



Department of Conservation  
*Te Papa Atawhai*

**Kohekohe Forest Condition Report For**  
**Areas With Regular Or Intermittent**  
**Possum Suppression**  
**Winter 2000**

WANGANUI CONSERVANCY MONITORING REPORT 2000/06

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## **Executive summary**

- ◆ Kohekohe trees were surveyed using the Foliar Browse index at 5 sites in the Taranaki Region.
- ◆ Three sites receive regular possum suppression using bait station, while the other two sites receive intermittent possum suppression through 1080 drops every 7 years or so.
- ◆ Condition of kohekohe trees at all sites was reasonable to good.
- ◆ Browse and damage levels tended to be greater at sites with intermittent possum control than those with regular control.
- ◆ The status of the trees, canopy or subcanopy, significantly affects the foliage density, stem diameter and fruit production.
- ◆ The purpose of pest suppression needs to be clarified and monitoring adjusted or modified accordingly.
- ◆ Review the pest management objectives for each site in 2005 if this has not been done prior to this date.

## **Introduction**

Kohekohe (*Dysoxylum spectabile*) is New Zealand's only representative of the large Meliaceae (Mahogany) family, members of which have a mostly tropical distribution (Court, *et al.*, 1988). It has large leaves and conspicuous flowers and fruits borne on panicles coming directly off the main trunk and branches. Flowers occur mostly in autumn and early winter. Fruit takes a year to mature and will have been set during the previous years flowering. It is a dioecious species, so fruit occurs on female trees and very occasionally on the males (Braggins, *et al.*, 1999).

In the Wanganui Conservancy kohekohe has a scattered distribution from North Taranaki down to Wanganui. However, on land administered by the Department of Conservation, it is found in only five main locations. Because of the relative scarcity of this forest type in Wanganui Conservancy, and also because possums are known to inhibit flowering and fruiting of kohekohe either directly or indirectly, three of these sites receive special protection in the form of bait station grids throughout.

The aim of this work was to provide long term, repeatable monitoring of kohekohe canopy condition, possum browse levels and flowering and fruiting intensity.

## **Methods**

Transects were laid out in 5 areas of public conservation land. Three of the sites are treatment areas, and receive systematic possum suppression using bait stations in grids. Two other sites were included as 'no-treatment' areas, however they do receive occasional, but less frequent or systematic, possum control.

The Foliar Browse Index method (Payton, *et al.*, 1999) was used to assess the kohekohe trees in each area. The data for trees at each area site been combined. The statistical difference between sites that have systematic possum suppression and occasional possum suppression was investigated using a one-way ANOVA in SPSS (SPSS, 1999).

## **Site descriptions**

### ***Lucy's Gully, Egmont National Park - possum suppression area (Cons. Unit 70001)***

Lucy's gully is situated on the western side of the Kaitake range within the boundaries of the Egmont National Park (NZMS 260 P19). Canopy dominants are kohekohe, pukatea (*Laurelia*

*novae-zelandiae*) and rewarewa (*Knightia excelsa*), with some emergent redwood (*Sequoia sempervirens*) and pine (*Pinus* sp.).

Egmont National Park was treated with 1080 in 1993 and 1994 in order to protect a range of indigenous vegetation types (from lowland semi-coastal to montane) and threatened species. Maintenance control within the park is now focused on several areas of special interest including the kohekohe forest in Lucy's Gully. Bait stations are baited with Brodifacoum wax block baits and filled every eight to ten weeks.

Seven plots (52 trees) were sampled (12 June 2000). Some of the plots are associated with existing bait station lines, but all FBI lines have been permanently marked.

Kohekohe trees were in very good condition with no browse seen and very little dieback in the canopy (Table 1). A few trees had moderate possum use on the trunks. Low to moderate quantities of fruit had set on 35% of the trees observed. Only one tree was flowering at this time (2%).

Kohekohe seedlings and saplings were common throughout the area surveyed.

#### ***Blue Rata Scenic Reserve - possum suppression area (Cons. unit 70376)***

Blue Rata Reserve (33 ha) is on the Western flanks of Egmont National Park, next to Stony River (NZMS 260 P20). The area of kohekohe is quite small and confined to the western end of the reserve. Canopy dominants are kohekohe, tawa (*Beilschmiedia tawa*) and rewarewa.

Initial knockdown using cyanide during (year?) currently filling 50 bait stations with Brodifacoum every 4 weeks during the summer months (six months in total) and a cyanide line once a year during winter. Boundary control by the Taranaki Regional Council also contributes significantly to the control within this reserve.

Six plots were put in and 50 trees sampled (21 June 2000). No possum browse was seen (Table 1) and only one tree had signs of possum use (probably old). Thirty four % of trees had low to moderate fruit set, and just one tree was in flower (2%). One large pile of ripe fruit was seen on the ground, with the seed mostly removed and eaten but it was not possible identify the agent responsible. Canopy condition was mostly good, although some trees scored moderately high in the dieback class. There was some indication of recovery of these trees. Some seedling regeneration of kohekohe was also noted.

The fence bordering the reserve at the start of the transect has fallen over and is just about horizontal in some places, but there was no sign of stock or goats inside the reserve.

#### ***Tarata Conservation Area - possum suppression area (Cons. Unit 70350)***

Tarata Reserve (133 ha) is in North Eastern Taranaki (NZMS 260 Q19). Described as a rimu tawa forest, with primary and secondary forest on a variety of land forms. This reserve is unusual in that it contains kohekohe further inland (24-km) than generally occurs in this district. The kohekohe is restricted to one face in the NW corner of the reserve. Canopy dominants in that area are kohekohe, pukatea and mahoe (*Melicytus ramiflorus*).

Initial knockdown of possums was undertaken by Task force Green in 1994/95, and continued during 1995/96. Ongoing control initially used 45 Talon baitstations(1998/99) but this has been upgraded to 150 baitstations (1999/2000) which are refilled with waxed Pestoff baits every month for the six months over summer. A cyanide line is run over winter.

Eight plots were put in and 52 trees sampled (20 June 2000). The condition of the canopy was good, with low levels of dieback. Low possum browse was scored on 9% of the Kohekohe trees (Table 1), and some heavy use was noted on Mahoe. Fresh possum pellets were found on the farm/bush boundary near transect 1. Fruit set was low (13% of trees), as was flowering (6% of trees). Regeneration of Kohekohe was scarce.

