lines misleadingly appeared to be intermittent or to disappear altogether.

Of course we have seen landslides before. The first one noted in Hinewai's log books was in October 1989 when a steep scrubby slope slumped in to Hinewai Stream downvalley from Ghost Falls. We eagerly set up a photopoint from lower South Track, but by October 1995 the slip was indistinguishable from the regenerating native hardwood canopy on either side. July 1994 was particularly wet. A big slip threatened to engulf the southern end of Akaroa town, but was foiled by some timely engineering. There was only one notable slip on Hinewai that month; it carried away two planted ribbonwoods in the Ōtānerito arboretum. Mid-January 2002 set a new daily rainfall record at Hinewai weather station (148.5 mm), which brought down about 12 significant slips across the reserve. The most dramatic one gutted North Mānatu Gully on the northern flank of Tarateretehu / Stony Bay Peak, spilling out across Brocheries Flat. Conspicuous in the October 2002 photo from Photopoint 1, it was completely vegetated by October 2004 and is now pretty much indiscernible from the surrounding steep hillsides of regenerating trees.

None of these events came anywhere near the scale of the 2021 disruption, nor can anyone alive on Banks Peninsula recall anything even remotely similar. But a bit of time travel would soon (ha ha) show that it is far from unprecedented. For example, a huge ancient landslide nearly a kilometre wide and one and a half kilometres long, completely

altered the topography of the upper Ōtānerito Valley, probably a few thousand years ago. High-tech Lidar imagery, which digitally removes the blanketing vegetation from the picture, makes the feature seem as though the land moved yesterday. In 1886, three weeks of winter rain brought gigantic landslides to Pigeon Bay and catastrophe to the Hay family there. These are just details in a big picture. Vast quantities of material have been eroded off the Akaroa Volcano since it became extinct around 8 million years ago, halving its height, not just by gradual weathering and stream flows but also undoubtedly by innumerable mass-movement events.

Rainfall

What does Hinewai's 34 year rainfall register reveal? We had already experienced precipitation approaching the extremes of last December. Two June days in 2013, for example, totted up 257 mm in the Hinewai rain gauge. The damage was far less than in 2021. Cyclone Gita in February 2018 gave us a new daily record of 181.1 mm (256.0 mm for the four day event) but caused no significant slippage at all. Yet a much more subdued rainfall in June of that year caused some major landslides near the coast. How come?

The usual pattern of rainfall across Hinewai is that precipitation increases rapidly from the coast to the valley heads. Both for single storms and for annual totals, Skyline rain gauge normally receives three times as much as the Headland. Cyclone Gita in February 2018 matched this pattern. June 2018 reversed it when by far the heaviest rainfall was along the coast, unused to such a deluge and unprepared for it. December 2021 was different again, unprecedented in our 34 years of recording. That weather system dropped around 300 mm across the whole span, so that Parakākāriki Headland measured almost the same as Skyline. The valley heads are used to that sort of rainfall from time to time; any slip-prone land there has had many opportunities to be bared, stabilised and revegetated. In contrast, further downvalley the land was ill-prepared for 300 mm all at once. Slopes gave way all over the place.

These observations sound almost like a vaccination programme, or a "once-infected, more or less immune thereafter" scenario. This was underlined in July 2022 when Hinewai copped another two hefty deluges not greatly less than the December 2021 event. There were few significant new slips on the reserve and no obvious further movement on the December landslides.

Recolonisation

On the scale of human lifetimes, such mass movement has undoubtedly been rare. Ever-increasing climate change, with its predictions of more frequent and greater extremes of both rainfall and drought, is a daunting prospect for a reserve manager!

Meanwhile, however, while we potter away at re-forming tracks and replacing vanished bridges, Nature is busy with the serious work of reclothing the bared surfaces with new vegetation.

Six months after the event I took a field notebook and walked slowly over three representative slips in the Ōtānerito Valley, to add more precise detail to what I had been noting on my way to various workfaces. I repeat below some observations from my daily Hinewai log, then add a few comments, before listing the species recorded on the three slips between the 18th and 25th of June 2022 (Table 1, p. 23).

5 January 2022 (21 days after deluge): Gorse seedlings (cotyledon stage) appearing on some slip surfaces.

14 January (30): Plants showing up on slip surfaces: grasses, sheep's sorrel, common vetch, gorse (cotyledon stage), white clover, etc.

21 January (37): Plants appearing on the Pikimai slip include bracken, grasses, white clover, sheep's sorrel, common vetch, gorse seedlings (cotyledon stage).

1 February (48): Seedlings of poroporo appearing in considerable numbers on the East Track slips.

18 February (65): On Kererū Stream slips, thousands of tiny wineberry seedlings evident, along with poroporo seedlings, gorse, broom, grasses, vetch, clover, etc. Some surfaces are appearing locally green from afar.

