Natural regeneration in the forest and shrublands at Tahi

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TAHI

Executive Summary

1. Pest control and stock exclusion since 2004 in the old-growth Forests and existing Shrublands has enabled a major recovery of natural regeneration.

2. At least 20 tree species are present in the regenerating understorey.

3. There are subtle, but important differences between the patterns of regeneration in the old-growth Forests as compared to the Shrublands.

4. The forests and shrublands of the 'Telfer Block' are still showing some of the signs of disturbance from uncontrolled pest and stock activity. However, they are clearly progressing towards a healthier state and can be expected to fully recover.

5. We estimate that as at 2023, there are at least 8.8 million seedlings across the older Forests and Shrublands of the property. With some 7.6 million in the areas under pest control since 2004 and a further 1.1 million in the added 'Telfer Block'.

Photo courtesy of Vicki Ross

Pest control is an integral part of conservation management. Originally, Tahi had just about every introduced, mammalian pest species. Consequently, the existing forests and shrublands had no understorey, there was no regeneration and many canopy trees were being heavily browsed.

From the outset in 2004, an intense programme of stock removal and pest control was initiated. Today, 20 years later, there is abundant natural regeneration in these forests and shrublands, as well as recovery of the forest canopy. In parallel, bird life which was once almost absent is now thriving.
The original forests (mostly kauri-podocarp-broadleaf) covered 57.3ha and shrublands (mostly manuka and kanuka) some 61.5ha.
In 2018 an adjoining block of land (the Telfer block) was purchased, adding an additional 14ha of forest and 18.5ha of shrublands.
The 'Telfer Block' forests and shrublands were all comparable in age to those on the main block, i.e. they were all present in 2002 and the areas of forest were all present on 1940 aerial imagery. Some examples of these forests can be seen in Figures 1 - 3.

At the same time, a considerable investment has been made in the purchase and planting of native trees and shrubs, to restore natural ecosystems in the old areas of pasture and restore carbon sequestration. Some 450,000 trees native trees, shrubs and other species have been planted. Since 2004, 55.7ha of land has been planted with native trees and shrubs.

The Tahi planting programme has quite rightly been applauded for the scale and quantity of plants established in the abandoned pastures. This approach is used in ecological restoration as native plants have considerable difficulty establishing unaided in abandoned pastures, particularly when dominated by kikuyu grass. Direct planting has been in use, since first used in the highly successful Tiritiri Matangi Island restoration.

Meanwhile, Nature has been recovering and restoring the damage wrought over perhaps a century of farming and logging to the original forests and shrublands.

This study is to evaluate the extent to which the forests and shrublands have been restoring themselves through seedling establishment. Essentially to estimate how many seedlings/saplings are now present through natural establishment.

Figure 1. An area of forest protected for 20 years.

Figure 2. An area of forest protected for 20 years

Figure 3. An area of forest protected for only 4-5 years

Methods

We devised a very simple, but objective method, to sample seedlings in the forests and shrublands. The main areas of old forest and shrublands have a number of tracks running through them. Most of the tracks are a single person wide, although the old farm tracks and coach road can be wider. Also a number of areas are untracked and we would simply focus on a distant point and walk towards it. We found following a compass bearing was impractical due to the complexity of the terrain.

The approach was as follows: at the beginning of the track move 50 steps along from the beginning. At the measurement point, lay a 1m stick at right angles to the edge of the track into the vegetation. Defining the edge of the track was often unclear, in these cases the baseline point would be moved an arbitrary distance, up to 1m, before the starting point was defined. The point of the stick was the mid-point of the track-side edge of a 1m square quadrat laid out at right angles.

Occasionally the 1m stick would come up against a tree, in these cases, the point of the stick was to the bottom right-(or left-) hand corner of the quadrat. After the beginning point, sample points were mostly laid out every 110 steps along (equated to approximately 100m). Where it was impractical to sample, e.g. a stream or steep bank, then a further arbitrary 20 steps was taken. In more restricted areas of vegetation, the sampling interval would be reduced to 50 steps. On one occasion our location became confused and we ended up resampling an area. This can be seen on the sampling map (Figure 6).

Figure 4. Illustration of plot sampling technique used.

Every established seedling or sapling in the plot would be counted. Decisions as to what constituted 'established' were not always easy and if in doubt were not counted. Essentially, any seedling that appeared to be at least one year (growing season) old was included. Species that could ultimately become small trees or canopy species were specifically enumerated, otherwise all other (shrub) species were grouped together. These other shrub species included a variety of Coprosma's, Hangehange, etc.