A herd of approximately 30 goats were seen just outside the reserve near transect 1. About 12 goats were seen inside the reserve. The fence at the farm/bush boundary near the transects is not in good repair and is no obstacle to goats.

A falcon was seen two days running (grid ref: 273 264) and may be resident?

### ***Timaru Road end, Egmont National Park - occasional possum suppression (Cons. unit 70001)***

This site is on the western side of the Kaitake Range and about 2 km from Lucy's gully (NZMS 260 P19). Canopy dominants are kohekohe, pukatea and rewarewa. Since it is part of Egmont National Park, it receives periodic 1080 poison drops, the first and only drop so far during 1993/94. In addition, about one month prior to the setting up of these plots, approx. 150 possums were taken out in a boundary poisoning operation.

Nine plots were put in and 50 trees sampled (15 June 2000). Canopy condition was good. From the adjoining farm kohekohe foliage is easily visible and forms a continuous layer. Stem use and browse were more frequent here than at the other sites, although browse levels were low overall. Thirty six % of kohekohe trees were fruiting and 10% flowering (Table 1). Regeneration of kohekohe appeared to be scarce.

### ***Taramoukou Conservation Area - occasional possum suppression (Cons. Unit 70020)***

Taramoukou is a 1600 ha forest patch in North Taranaki (NZMS 260 Q19), with a much smaller area of kohekohe forest within. This forest is an outlying area of pukatea and kohekohe-dominant forest with emergent rimu and abundant nikau and kawakawa. It is the most extensive remaining tract kohekohe forest in the ecological district. A small enclave of primary kahikatea forest represents a type now very rare in North Taranaki.

Possum numbers have been high here in the past (pers. com Darren Howell). Approximately 700 ha of this area was treated with 1080 in 1992/93 resulting in a 93.2% kill. Sustained control is maintained around the perimeter, an approximate area of 400 ha, using Brodifacoum in bait stations and occasional use of leghold traps.

This site was sampled nearly one month later than the other four areas (17 July 2000). Seven plots were established and 48 trees sampled.

Possum browse was observed at low to moderate levels in 29% of trees sampled (Table 1), with a similar frequency of stem use. Fruiting frequency was lower than at three of the other sites, and was generally very sparse (often only one or two fruits on a tree) possibly due to surveying this site later than the other sites. Few trees were flowering. A few trees had moderately severe dieback, with no sign of recovery. Low levels of dieback were observed in most trees.

### **General observations**

Generally, the condition of kohekohe forest at all the sites was good. Foliar density scores were high and similar at each site (Figure 1). Browse (Figures 3 & 4) was non-existent, or at low

intensity at sites with regular possum suppression (Lucy's Gully, Tarata, and Blue Rata), and somewhat higher at sites with occasional pest suppression (Taramoukou, and Timaru). Dieback (Figures 5 & 6) was mostly low at sites with pest suppression and slightly higher at other sites. The few trees at Blue Rata that had more extensive dieback also showed signs of canopy recovery. Stem use was somewhat heavier in areas with intermittent possum control than in areas with regular possum control (Figure 2).

Fruiting and flowering intensity was generally low at all sites (Figures 7 & 8). The lower fruiting frequency at Tarata may just be natural variation but requires further investigation. Kohekohe can be quite variable in its fruiting and flowering between individual trees, areas, and years, and sub-canopy trees are less likely to flower and fruit than canopy trees. The smaller average diameter for kohekohe stems could indicate that trees are less mature or sub-canopy rather than canopy trees.

Condition of Kohekohe forest at the two "non-treatment" sites (Timaru Rd. and Taramoukou) was not as good as at the treatment sites. Timaru Rd had the lowest mean FDI score (Table 2), and possum browse and stem use was noted on a quarter of trees sampled (Table 1). However, intensity of this browse was generally low. Taramoukou also had a significant number of trees browsed, some of them fairly heavily. Trees showing more extensive levels of dieback also had no sign of recovery.

**Table 1: Frequency of fruit, flowers, whole tree browse and stem use as a percentage of the total number of trees sampled at each site.**

Area	Sample size	Fruit (%)	Flowers (%)	Browse (%)	Stem use (%)
Blue Rata	50	34	2	0	2
Tarata	52	13	6	9	21
Lucy's gully	52	35	2	0	15
Timaru Rd.	50	36	10	26	26
Taramoukou	48	21	4	29	24

**Table 2: Mean Foliar Density Index, standard error and sample size for each site.**

Area	Mean FDI	95% SE	n
Lucy's Gully	63.00	2.49	52
Tarata	62.83	2.59	52
Blue Rata	60.56	2.62	50
Taramoukou	60.95	2.71	48
Timaru	57.24	2.51	50

Regeneration of Kohekohe varied. Seedlings and saplings were abundant at Lucys Gully and Blue Rata while regeneration at Tarata, Timaru Rd. and Taramoukou was scarce.

### **Comparison between sites**

The pairwise analysis table can be found in appendix 1. This section summarises those findings and illustrates them with Figures 9 to 11.

Stem diameter at Taramoukou was significantly greater than any other site (Figure 9). Lucy's Gully had significantly larger tree diameter than Tarata and Timaru, but the other sites were not significantly different from each other.

Foliage density was similar for all sites, but Timaru Road had significantly lower foliage density than all sites except Blue Rata Reserve (Figure 11).

Lucy's Gully and Tarata tended to have significantly less dieback (both top and whole) than the other sites. Taramoukou (intermittent possum suppression) had the greatest degree of top dieback (though this was not significantly different from Blue Rata or Timaru) while Timaru (intermittent possum suppression) had the greatest degree of overall dieback (although this was not different from dieback scores in Blue Rata Reserve).

The two sites with intermittent possum suppression (Taramoukou and Timaru) had significantly greater levels of browse, both top and whole, than seen at the sites with systematic possum suppression.

Stem use was greatest at Timaru and smallest at Blue Rata. Stem use scores were low for all sites and did not generally differ significantly between sites.

