

# Restoration monitoring plots – September 2008 update

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25 September 2008

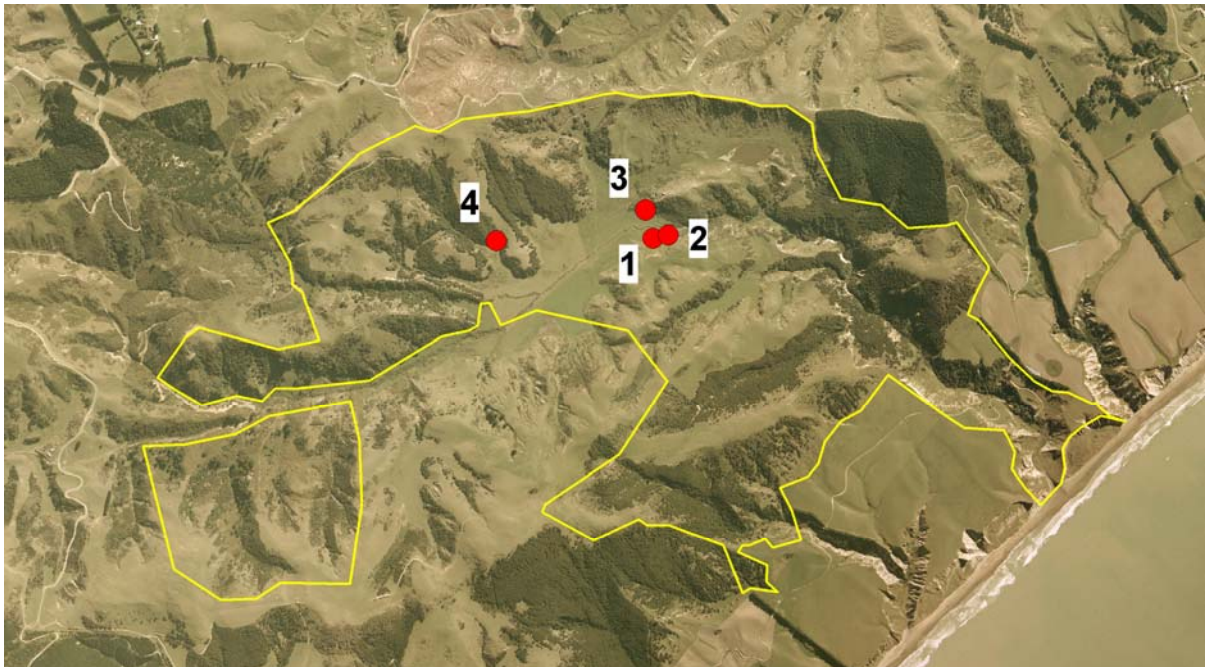
## Background

Section 9.3 of the Tiromoana Bush Restoration Project Management Plan identifies the need to establish permanent monitoring plots within areas of restored vegetation to assess the overall success of the plantings. These plots are to be used to assess both the survivorship and growth of the plantings, and in the longer term, the establishment of ecosystem processes within the plantings. The Plan suggests that plots should be assessed annually, at least during the first 5-10 years after planting, and that at least two plots should be established each year.

This report presents the results of monitoring of five plots established in the first year of planting (2006) and makes recommendations on future monitoring.

## Plot establishment

Four plots were established in August 2006 approximately two months after the first restoration plantings were established. The plots were located in two areas dominated by mixed broadleaved plantings and two in areas of flax-cabbage tree-purei plantings (Figure 1, Table 1). One additional plot was established in an area where tree lucerne was planted, but as all the plants were killed by hares soon after planting this plot was then removed. While the aim was to establish 10 x 10 m plots, plot size was varied depending on the area available.



**Figure 1.** Location of restoration monitoring plots.

**Table 1.** Summary information on restoration monitoring plots.

Plot	Size	Vegetation type	Established	Measured	Measured
1	8x15 m	flax-cabbage tree-sedge	18/8/2006	26/4/2007	24/9/2008
2	10x10 m	mixed broadleaved	18/8/2006	26/4/2007	24/9/2008
3	8x6 m	flax-cabbage tree-sedge	18/8/2006	26/4/2007	14/9/08
4	10x10 m	mixed broadleaved	18/8/2006	26/4/2007	14/9/08

All broadleaved and cabbage tree plants were individually tagged, while numbers of flax and purei were counted. In addition, 10 kahikatea plants established close to R3 were also tagged. The heights of all tagged plants were measured to the top growing tip (or longest alive leaf for cabbage tree) at the initial measurement, and then again in April 2007 and September 2008.

## Results

The overall success of these initial plantings has been poor. The following notes review results from the 2008 re-measurement and contrasts this with the 2006 and 2007 measurements.

Cabbage tree survival was variable, with good survival in R1 and R2, but low survival in R3 and R4 (Table 2). The high mortality in R3 and R4 was a direct result of hares eating out the tops of the plants. Plants in R1 and R2 were less impacted as plastic netting was placed over these plants soon after planting. In contrast flax survival was more consistent across the three sites where it was planted. While cabbage tree survival was higher at some sites than flax, surviving flax plants are now growing vigorously (Figure 2). While purei survival was low (32%) at the one site monitored, remaining plants at this site and elsewhere also look vigorous (Figure 3).