The usual approach was to go up a track, sampling on the right hand side every 110 steps. At the top or return point, move an arbitrary distance up or down, then recommence sampling every 110 steps on the other side. When off tracks, we advanced along our sampling line, laying out samples on either side. A total of 190 samples were collected this way.

In the pilot study of 8 locations, a different approach was employed. In this study a 10m x 10m plot was set up for measurement of the canopy trees, with a 1m x 1m seedling plot in the centre. Seedlings in the plot were then enumerated.

At every sample plot the canopy species immediately above the plot were noted and the location georeferenced by gps.

The category of Forest or Shrubland was initially assigned to a plot based on early aerial imagery (from 1940-2002). This general distinction between forest and shrublands was then used to classify each plot. On some occasions plots were clearly in shrubland or more rarely forest, this was taken as the category of the site, rather than the original mapping. A few sites ended up in a grassed area, this was duly noted.

Figure 5. Vicki counting seedlings in the depths of dense regeneration

Locations

The map below shows the location of every sampled plot.

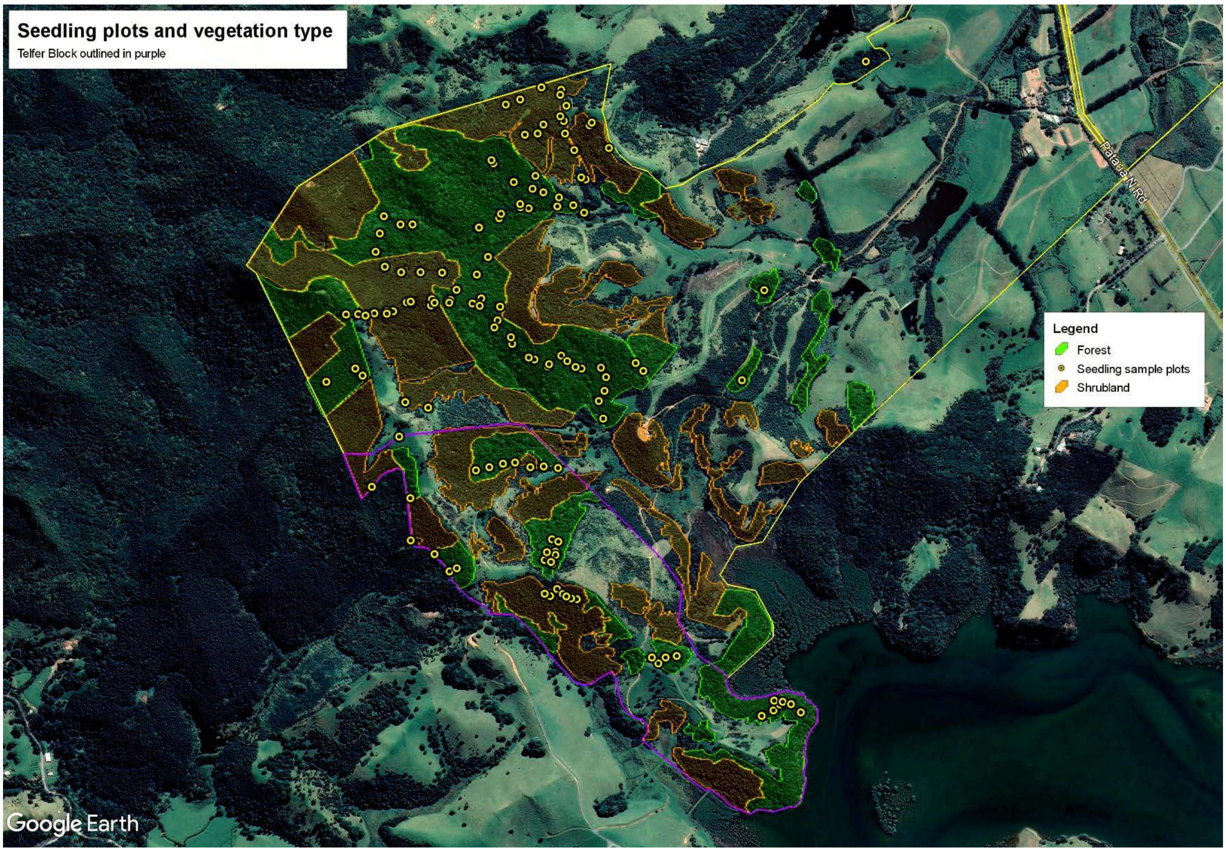

Figure 6. A map to show the distribution of sample points across the property.