Flower scores were low with Timaru having the highest average score, which was significantly different from the flowering intensity at Blue Rata. Fruiting varied among the sites with no obvious relationship of the intensity of fruiting with the possum suppression history. Tarata (regular pest suppression) had significantly smaller quantities of fruit compared to all other sites except for Taramoukou (intermittent pest suppression). Lucy's Gully, Blue Rata (both regular possum suppression) and Timaru (intermittent suppression) had roughly equal and somewhat higher intensities of fruit production.

### **Comparison between sites with and without regular pest suppression**

The sites were grouped according to their possum management history. The three sites with regular bait station programs were compared to the sites that receive intermittent aerial 1080 or other possum suppression treatment.

For all indices, except fruiting and flowering, sites with regular possum suppression had significantly better scores than sites with intermittent suppression. That is, dieback, browse, and stem use were all lower while foliage density was higher at sites with pest suppression (Table 3 and Figure 13).

**Table 3: ANOVA comparison of sites with regular possum suppression with those with intermittent possum suppression**

Foliar browse index	df	F	Pr>F	Significant
Foliage density	1	8.74	0.0034	yes
Dieback top	1	11.58	0.0008	yes
Dieback whole	1	15.91	0.0001	yes
Browse top	1	28.27	0.0000	yes
Browse whole	1	35.78	0.0000	yes
Stem use	1	7.11	0.0082	yes
Flowers	1	2.55	0.1115	
Fruits	1	0.31	0.5773	

### **Comparison of canopy and sub-canopy trees**

Some of the above differences, or lack of differences, can possibly be attributed to the number of canopy trees or sub-canopy trees that were scored for each site. For instance, more sub-canopy trees were scored at Tarata than any other site (Figure 14). This has probably contributed to the low fruiting intensity and small average stem diameter for that site.

Canopy trees tended to have significantly denser foliage, significantly greater stem diameters, and generally more fruit than sub-canopy trees. Browse was mostly confined to canopy trees, and stem use was more prevalent on canopy trees than sub-canopy trees.

### **Discussion**

Both the intermittent and regular possum suppression appears to be maintaining the kohekohe canopy in reasonable health. Regular possum suppression does have more positive benefits than the intermittent control since it reduces damage indices, produces denser kohekohe canopies and there is a tendency towards more fruit production.

Canopy trees appear to be more sensitive indicators of possum browse than sub-canopy trees. Fruit production, and to some extent flower production, is more likely to occur on canopy trees than sub-canopy trees. Both these factors are probably related to greater energy availability for trees that penetrate the canopy, as opposed to those that are shaded out by overtopping trees (A Dijkgraaf pers. obs.).

The monitoring needs to be linked to the purpose for the systematic possum control. If the emphasis of the possum suppression programme at these sites is to maintain the kohekohe canopy then monitoring every second year, or when the pest management changes, will be sufficient.

If pest suppression is undertaken to ensure that the kohekohe trees are maintained in a condition to be reproductively successful, then seedling plots need to be established. Some seedling plots have already been established at Lucy's Gully and need to be remeasured this summer. Similar seedling plots could be established in the other four sites to monitor regeneration success. To obtain the most comprehensive information these plots should be remeasured at the same time of the year on an annual basis. Once the seedling plots are laid out it would probably take a day or so to remeasure per site.

If the production of food for birds is the main criteria for protecting the various kohekohe forests then the foliar browse index should be supplemented by a method that more accurately quantifies the number of flowers and fruits. This can easily be done in conjunction with the FBI, but will require annual surveys during May or July. Possible methods include counting fruits per cubic metre (A. Dijkgraaf PhD thesis) or counting fruit per X metre of trunk.

Current levels of protection appear to be adequate to maintain a kohekohe canopy at all sites. However, none of the sites are totally without pest suppression and therefore can not reveal the true impact that pest suppression has in these forests. If the purpose of the monitoring is to illustrate the effectiveness of pest suppression then kohekohe forest patches without any possum suppression need to be located and monitored.

### **Recommendations**

- ◆ There is a need to more accurately identify the purpose of the possum suppression regimes at the various sites and implement the appropriate monitoring (as discussed above). The four main reasons for possum suppression are;
  1. Maintain the kohekohe canopy;
  2. Ensure regeneration potential of the kohekohe forest;
  3. Ensure adequate food supply for birds within the forest;
  4. Illustrate the effectiveness of possum control.
- ◆ The monitoring methods and periodicity should reflect the objective for possum suppression management.
- ◆ Continue monitoring. Plots should be remeasured at around the same time either annually or biannually as appropriate to pest management objectives.

- ◆ If any further lines are set up, or if additional trees are required, canopy trees should be selected in preference to sub-canopy trees. Canopy trees appear to be more sensitive to changes in possum suppression management.
- ◆ The objectives of pest suppression for each sites and appropriate monitoring should be reviewed in 2005, if this has not been done earlier.
- ◆ Additional data on flowering and fruiting intensity could be collected annually.
- ◆ Seedling plots could be established at all sites and measured in conjunction with the foliar browse method to ensure that the kohekohe forest is regenerating. This is especially important for areas that also experience goat browse.
- ◆ Fencing at Blue Rata and Tarata could be improved, and goat control continued.

### **Data and spreadsheets**

#### *Excel files*

Data has been entered and checked, file - dys spe data WANCO-19503

Kohekohe data for SPSS - WANCO-20498

Kohekohe data (incl canopy – subcanopy) WANCO-20852

#### *Data analysis SPSS input files*

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U:\WANCO\Adijkgraaf\SPSS stuff\kohekohe\kohekohe FBI 2000 +canopy-subcanopy

#### *Data analysis SPSS output files*

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U:\WANCO\Adijkgraaf\SPSS stuff\kohekohe\comparing sites kohekohe 2000 for canopy vs subcanopy

#### *Graphs*

U:\WANCO\Adijkgraaf\kohekohe monitoring\kohekohe monitoring 2000.dg4 (Deltagraph file)

U:\WANCO\Adijkgraaf\kohekohe monitoring\kohekohe monitoring 2000 canopy vs subcanopy.dg4 (Deltagraph file)

### **Acknowledgements**

Thanks to Keith Beautrais, Delisa Rutland, Darren Howell and Paul Prip for field assistance. A special thanks to Chris Stowe for all his hard work setting all the lines up.