**Table 2.** Survival data for Cabbage tree and flax.

Site	Cabbage tree				Flax			
	2006	2007	2008	% survival	2006	2007	2008	% survival
R1	9	9	9	100	44	36	24	55
R2	9	8	6	67	-	-	-	-
R3	14	3	3	21	10	9	8	80
R4	7	7	2	29	4	4	2	50



**Figure 2.** 2006 (left) and 2008 (right) photos of R1 showing strong flax growth of surviving plants.



**Figure 3.** Vigorous purei near R3.

The success of broadleaved tree plantings was variable between species. Overall, survival of broadleaved trees at R2 and R4 was 60%, although most of the mortality occurred between 2007 and 2008. However, some species did much better than others (Table 3). In particular, lowland ribbonwood (93% survival) and kohuhu (88% survival) did very well, while the other planted species did poorly (lemonwood and kowhai) or totally failed (five-finger, broadleaf and kaikamoko), although the sample sizes for many of these species are very small. Interestingly, lowland ribbonwood individuals are now putting on rapid height growth (56% 2006-07 and 64% 2007-08 increases) while kohuhu individuals are growing much more slowly (46% 2006-07 and 10% 2007-08 increases).

**Table 3.** Survival and growth (cm) for broadleaved trees at R2 and R4 (combined data).

Species	No. 2006	No. 2007	No. 2008	% survival	Height 2006	Height 2008	% increase
Lemonwood	21	18	7	33	57	68	18
Kohuhu	16	14	14	88	35	56	60
Ribbonwood	15	15	14	93	51	131	157
Kowhai	4	2	2	50	27	76	181
Five-finger	2	1	0	0	47	0	-
Broadleaf	2	1	0	0	14	0	-
Kaikamoko	2	2	0	0	42	0	-

The 10 kahikatea planted between the weir and R3 have all survived and put on consistent height growth, increasing from an average height of 100 cm in 2006 to 132 cm in 2008 (33% increase).

### Discussion

Overall, the success of the 2006 restoration plantings can be described as disappointing, with only 101 of the 165 plants tagged in 2006 still alive in 2008 (61% survival). While there was

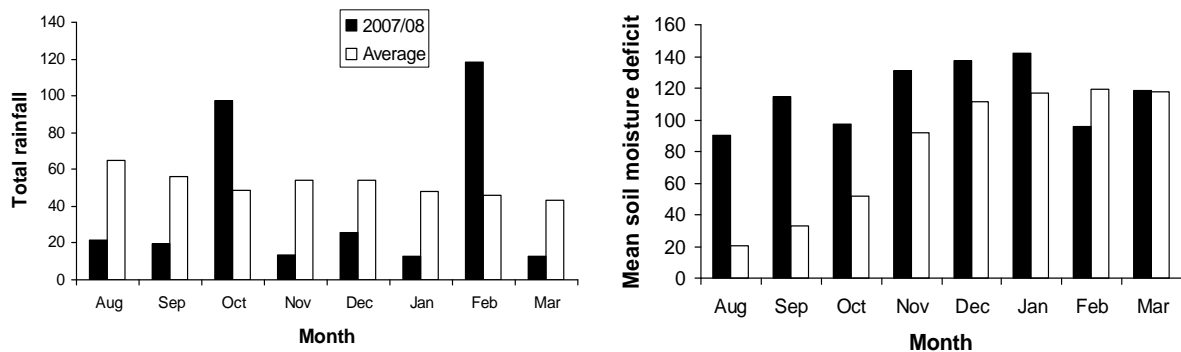
an initial impact on plantings as a result of hare browse, this was addressed through a hare control programme coupled with the use of plastic netting over and repellents sprayed onto plants.

Several changes were made to planting plans as a result of the hare browse in 2006 including:

- Establish plantings later in year (September/October) when other hare food is available.
- Use a spray retardant on all plantings, and on the ground around plants.
- Focus on planting larger plants.
- Focus plantings on same areas where initial plantings were established so as to fill in places where plants have died.

It was also decided to make more use of ngaio in the plantings, a species that is widely regarded as less palatable than other broadleaved species.

Unfortunately there has been ongoing mortality since the April 2007 measurements which appears most likely the result of competition for soil moisture with the dense grass sward that is present at all restoration sites. The 2007/08 spring and summer was particularly dry in North Canterbury, with below average rainfall in all months except October and February and above average soil moisture deficits until February (Figure 4). Interestingly, restoration plantings of the same age in sites that either have a more southerly aspect and/or are in areas with less rank grass growth do appear to be doing significantly better than those monitored here (Figure 5).



**Figure 4.** Total monthly rainfall and mean soil moisture deficits from the NIWA Waipara West climate station for 2007/08 and the 1990-2008 average.

Notwithstanding this, once plants have become well established and start to overtop the grass sward, growth appears to be much more rapid and it would seem likely that these plants (especially lowland ribbonwood, flax and purei) will now survive. However, smaller individuals remain vulnerable to soil moisture stress should a further dry summer occur.

Success of the 2007 plantings appears to have been better than for the 2006 plantings, reflecting the changes in plant establishment described above. However, a severe frost during the 2008 winter has killed a number of ngaio, especially in sites that do not receive any winter sun (Figure 6), while deer browse has been noticed on some other plants (e.g., kohuhu).



**Figure 5.** Restoration plantings in a less dense grass sward opposite the R2 monitoring site.



**Figure 6.** Frost killed ngaio seedling near restoration monitoring site R4.

The results of the monitoring reported in this report have been discussed with Jason Butt at Waioira Landscapes, and it is proposed to take the following approach for future plantings:

- Continue to use larger plants, especially for vulnerable species such as cabbage tree
- Use repellents and covers to make plants less attractive to hares (and CWS will continue with their hare, goat and deer control programme)
- Focus on plants that are less palatable
- Use blanket spraying rather than spot spraying to provide greater relief from the grass sward, especially during the first year.

It is proposed to establish two further monitoring plots in mixed broadleaved plantings established in October 2008, and continue monitoring the existing plots.