15 March (90): Green areas expanding on slips (Fig. 2, p.18). Other areas still look bare, fawn-grey. Poroporo plants, many thousands, increasing in size, up to 40 cms.

27 March (102): Poroporo abundant, some now more than 40 cms tall. Some thick patches of gorse seedlings, beyond cotyledon stage.

8 June (175): Middle Lisburn slip, where Lisburn Track crosses: there is a thick sward of toad rush, with native groundsels and a few plants of naturalised exotic wood groundsel. Lots of gorse seedlings where the toad rush thins or is absent. On slips generally: poroporo up to a metre tall. Common vetch and sheep's sorrel numerous. Lots of sprouting sevenfinger, māhoe, fuchsia, much of it apparently from broken fragments and transported root clumps, but also new seedlings.

Seedbanks, seedlings and re-sprouts

Six months after the deluge it was interesting to note that where the original soil was more or less intact or only shallowly stripped, the bared surfaces were now more or less continuously vegetated, looking green from afar. In contrast, deeply eroded surfaces, such as the head-slopes of slips and the scoured out trenches down the centres of the landslides, were hardly colonised at all, and looked fawn-grey and bare from afar. The devastated beds of streams were different again, with many plants establishing among bared boulders on finer deposited sediments. The sheer number and spread of establishing plants demonstrates astonishingly profuse and efficient seed production and dispersal (Fig. 3, p. 21). It also made me think about which species have long-lived accumulating seed banks in surface and near-surface soils across the whole reserve. It's well-known that gorse, broom and poroporo (Fig. 4, p. 21) accumulate seed banks, and take immediate advantage of cleared sites. The widespread abundance of wineberry seedlings suggests that this species accumulates seed banks as well.

Kānuka is common enough too as seedlings on the slips in these first few months, but its tiny seeds are unlikely to last long in the soil. Inkweed is abundant both on the slips and along devastated stream beds, but only below around 250 m elevation. On the slips above the Ōtānerito carpark, there was one notable area of many square metres dominated by vigorous plants of cape gooseberry. The hard seeds of kōwhai, like those of other legumes, are likely to contribute to long-lived seedbanks, but I have not noted them so far on the current crop of slips. Somehow the "fireweed groundsels", also rushes, sorrel,

Figure 3. Slip recolonisation in Hinewai Reserve seven months after the December deluge with dense growth of poroporo, foxglove, gorse, mullein, and thistles. Photo taken 26 July 2022 by Paul Newport.