### **References:**

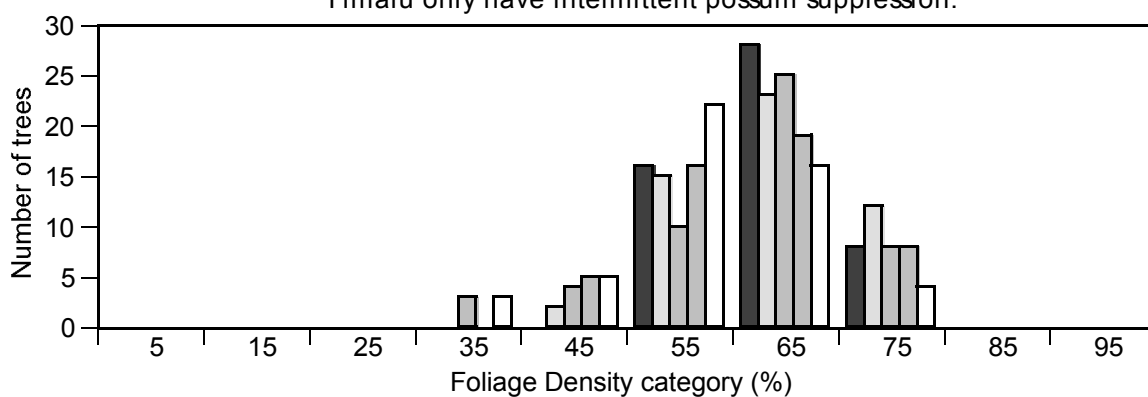
Braggins, J. E., Large, M. F., *et al.* (1999). “Sexual arrangements in kohekohe (*Dysoxylum spectabile*, Meliaceae).” *Telopea* **8**(3): 315-324.

Court, A. J. and Mitchell, N. D. (1988). “The germination ecology of *Dysoxylum spectabile* (Meliaceae).” *New Zealand Journal of Botany* **26**(1): 1-6.

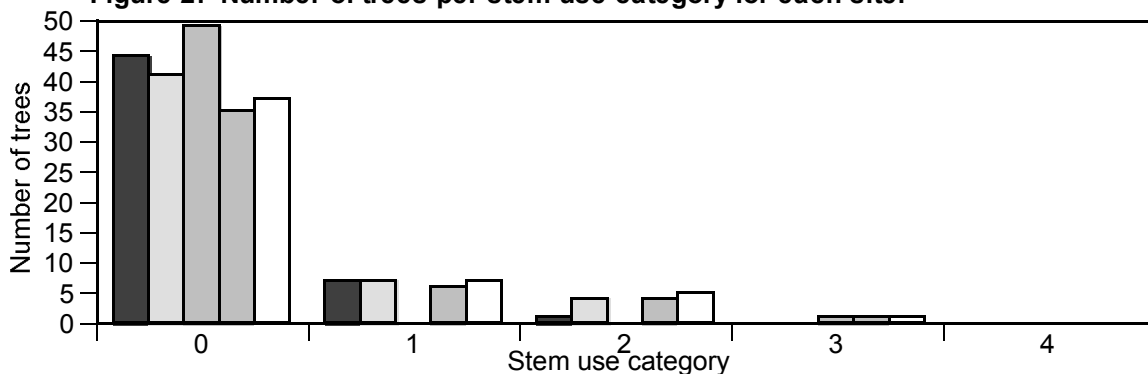
Payton, I. J., Pekelharing, C. J., *et al.* (1999). Foliar Browse Index: A method for monitoring possum (*Trichosurus vulpecula*) damage to plant species and forest communities. Contract report for Department of Conservation. Lincoln, Manaaki Whenua - Landcare Research: 62. of 62 pp.

SPSS (1999). SPSS for Windows.

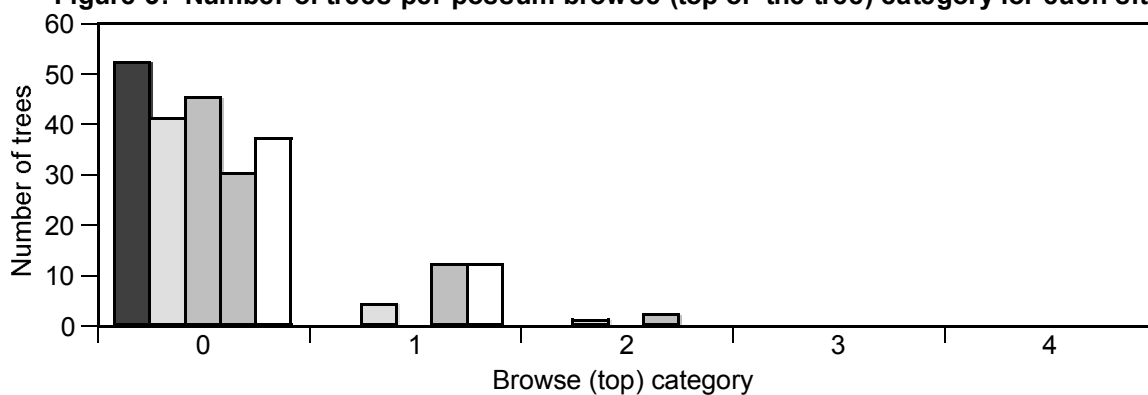
**Figure 1: Number of trees in each Foliage Density Index category at each of five sites.**  
 Lucy's Gully, Tarata, Blue Rata have regular possum suppression, while Taramoukou and Timaru only have intermittent possum suppression.