Results

In total 190 plots were sampled in the main study, with an additional 8 from the pilot study. There were 141 forest sites, 55 shrubland sites and 2 grass sites. The grass sites had no seedlings and were not considered in the rest of the analysis. In total 29 species were noted of which 26 were in the canopy and 22 tree species recorded in the samples; 19 species were found in both the canopy and as seedlings.

Eight species were only found in the canopy, although it should be noted that for most of these, seedlings were observed elsewhere on the property. One species (White maire) was only recorded as a seedling, even though mature trees are known. The total number of seedlings counted, amounted to 1055.

Table 1. Summary of seedling sampling results

Vegetation	Area ha	Number of samples	Seedlings /m^2	Seedlings estimate
Old growth Forest	57.3	84	6.2±1.3	3,555,205
Pre-2004 Shrublands	61.5	40	6.9±2.6	4,210,467
Telfer Block Forests	14.0	57	3.4±1.3	477,921
Telfer Block Shrublands	18.	5 15	4.3±2.2	801,233

The results clearly suggest that the density of seedlings in the vegetation protected for 20 years are at a higher density than the more recently protected 'Telfer Block'. It can be concluded that the density of seedlings in the longer protected forest is significantly greater than in the 'Telfer Block'. In the case of the shrublands, the variability in density of seedlings is such that although the means differ, they are not significantly different.

Further analysis of these results is possible which enables a more precise insight to be developed (Table 2). Essentially the mean and standard deviation of the results is used to combine the four categories of vegetation to develop a more precise estimate of the range within which the true value lies.

Two results are presented in Table 2, based on an approach of using the combined variances. Firstly, there is the estimate of overall seedling numbers in the original pre-2004 Forests and Shrublands, and also the Telfer Block data. The results are then further combined, using the combined variance approach, to provide an overall estimate of the total numbers as at 2023. This approach has also allowed an estimate of the range within which the true means lie (with a 95% confidence).

Table 2. Analysis of the overall numbers by combining the different datasets.

Forest type	Seedlings /m²	Tree species	Samples	Std.dev	Area ha	Total	Combined	Ranges within estimate lies(95% c.l.)	
Old-growth Forest	6.2	56%	84	6.2	57.3	3,555,205			
Pre-2004 Shrublands	6.9	42%	40	8.1	61.5	4,210,467	7,615,758	7,411,971	7,819,545
Telfer Forests	3.4	71%	57	4.9	14.0	477,921			
Telfer Shrublands	4.3	66%	15	3.9	18.5	801,233	1,172,167	1,124,093	1,220,240
						Combined total 2023	**8,787,925**	**8,758,207**	**8,817,642**

The results show with considerable confidence (95%), the total number of seedlings in the pre-2004 vegetation, that has been under 20 years of pest and stock control, lies within the range 7.4-7.8 million with a total of 7.6 million. For the ‘Telfer Block’ forests and shrublands the range is 1.12-1.22 million, with an estimate of the total of 1.17 million. Further combining these results, allows an estimate of the total number of seedlings regenerated in the old-growth forest and shrublands as being in the range of 8.76-8.82 million, with a best estimate of 8.79 million.

These results clearly show, that abundant natural regeneration will occur in forests and shrublands that are under pest control for 20 years.

For the ‘Telfer Block’, natural regeneration has begun, even within only 4-5 years of stock and pest control. This demonstrates, that even within a few years of stock/pest control commencing, natural regeneration will get under way. With time this will only get better.