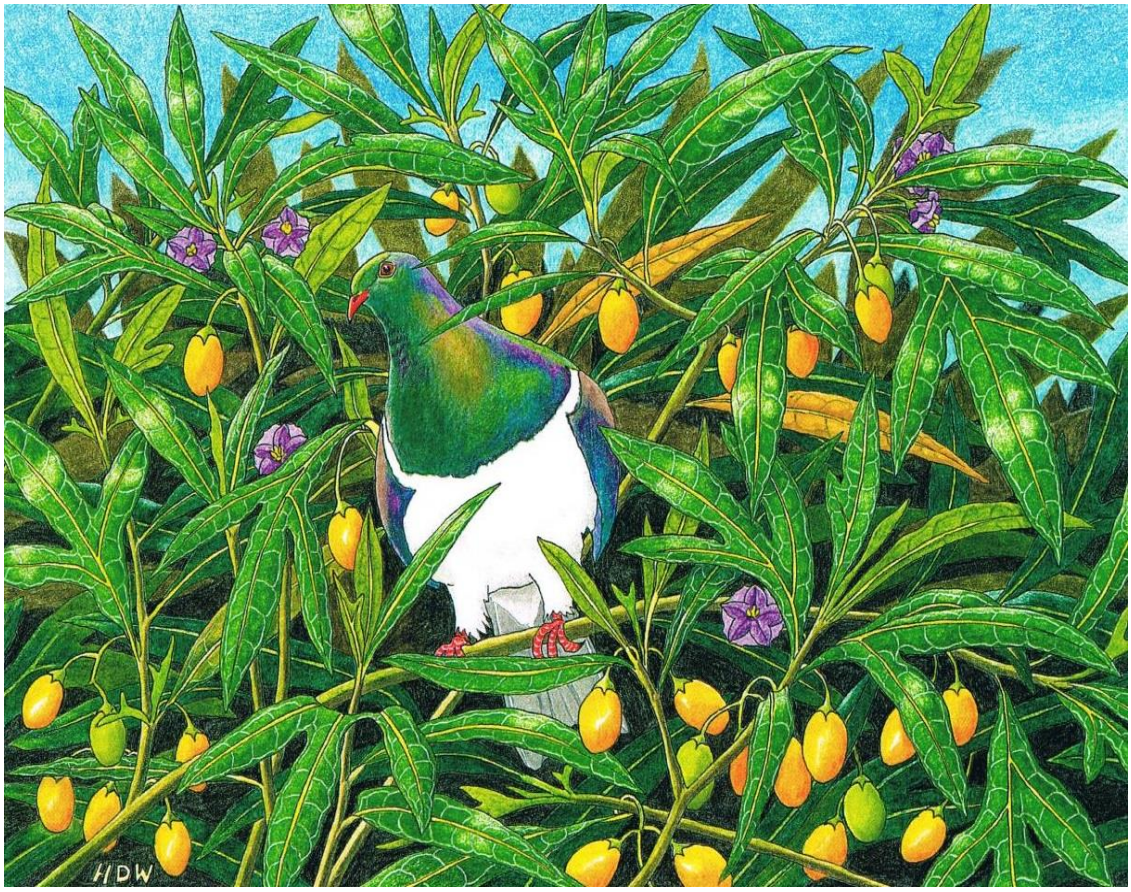

Figure 4. Poroporo (*Solanum laciniatum*), with a soil seedbank continuously recharged by kererū, is one of the most prominent early colonisers on the slips. Drawing by Hugh Wilson.

thistles, harebells, vetches, foxgloves, clovers and cudweeds, manage early colonisation with ease. Foxgloves and gorse are the two most abundant species, both of them naturalised exotics, joined by inkweed, also exotic, at lower altitudes. Where bracken occurs, it appears to be sprouting from rhizomes that have been shunted some distance downslope. Some native tree species are resprouting from transported root clumps or even from severed branch fragments – notably māhoe, sevenfinger, fuchsia and karamū. All of these are already represented by newly establishing seedlings.

A final thought

I am tempted to draw some conclusions from all this, of relevance to current debates about forest carbon sequestration, pine-planting, and native forest regeneration. Proponents of planting fast-growing exotic pines for carbon sequestration often claim that mature "carbon plantations"[2] of *Pinus radiata* will transition in time to native forest. They also claim that planting native "carbon forests" is far more expensive than planting pines. They miss at least two important points:

1) Once established in an ecosystem, pines will act as highly competitive colonisers on land bared by landslides or fire; they are not going to disappear meekly as old age catches up with the first cohort after a century or two.

2) The cost comparison is not between planted pines and planted natives. How we humans underestimate the astonishing natural production and dispersal of native seed, and overestimate our own self-importance. The way forward lies in natural regeneration of native forest across millions of hectares of marginal, otherwise economically unproductive, often "weed-infested" hill country. Nature covers most of the costs. At the same time she deals with a threat about equal to climate change – dwindling biodiversity.

Writing in *New Scientist* (31 July 2021) Fred Pearce summed this up nicely: "The answer isn't mass replanting, but instead letting forests reclaim vast swathes of Earth at their own pace!" Hinewai, as lovely as ever after her latest "disaster", albeit a bit battered and scarred, can only say "hear hear!"

Reference

Wilson HD. 1994. Regeneration of native forest on Hinewai Reserve, Banks Peninsula. New Zealand Journal of Botany 32: 373–383.

[2] more human hubris

Table 1. Species recorded 6 months after the deluge of 15 December 2021 from three slips on Hinewai Reserve; **1.** Slip above Ōtānerito carpark (c. 75 m altitude), **2.** Western slip across West Track (c. 390 m), and **3.** Eastern slip across East Track (c. 410 m).

The species are listed roughly in order of overall abundance; **A** = abundant, **B** = more or less common, **C** = uncommon or rare. * = naturalised exotic

	Botanical name	Common name	Slip		
			1	2	3
*	*Digitalis purpurea*	foxglove	A	A	A
*	*Ulex europaeus*	gorse	A	A	A
	Solanum laciniatum	poroporo	A	B	A
	Aristotelia serrata	makomako, wineberry	B	A	A
	Hydrocotyle moschata		A	B	A
*	*Juncus bufonius*	toad rush	A	C	A
*	*Rumex acetosella*	sheep's sorrel	A	-	B
*	*Trifolium repens*	white clover	A	-	B
	Mosses, mostly *Ceratodon* and Polytrichaceae		C	A	B
*	*Cirsium vulgare*	Scotch thistle	A	-	B
*	*Agrostis capillaris*	browntop	A	C	-
	Wahlenbergia gracilis	harebell	A	-	C
*	*Hypochaeris radicata*	catsear	B	B	B
	Senecio minimus	fireweed, native groundsel	A	-	C
	Urtica ferox	ongaonga, bush nettle	C	-	A
	Pseudognaphalium luteoalbum	woolly cudweed	B	C	B
*	*Holcus lanatus*	Yorkshire fog	B	C	C
*	*Anthoxanthum odoratum*	sweet vernal	B	C	B
	Melicytus ramiflorus	māhoe, whiteywood	C	C	B
	Euchiton audax	cudweed	C	C	B
*	*Phytolacca octandra*	inkweed	A	-	-
	Senecio glomeratus	fireweed, native groundsel	A	-	-
*	*Anagallis arvensis*	scarlet pimpernel	A	-	-
	Haloragis erecta	toatoa	A	-	-
*	*Solanum nigrum*	black nightshade	A	-	-
	Hydrocotyle heteromeria	waxweed	-	-	A
*	*Cerastium fontanum* subsp. *vulgare*	perennial mouse-ear chickweed	-	-	A
	Juncus ?*edgariae* (young plants)	wiwi, rush	B	-	B