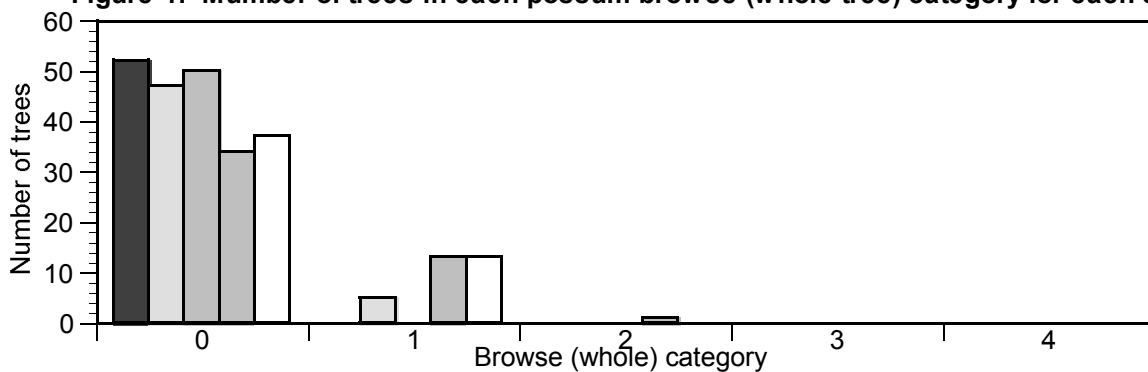
**Figure 2: Number of trees per stem use category for each site.**



**Figure 3: Number of trees per possum browse (top of the tree) category for each site**

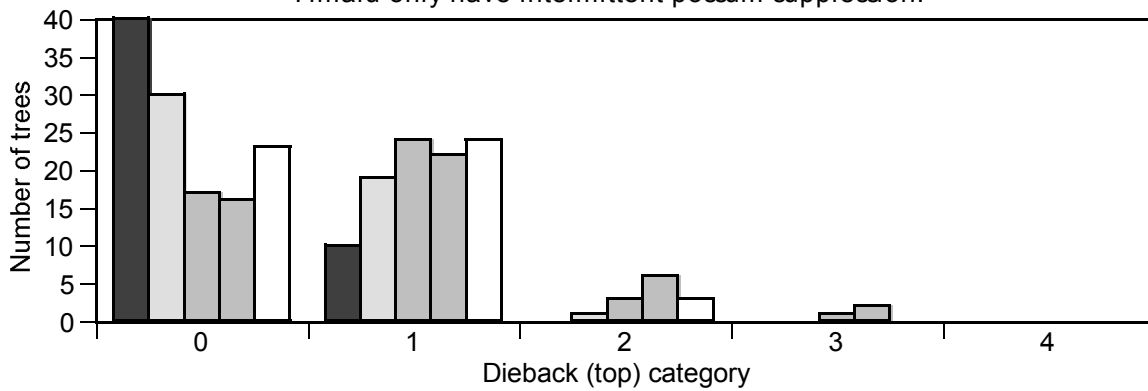


**Figure 4: Number of trees in each possum browse (whole tree) category for each site**

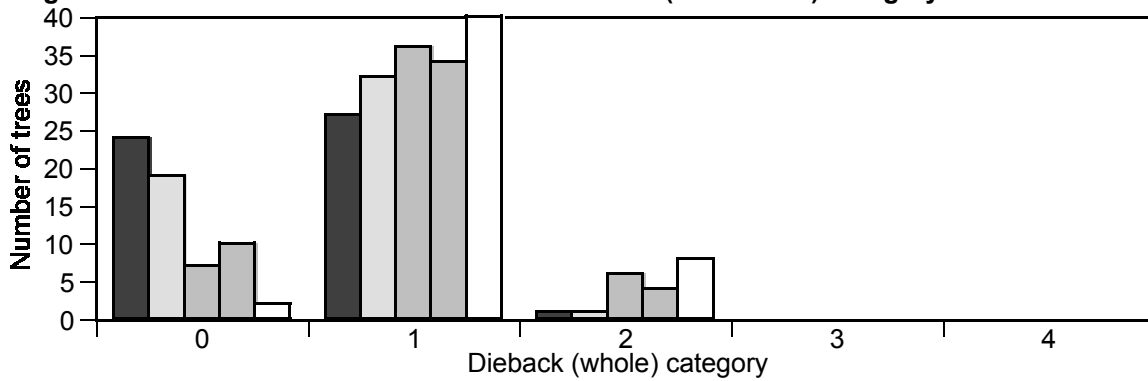


Lucy's Gully  
  Tarata  
  Blue rata  
  Taramoukou  
  Timaru

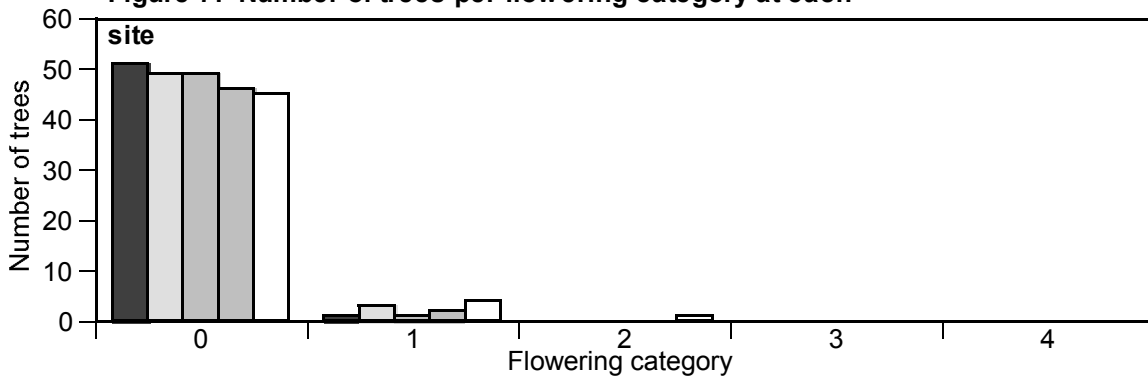
**Figure 5: Number of trees in each Dieback Index (top of tree) category at each of five sites.**  
 Lucy's Gully, Tarata, Blue Rata have regular possum suppression, while Taramoukou and Timaru only have intermittent possum suppression.