Table 3. Summary of tree species and estimate of numbers found in the Forest plots

Species	Forest 20 year control	Forest 5 year control
Nikau	552,729	46,100
Karaka	361,662	15,367
Kohekohe	204,714	122,933
Tanekaha	184,243	230,500
Ponga	129,652	245,867
Taraire	116,005	15,367
Totara	102,357	414,900
Rewarewa	81,886	15,367
Mapou	75,062	169,033
Pigeon wood	54,590	-
Kauri	34,119	-
Turepo	34,119	-
Kanuka	20,471	92,200
Kahikatea	13,648	-
Mahoe	13,648	-
Māmāngi	13,648	-
Manuka	-	353,433
Wheki	-	30,733
Kowhai	-	-
Mamaku	-	-

Table 4. Summary of tree species and estimate of the numbers found in the Shrubland plots

Species	Shrubland 20 year control	Shrubland 5 year control
Karaka	122,544	4,623
Kohekohe	98,035	36,980
Taraire	31,861	4,623
Nikau	19,607	13,868
Totara	17,156	124,808
Manuka	12,254	106,318
Tanekaha	9,804	69,338
Kanuka	7,353	27,735
Kowhai	7,353	-
Mapou	7,353	50,848
Mamaku	2,451	-
Ponga	2,451	73,960
Wheki	-	9,245
Rewarewa	-	4,623
Kahikatea	-	-
Kauri	-	-
Mahoe	-	-
Māmāngi	-	-
Pigeon wood	-	-
Turepo	-	

It is quite clear that there are similar species found across the property; however, the relative balance of species is quite different. In the old-growth forests, the larger seeded species, e.g. Nikau, Kohekoke and Karaka are prominent, being dispersed by the larger birds. In the Shrublands, the smaller (bird dispersed) seeded and wind dispersed species are more prominent, e.g. Totara, Manuka, Tanekaha, Ponga. In the Shrublands, fewer larger seeded species are found. It is also clear that there is a greater diversity of species present in the seedling populations of the old-growth Forests.

The more recently controlled forests and shrublands are still showing the effects of the extensive disturbance and damage caused by stock and pests.

This is illustrated by the larger quantities of tree ferns (Ponga, Wheki and Mamaku), Manuka and Kanuka, than in the longer controlled forests. This aspect of disturbance is often overlooked when considering the effects of stock and pests. The more common presence of seedlings from small-seeded species in the Telfer Block, e.g. Totara, Tanekaha and Mapou, also suggests that it will take some time for the larger birds, such as Kereru and Tui to make extensive use of these previously very disturbed places.

One of the effects of having different structural types of vegetation, i.e. old-growth Forest and Shrublands, is that a much greater variety of species are dispersing and becoming established. This is probably due to the presence of quite different environments/habitats for bird species and plant species.

Possibly there is more ecological information that could be extracted from this data, but is not relevant to the immediate question. A supplementary report may be produced at a future date.

Conclusions

Effective pest control has enabled the establishment of many millions of seedlings. It clearly takes numbers of years after pest and stock control are established, for the environment to recover. Now that pest and stock control has been in place for 20 years, these forests are clearly on track to being self-maintaining, as shown by the quantities of canopy tree seedlings present. In the comparable shrublands, these are becoming forests with a similar species composition to the rest of the property. The more recently protected 'Telfer Block' woody vegetation, is still recovering, but the signs are there that they will fully recover and become the biodiverse forests they once were.

The more recently protected 'Telfer Block' woody vegetation, has some way yet to go, but are showing signs that they will become forests of a similar composition to the rest of the property.

Not all of the seedlings we observe today will survive, but it also illustrates that these forests are once again able to regenerate themselves. In the face of uncertain future environments, the forests will have the resilience to develop into whatever are the best adapted systems.

Acknowledgements

I especially want to thank Vicki Ross for her resilience, competence and accuracy in identifying the bulk of the samples. For some of the study, we were working under deteriorating weather conditions and speed was of the essence. Her support meant that we collected a large quantity of samples in a limited time. Conveniently, 110 of her steps are 100m. I would also like to thank Mariana Basilio for her help with the pilot study, that led to development of the current approach. To John Craig for clearly enunciating the question and suggesting a similarly simple approach.