	Botanical name	Common name	Slip		
			1	2	3
*	*Rubus echinatus* (*fruticosus* agg.)	blackberry	B	C	-
	Kunzea ericoides	kānuka	B	-	C
	Muehlenbeckia australis	pōhuehue	B	-	C
	Schefflera digitata	patē, sevenfinger	-	C	B
	Fuchsia excorticata	kōtukutuku, tree fuchsia	-	C	B
	Histiopteris incisa	mātātā, water fern	-	B	C
	Hypolepis ambigua		B	-	C
*	*Verbascum thapsus*	woolly mullein	B	-	-
*	*Vicia sativa*	vetch	B	-	-
	Pteridium esculentum	rauaruhe, bracken	-	B	-
	Oxalis exilis	yellow oxalis	B	-	-
*	?*Lavatera* ?*cretica* (= ?*Malva* ?*linnaei*)	Cretan mallow	B	-	-
*	*Dactylis glomerata*	cocksfoot	-	-	B
*	*Poa annua*	annual poa	-	-	B
*	*Mimulus moschatus*	musk	-	-	B
*	*Mimulus guttatus*	monkey musk	-	-	B
	Veronica (*Hebe*) *salicifolia*	koromiko	-	-	B
*	*Physalis peruviana*	cape gooseberry	B	-	-
	Carex (*Uncinia*) *uncinata*	hooked sedge	C	C	C
*	*Sonchus oleraceus*	pūhā, smooth sow thistle	C	-	C
	Juncus planifolius		C	-	-
*	*Cirsium arvense*	Californian thistle	C	-	-
	Myoporum laetum	ngaio	C	-	-
	Coprosma robusta	karamū	C	-	-
	Pelargonium inodorum		C	-	-
	Euchiton ?*limosus*	cudweed	C	-	-
*	*Cytisus scoparius*	broom	C	-	-
*	*Lepidium* sp. (rosettes only)	pepper cress	C	-	-
*	*Spergula arvensis*	spurrey	C	-	-
	Microlaena stipoides	pātītī, meadow rice grass	C	-	-
	Euchiton sphaericus	cudweed	C	-	-
*	*Conyza sumatrensis*	broad-leaved fleabane	C	-	-
*	*Silene gallica*	catchfly	C	-	-

	Botanical name	Common name	Slip		
			1	2	3
*	*Leycesteria formosa*	Himalayan honeysuckle	-	C	-
*	*Epilobium ciliatum*	tall willowherb	-	-	C
	Stellaria decipiens (incl. *parviflora*)	native chickweed	-	-	C
*	*Sagina procumbens*	mossy pearlwort	-	-	C
*	*Bellis perennis*	daisy	-	-	C
	Epilobium nummularifolium	creeping willowherb	-	-	C
*	*Senecio vulgaris*	groundsel	-	-	C
*	*Callitriche stagnalis*	starwort	-	-	C
	Asplenium hookerianum	maidenhair spleenwort	-	-	C
*	*Crepis capillaris*	hawksbeard	-	-	C
*	*Sonchus asper*	prickly sow thistle	-	-	C
*	*Myosotis ?arvensis*	field forget-me-not	-	-	C
*	*Cardamine hirsuta*	bitter cress	-	-	C
*	*Senecio sylvaticus*	wood groundsel	-	-	C
	Acaena anserinifolia	piripiri, biddibid	-	-	C

Braided river berm transition, a climate resilience project

Greg Stanley

Team Leader, Braided River Revival, Environment Canterbury

Introduction: our catchments and communities

The unique values of Waitaha Canterbury's braided rivers [1] are well known, as are many of the challenges and threats to their natural value. Loss of habitat – wetlands, braid-plains, or terrestrial vegetation – frequently form the introductory context of our presentations. It is due to habitat loss and land modification that my job as part of the Regionwide Berm Transition Project [2] exists.

My name is Greg Stanley and I have worked with vegetation on modified river berms with Environment Canterbury for the last decade. My work has been primarily located in the lower reaches of the Waimakariri and Rakahuri rivers with a focus on the retention and encouragement of native vegetation among our exotic flood protection assets.