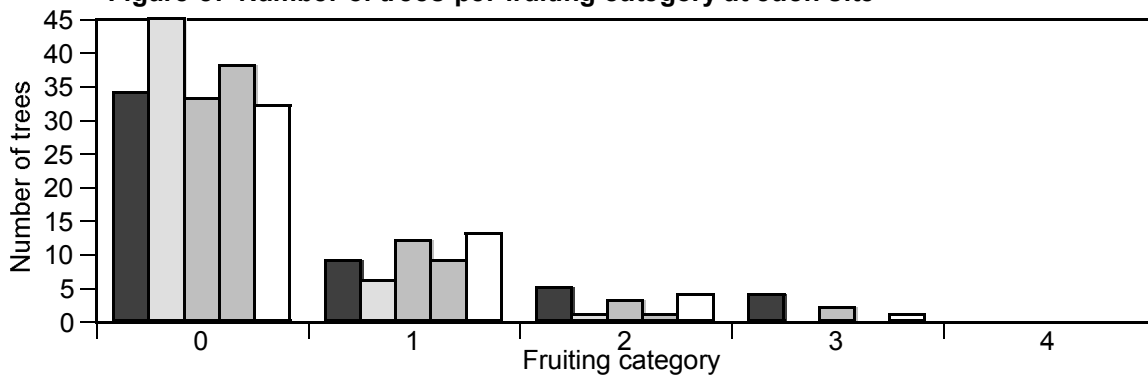
**Figure 6: Number of trees in each Dieback Index (whole tree) category at each of five sites.**



**Figure 7: Number of trees per flowering category at each site**

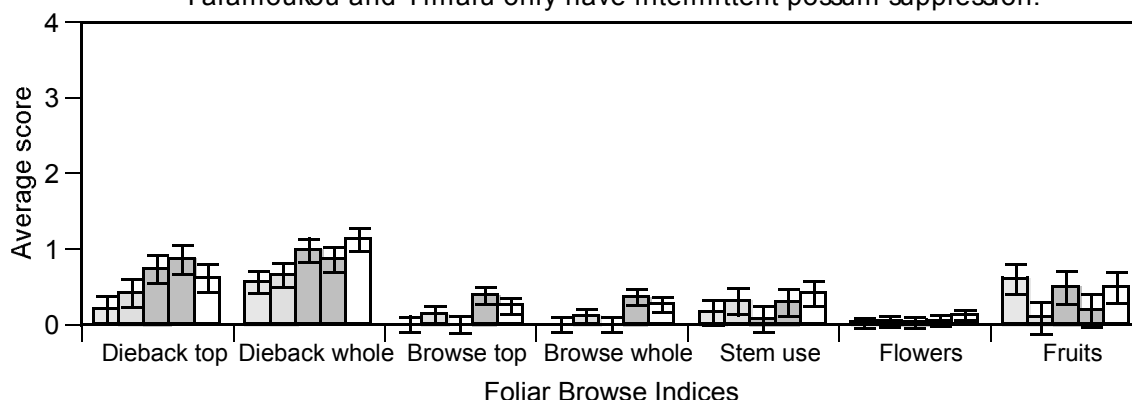


**Figure 8: Number of trees per fruiting category at each site**

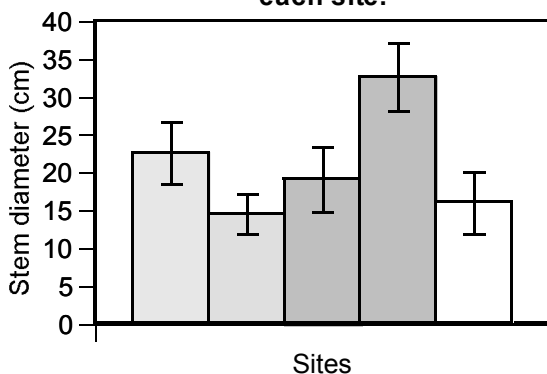


Lucy's Gully  
  Tarata  
  Blue Rata  
  Taramoukou  
  Timaru

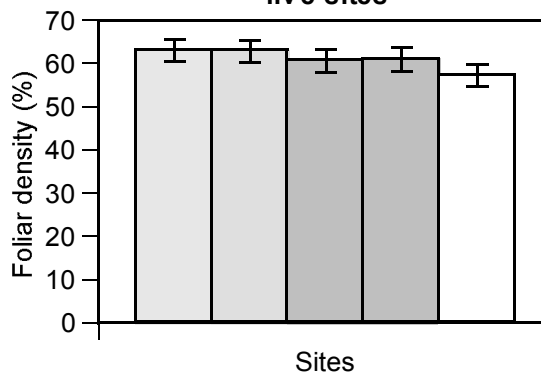
**Figure 9: Average Foliar Browse Indices for each of five sites.**  
 Lucy's Gully, Tarata, Blue Rata have regular possum suppression, while Taramoukou and Timaru only have intermittent possum suppression.