APPENDIX 1. THE COLLECTED FIELD DATA

Plot	Latitude	Longitude	Seedling Total	Vegetation type	Trees directly above plot			Number of seedling canopy and small tree species recorded																			
					Canopy 1	Canopy 2	Canopy 3	Kohekohe	Taraire	Karaka	Nikau	Tanekaha	Ponga	Pigeon wood	Rewarewa	Totara	Kanuka	Turepo	Mapou	Kauri	Manuka	Kahikatea	Wheki	Kohai	Mamaku	Mahoe	Māmāngi
1a	-35.709	174.495	8	forest	Totara	Kanuka					1																
1b	-35.7097	174.495	5	forest	Tanekaha																						
2a	-35.7084	174.4949	5	forest						1	1			2													
2b	-35.7093	174.4949	2	forest	Kanuka						2																
3a	-35.7084	174.4941	13	forest				5			6			2													
3b	-35.7087	174.4951	3	forest				1	1				2														
4a	-35.7081	174.4937	5	forest							5																
4b	-35.7084	174.4943	8	forest	Kohekohe					3	4																
5a	-35.7084	174.4933	8	forest	Kanuka	Tanekaha																					
5b	-35.7083	174.4939	1	forest	Kohekohe	Nikau	Taraire	1																			
6a	-35.7082	174.4927	5	forest	Kanuka	Tanekaha					1		1		1												
6b	-35.7083	174.4933	4	forest	Kanuka	Rimu						4															
7a	-35.7076	174.4921	13	forest	Kohekohe	Tanekaha	Kauri				1				1	1											
7b	-35.7082	174.4928	5	forest	Tanekaha	Lacebark					4	1															
8a	-35.7072	174.4917	8	forest	Kanuka							1	2		1			1									
8b	-35.7078	174.4921	1	forest	Kohekohe	Cabbage tree				1																	
9a	-35.7068	174.4911	4	forest	Kanuka	Totara							2														
9b	-35.7074	174.4916	17	forest	Kohekohe	Totara		3		1	1					3											
10a	-35.7067	174.4902	0	forest	Kauri																						
10b	-35.7068	174.4909	8	Shrubland	Kanuka			4																			
11a	-35.7068	174.4897	3	shrubland	tanekaha	kanuka						1				2											
11b	-35.7068	174.4902	2	forest																							
12a	-35.7067	174.489	33	shrubland	totara	kanuka						9				1	1										
12b	-35.7067	174.4896	11	shrubland								1															
13a	-35.707	174.4882	2	shrubland	totara	kanuka																					
13b	-35.7068	174.4888	27	shrubland	manuka	kanuka						1				3	3										
14a	-35.7071	174.4875	1	shrubland	kanuka							1															
14b	-35.707	174.4882	0	shrubland	kanuka																						
15a	-35.7071	174.4869	1	forest	Totara			1																			
15b	-35.7071	174.4876	0	shrubland																							
16a	-35.7069	174.4918	4	Shrubland	Kanuka	Tanekaha		1	1										1								
16b	-35.7069	174.4918	6	Shrubland	Kanuka	Tanekaha		1											1								
17b	-35.7036	174.4943	5	shrubland	totara																						
18a	-35.7029	174.4941	2	shrubland	manuka								1														
19a	-35.7024	174.4938	0	forest	puriri																						
20a	-35.7015	174.4937	1	shrubland	manuka	tf							1														
21a	-35.7013	174.4937	17	shrubland	manuka											7					2						
21b	-35.7013	174.4931	13	shrubland	manuka	totara						1	1			1					5						
22a	-35.7017	174.4919	0	grass																							
22b	-35.7016	174.4924	5	shrubland	manuka	totara																					
23b	-35.7017	174.4938	0	grass																							
24a	-35.7022	174.4946	10	shrubland	tf	manuka							1						1								
25b	-35.7028	174.4952	14	shrubland	manuka								9								2						
26b	-35.7022	174.4946	25	shrubland	manuka										1	8					13						
30a	-35.702	174.4937	1	shrubland	manuka	totara										1											
31a	-35.7024	174.4929	1	forest	puriri	manuka																					
32a	-35.7025	174.4925	9	shrubland	totara																						
32b	-35.7022	174.4931	4	shrubland	kanuka																						
33b	-35.7021	174.4938	1	shrubland	kanuka	puriri											1										
34b	-35.7029	174.4941	2	shrubland	manuka								1						1								
35b	-35.7036	174.4943	12	shrubland												1			5								
36b	-35.7036	174.4944	0	shrubland																							
40a	-35.7041	174.4936	6	forest	Puriri	totara		2	1					1					2								