**Figure 10: Average diameter of kohekohe at breast height for each site.**

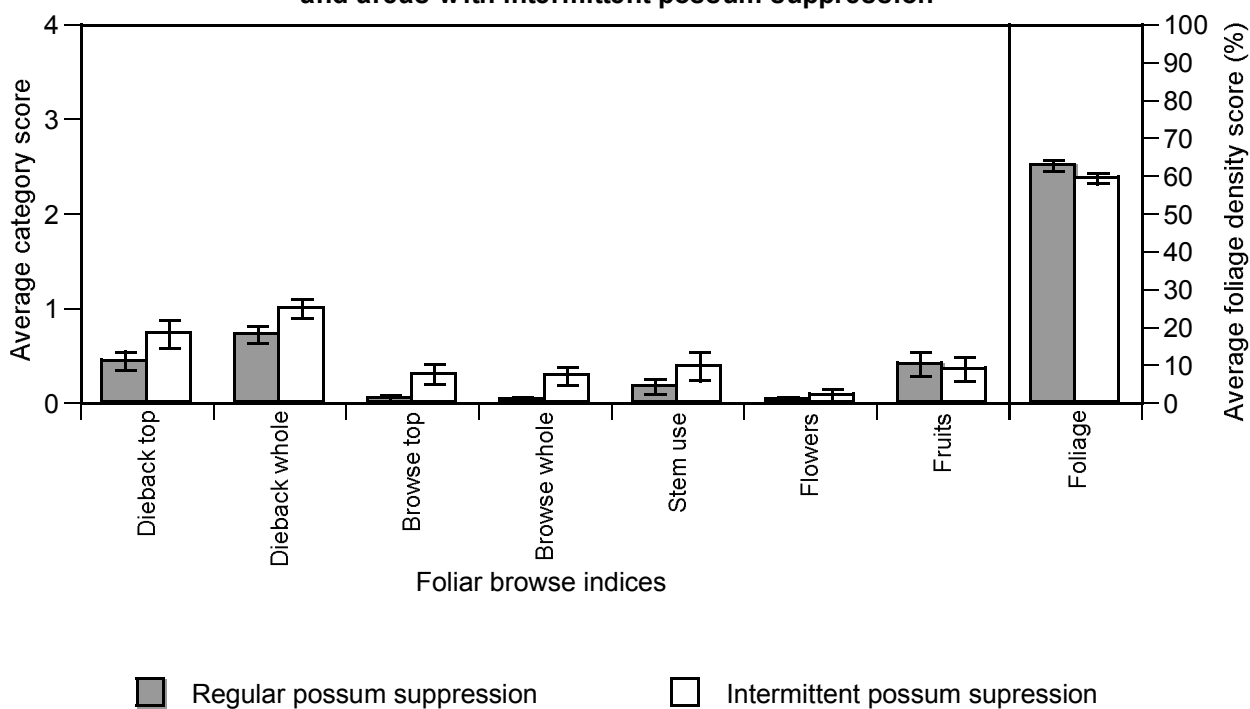


**Figure 11: Average foliar density of kohekohe for each of five sites**

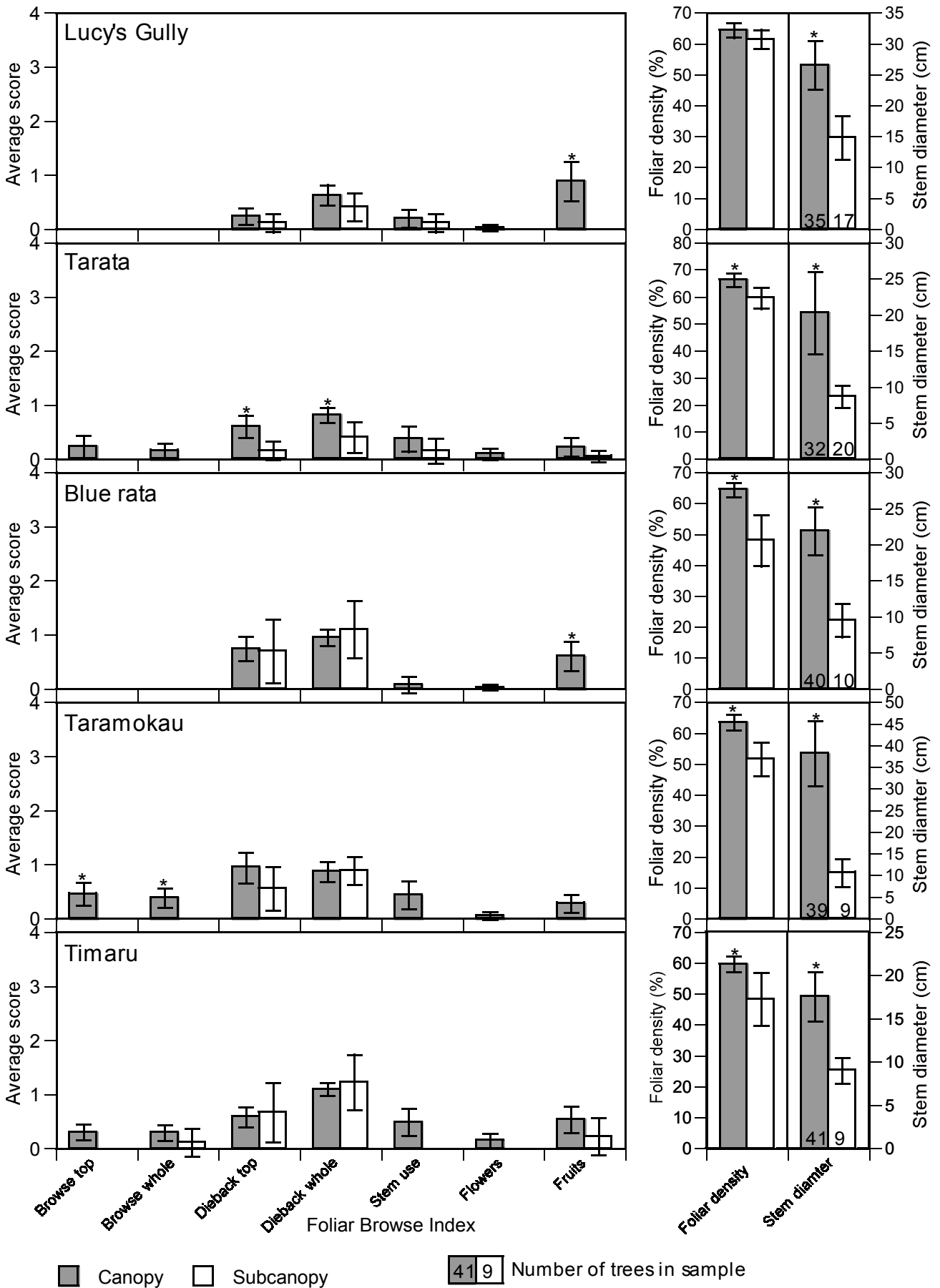


Legend for Figures 10 and 11:  
 □ Lucy's Gully   □ Tarata   ■ Blue Rata   ■ Taramoukou   □ Timaru

**Figure 13: Comparison of means for areas with regular possum suppression, and areas with intermittent possum suppression**



**Figure 14: FBI indices for canopy and subcanopy kohekohe trees for each of five sites**  
 Lucy's Gully, Tarata, Blue Rata have regular possum suppression,  
 while Taramokau and Timaru only have intermittent possum suppression.



Legend:  Canopy  Subcanopy 41 9 Number of trees in sample  
 Error bars = 95% standard error of the mean; \* = Significant difference at 5% level  
 WANCO-20802