40b	-35.7043	174.4941	6	forest	Kanuka								1		1	2			1								
41a	-35.7039	174.4928	4	forest	Kohekohe						1																
41b	-35.7039	174.4931	4	forest				2					1		1												
42a	-35.7035	174.4929	9	forest	Kohekohe			3				2	1						2								
42b	-35.7037	174.4922	8	forest	Kanuka	Rimu					3	2			1												
43a	-35.7031	174.4915	5	forest	Kanuka																						
43b	-35.7032	174.4916	2	forest	Totara			1																			
50a	-35.7043	174.4936	7	forest	Kohekohe	Kanuka		1					1									2					
50b	-35.7043	174.4935	5	forest	Kanuka																						
50x	-35.7045	174.4944	14	forest	Kanuka																						
51a	-35.7043	174.4924	2	forest	Taraire	Nikau	Tree fern	1		1																	
51b	-35.7044	174.4927	16	forest	Karaka	Totara																					
52a	-35.7046	174.4917	3	forest	nikau	kanuka		1																			
52b	-35.7045	174.4918	12	forest	Karaka	Nikau	Kanuka				7		3		1												
53a	-35.7048	174.4911	7	forest	Rewarewa	Rimu									3					2							
53b	-35.7048	174.4911	15	forest	Kauri	Kanuka	Rimu					6			2	3			1	3							
60a	-36	174.4863	3	forest	tanekaha	pine								1		1											
60b	-36	174.4863	3	forest	mamaku	tanekaha	kanuka				2																
61a	-36	174.4872	3	forest	totara	tanekha																					
61b	-36	174.4872	1	forest	lancewoo	ponga																					
62a	-36	174.4874	3	forest	tanekaha	kanuka																					
62b	-36	174.4874	3	forest	tanekaha	mamaku							1														
63a	-36	174.4888	1	shrubland																							
63b	-35.7093	174.4888	0	shrubland																							
64a	-35.7094	174.4895	0	shrubland	kanuka	manuka																					
65a	-35.7094	174.4895	23	shrubland	kanuka														1								
65b	-35.7094	174.4895	4	shrubland	kanuka								2										2				
66a	-35.7115	174.4877	5	tforest	manuka																2						
66b	-35.7115	174.4877	4	tforest	kanuka	totara										1					3						
67a	-35.7102	174.4886	7	tshrubland	karaka	kahikatea	nikau			6																	
67b	-35.7102	174.4886	2	tshrubland	rewarewa	kahikatea	karaka	1																			
68a	-35.7118	174.4889	1	tforest	kanuka																						
68b	-35.7118	174.4889	1	tforest	manuka																						
69a	-35.7128	174.489	4	tforest	kanuka								1			2											
70a	-35.7132	174.4897	4	tforest	totara																						
70b	-35.7132	174.4897	10	tforest	lancewoo	totara						3															
71a	-35.7136	174.4902	2	tforest	totara			1																			
71b	-35.7136	174.4902	2	tforest	kohekohe	totara		1																			
72a	-35.7141	174.4936	0	tshrubland																							
73a	-35.7142	174.4937	8	tshrubland	kanuka																						
75a	-35.7143	174.4938	4	tshrubland	kanuka																						
75b	-35.7143	174.4938	12	tshrubland	kanuka											1											
76a	-35.7143	174.494	12	tshrubland	totara	kanuka		1				1									1						
77a	-35.7143	174.4942	4	tshrubland	kanuka	totara																					
77b	-35.7143	174.4942	7	tshrubland	kanuka																						
78a	-35.7143	174.4933	1	tshrubland	kanuka																						
78b	-35.7143	174.4933	4	tshrubland	kanuka											4											
79a	-35.7142	174.4932	2	tshrubland	kanuka											2											
79b	-35.7142	174.4932	0	tshrubland	kanuka																						
80a	-35.7134	174.4934	2	tforest	totara	kohekohe		2																			
80b	-35.7134	174.4934	0	tforest	kauri	kohekohe																					
81a	-35.7133	174.4932	3	tforest	tawa	karaka		1		2																	
81b	-35.7133	174.4932	5	tforest	tawa	kohekohe	totara	5																			
82a	-35.7131	174.4932	6	tforest	tawa	totara				5	1																
82b	-35.7131	174.4932	4	tforest	karaka	tawa				3	1																

83a	-35.7128	174.4934	1	tforest	rimu	kohekohe			1																		
83b	-35.7128	174.4934	2	tforest	kohekohe			2																			
84a	-35.7129	174.4936	6	tforest	karaka	kohekohe		2		4																	
84b	-35.7129	174.4936	11	tforest	karaka	rimu	dackirk			11																	
85a	-35.7132	174.4935	0	tforest	kohekohe																						
86a	-35.7131	174.4935	24	tforest	kohekohe			23		1																	
86b	-35.7131	174.4935	1	tforest	kohekohe	totara		1																			
87a	-35.7134	174.4934	0	tforest	kauri	kohekohe																					
87b	-35.7134	174.4934	0	tforest	kohekohe	tawa																					
90a	-35.7172	174.5012	0	tforest	totara																						
90b	-35.7172	174.5012	0	tforest	totara																						
91a	-35.717	174.5009	4	tforest	totara	kanuka													1					1			
91b	-35.717	174.5009	1	tforest	totara	kowhai																		1			
92a	-35.717	174.5006	4	tforest	puriri				1		2								1								
92b	-35.717	174.5006	2	tforest	puriri						1													1			
93a	-35.7169	174.5004	3	tforest	puriri	totara	kanuka				3																
93b	-35.7169	174.5004	5	tforest	kanuka	puriri	totara												1								
94a	-35.717	174.5006	3	tforest	kanuka																						
94b	-35.717	174.5006	2	tforest	kanuka											1											
95a	-35.7173	174.5	0	tforest	kanuka																						
95b	-35.7173	174.5	0	tforest	kanuka																						
96a	-35.7172	174.5004	0	tforest	kanuka																						
96b	-35.7172	174.5004	0	tforest	kanuka	totara																					
97a	-35.7158	174.4965	3	tforest	puriri	totara				3																	
97b	-35.7158	174.4965	1	tforest	totara	puriri			1																		
98a	-35.7158	174.497	0	tforest	kauri	totara																					
98b	-35.7158	174.497	0	tforest	kauri	totara																					
99a	-35.7158	174.4973	9	tforest	rimu				9																		
99b	-35.7158	174.4973	1	tforest	rimu	kahikatea			1																		
100a	-35.711	174.4936	1	tforest	kanuka																				1		
101a	-35.7109	174.4931	1	tforest	kanuka												1										
101b	-35.7109	174.4931	1	tforest	manuka																						
102a	-35.711	174.4927	1	tshrubland	kanuka																						
102b	-35.711	174.4927	1	tshrubland	manuka								1														
103a	-35.7108	174.4922	0	tforest	kanuka																						
103b	-35.7108	174.4922	7	tforest	kanuka	totara						1															
104a	-35.7109	174.4919	0	tforest	kanuka	open																					
104b	-35.7109	174.4919	6	tforest	totara	kanuka																					
105a	-35.711	174.4914	3	tforest	totara	karaka				3																	
105b	-35.711	174.4914	0	tforest	totara	karaka																					
106a	-35.711	174.491	7	tforest	kanuka												1										
106b	-35.711	174.491	6	tforest	manuka	kanuka										1	1										
110a	-35.7056	174.4914	3	forest	kanuka						1																
110b	-35.7056	174.4914	0	forest	ponga	cab tree	kanuka																				
111a	-35.706	174.491	7	forest	kohekohe	kanuka					1								1							1	
111b	-35.706	174.491	3	forest	tanekaha	kauri	milk tree				2																
112a	-35.7067	174.4912	7	forest	taraire	kohekohe			1	1	1															1	
112b	-35.7067	174.4912	6	forest	rimu					2	4																
113a	-35.7068	174.491	1	forest	tanekaha	totara	coparb				1																
113b	-35.7068	174.491	2	forest	kahikatea																						2
114a	-35.7067	174.4901	7	forest	kauri	tanekaha			1				1						1								
114b	-35.7067	174.4901	0	forest	kauri	tanekaha																					
115a	-35.7068	174.4896	1	shrubland	tanekaha	kanuka										1											
115b	-35.7068	174.4896	12	shrubland	kanuka											2	1		1								
116a	-35.7068	174.489	4	shrubland	manuka	kanuka															1						
116b	-35.7068	174.489	0	shrubland	totara	kanuka																					

117a	-35.707	174.4884	4	shrubland	kohekohe			1			3																
117b	-35.707	174.4884	2	shrubland	kohekohe	puriri		1		1																	
118a	-35.707	174.4878	7	shrubland	kanuka							1															
118b	-35.707	174.4878	0	shrubland	manuka																						
119a	-35.7071	174.4873	0	forest	kanuka																						
119b	-35.7071	174.4873	0	forest	kanuka																						
120a	-35.7064	174.4904	4	forest	kanuka																						
120b	-35.7064	174.4904	21	forest	tanekaha	kanuka							1														
121a	-35.706	174.4899	24	forest	totara	tanekaha													2								
121b	-35.706	174.4899	12	forest	totara	tanekaha											1		1								
122a	-35.706	174.4893	13	forest	kanuka	tanekaha						2				4											
122b	-35.706	174.4893	24	forest	kanuka							9		1		1	2										
123a	-35.706	174.4887	2	forest	tanekaha			1			1																
123b	-35.706	174.4887	0	forest	tanekaha																						
124a	-35.7058	174.4881	8	forest	totara	kohekohe		1		3	4																
124b	-35.7058	174.4881	4	forest	taraire	kohekohe			1	1			1														
125a	-35.7055	174.4879	5	forest	puriri	nikau					1																
125b	-35.7055	174.4879	1	forest	puriri			1																			
126a	-35.705	174.488	0	forest	kohekohe																						
126b	-35.705	174.488	6	forest	karaka	kohekohe																					
127a	-35.7046	174.4881	1	forest	kanuka	mahoe			1																		
127b	-35.7046	174.4881	9	forest	mahoe			1	3		5																
128a	-35.7048	174.4886	15	forest	kohekohe	rewarewa		1	3	6	2																
128b	-35.7048	174.4886	35	forest	kohekohe	kanuka				30	5																
129a	-35.7048	174.489	4	forest	puriri	kohekohe					2		1	1													
129b	-35.7048	174.489	1	forest	puriri	kohekohe		1																			
r1	-35.7135	174.4904	26	tforest				2		18																	
r2	-35.716	174.4967	1	tforest												2											
r3	-35.7085	174.4963	5	forest																							
r4	-35.7087	174.4994	2	forest					1	1																	
r5	-35.7042	174.4924	6	forest					4	2																	
r6	-35.7064	174.5001	7	forest							7																
r7	-35.7006	174.5033	6	forest				1			5																
r8	-35.7083	174.496	10	forest				1										4									

Notes:

Seedling total includes all trees and shrubs, all those listed to the right together with shrub species not specifically recorded.

Canopy1… in some cases, this has not been filled in due to forgetting to do it in the field. This will be completed at a later date.

Plot r1, r2, etc These plots were recorded in the earlier pilot study.

tForest and tShrublands refer to plots in the 'Telfer Block'

APPENDIX 2. SPECIES RECORDED DURING THE STUDY

Common name	Latin name*	Tree	Seedling
Cabbage tree	*Cordyline excelsa*	X	
Monoao	*Dacrydium kirkii*	X	
Kahikatea	*Dacrycarpus dacrydioides*	X	X
Kanuka	*Kunzea ericoides*	X	X
Karaka	*Corynocarpus laevigatus*	X	X
Kauri	*Agathis australis*	X	X
Kohekohe	*Dysoxylum spectabile*	X	X
Kowhai	*Sophora chathamica*	X	X
Lacebark	*Hoheria populnea*	X	
Lancewood	*Pseudopanax crassifolium*	X	X
Mahoe	*Melicytus ramiflorus*	X	X
Mamaku	*Cyathea medullaris*	X	X
Māmāngi	*Coprosma arborea*	X	X
Manuka	*Leptospermum scoparium*	X	X
Mapou	*Myrsine australis*	X	X
Milk tree	*Streblis banksii*	X	
Nikau	*Rhopalostylis sapida*	X	X
Pigeon wood	*Hedycarya arborea*	X	X
Ponga	*Cyanthea dealbata*	X	X
Puriri	*Vitex lucens*	X	
Rewarewa	*Knightia excelsa*	X	X
Rimu	*Dacrydium cupressinum*	X	
Tanekaha	*Phyllocladus trichomanoides*	X	
Taraire	*Beilschmiedia tarairi*	X	
Tawa	*Beilschmiedia tawa*	X	
Totara	*Podocarpus totara*	X	X
Turepo	*Streblus banksii*	X	X
Wheki	*Dicksonia squarrosa*	X	X
White maire	*Nestegis lanceolata*		X
Notable other seedlings			
Clematis	*Clematis paniculata*		X
Taurepo	*Rhabdothamnus solandri*		X

*A number of these species have been reclassified within taxonomic nomenclature. The names used here are those still widely used in New Zealand

APPENDIX 3. SOME FURTHER PHOTOS FROM TAHI

TAHI old growth forest - (Courtesy Vicki Ross)

A forest in the 'Telfer block'