**Appendix 1:** Comparison between sites.

Dependent Variable	(I) Site	(J) Site	Mean Difference (I-J)	95% Std. Error	Significance value	Difference between sites signif?
Stem diameter	Blue Rat	Lucy's Gully	-3.50	5.93	0.24	no
		Taramoukou	-13.58	6.19	0.00	yes
		Tarata	4.53	6.05	0.14	no
		Timaru	3.06	5.95	0.30	no
	Lucys	Blue Rata	3.50	5.93	0.24	no
		Taramoukou	-10.08	6.04	0.00	yes
		Tarata	8.04	5.89	0.01	yes
		Timaru	6.57	5.80	0.02	yes
	Taramoka	Blue Rata	13.58	6.19	0.00	yes
		Lucy's Gully	10.08	6.04	0.00	yes
		Tarata	18.11	6.15	0.00	yes
		Timaru	16.64	6.06	0.00	yes
	Tarata	Blue Rata	-4.53	6.05	0.14	no
		Lucy's Gully	-8.04	5.89	0.01	yes
		Taramoukou	-18.11	6.15	0.00	yes
		Timaru	-1.47	5.92	0.62	no
	Timaru	Blue Rata	-3.06	5.95	0.30	no
		Lucy's Gully	-6.57	5.80	0.02	yes
		Taramoukou	-16.64	6.06	0.00	yes
		Tarata	1.47	5.92	0.62	no
foliage	Blue Rat	Lucy's Gully	-2.44	3.61	0.18	no
		Taramoukou	-0.40	3.77	0.83	no
		Tarata	-2.27	3.69	0.22	no
		Timaru	3.31	3.63	0.07	no
	Lucys	Blue Rata	2.44	3.61	0.18	no
		Taramoukou	2.05	3.68	0.27	no
		Tarata	0.17	3.59	0.92	no
		Timaru	5.76	3.54	0.00	yes
	Taramoka	Blue Rata	0.40	3.77	0.83	no
		Lucy's Gully	-2.05	3.68	0.27	no
		Tarata	-1.87	3.75	0.32	no
		Timaru	3.71	3.70	0.05	yes
	Tarata	Blue Rata	2.27	3.69	0.22	no
		Lucy's Gully	-0.17	3.59	0.92	no
		Taramoukou	1.87	3.75	0.32	no
		Timaru	5.58	3.61	0.00	yes
	Timaru	Blue Rata	-3.31	3.63	0.07	no
		Lucy's Gully	-5.76	3.54	0.00	yes
		Taramoukou	-3.71	3.70	0.05	yes
		Tarata	-5.58	3.61	0.00	yes

Dependent Variable	(I) Site	(J) Site	Mean Difference (I-J)	95% Std. Error	Significance value	Difference between sites signif?
dbackt	Blue Rat	Lucy's Gully	0.53	0.26	0.00	yes
		Taramoukou	-0.12	0.27	0.36	no
		Tarata	0.32	0.26	0.02	yes
		Timaru	0.12	0.26	0.35	no
	Lucys	Blue Rata	-0.53	0.26	0.00	yes
		Taramoukou	-0.66	0.26	0.00	yes
		Tarata	-0.21	0.26	0.10	no
		Timaru	-0.41	0.25	0.00	yes
	Taramoka	Blue Rata	0.12	0.27	0.36	no
		Lucy's Gully	0.66	0.26	0.00	yes
		Tarata	0.44	0.27	0.00	yes
		Timaru	0.24	0.26	0.06	no
	Tarata	Blue Rata	-0.32	0.26	0.02	yes
		Lucy's Gully	0.21	0.26	0.10	no
		Taramoukou	-0.44	0.27	0.00	yes
		Timaru	-0.20	0.26	0.12	no
	Timaru	Blue Rata	-0.12	0.26	0.35	no
		Lucy's Gully	0.41	0.25	0.00	yes
		Taramoukou	-0.24	0.26	0.06	no
		Tarata	0.20	0.26	0.12	no
dbackw	Blue Rat	Lucy's Gully	0.42	0.22	0.00	yes
		Taramoukou	0.12	0.22	0.28	no
		Tarata	0.33	0.22	0.00	yes
		Timaru	-0.14	0.22	0.18	no
	Lucys	Blue Rata	-0.42	0.22	0.00	yes
		Taramoukou	-0.30	0.22	0.01	yes
		Tarata	-0.09	0.21	0.39	no
		Timaru	-0.56	0.21	0.00	yes
	Taramoka	Blue Rata	-0.12	0.22	0.28	no
		Lucy's Gully	0.30	0.22	0.01	yes
		Tarata	0.20	0.22	0.07	no
		Timaru	-0.27	0.22	0.02	yes
	Tarata	Blue Rata	-0.33	0.22	0.00	yes
		Lucy's Gully	0.09	0.21	0.39	no
		Taramoukou	-0.20	0.22	0.07	no
		Timaru	-0.47	0.21	0.00	yes
	Timaru	Blue Rata	0.14	0.22	0.18	no
		Lucy's Gully	0.56	0.21	0.00	yes
		Taramoukou	0.27	0.22	0.02	yes
		Tarata	0.47	0.21	0.00	yes

Dependent Variable	(I) Site	(J) Site	Mean Difference (I-J)	95% Std. Error	Significance value	Difference between sites signif?
browset	Blue Rat	Lucy's Gully	0.00	0.15	1.00	no
		Taramoukou	-0.38	0.16	0.00	yes
		Tarata	-0.13	0.15	0.09	no
		Timaru	-0.24	0.15	0.00	yes
	Lucys	Blue Rata	0.00	0.15	1.00	no
		Taramoukou	-0.38	0.15	0.00	yes
		Tarata	-0.13	0.15	0.08	no
		Timaru	-0.24	0.15	0.00	yes
	Taramoka	Blue Rata	0.38	0.16	0.00	yes
		Lucy's Gully	0.38	0.15	0.00	yes
		Tarata	0.25	0.16	0.00	yes
		Timaru	0.14	0.15	0.08	no
	Tarata	Blue Rata	0.13	0.15	0.09	no
		Lucy's Gully	0.13	0.15	0.08	no
		Taramoukou	-0.25	0.16	0.00	yes
		Timaru	-0.11	0.15	0.13	no
	Timaru	Blue Rata	0.24	0.15	0.00	yes
		Lucy's Gully	0.24	0.15	0.00	yes
		Taramoukou	-0.14	0.15	0.08	no
		Tarata	0.11	0.15	0.13	no
browsew	Blue Rat	Lucy's Gully	0.00	0.14	1.00	no
		Taramoukou	-0.36	0.14	0.00	yes
		Tarata	-0.11	0.14	0.12	no
		Timaru	-0.27	0.14	0.00	yes
	Lucys	Blue Rata	0.00	0.14	1.00	no
		Taramoukou	-0.36	0.14	0.00	yes
		Tarata	-0.11	0.14	0.11	no
		Timaru	-0.27	0.14	0.00	yes
	Taramoka	Blue Rata	0.36	0.14	0.00	yes
		Lucy's Gully	0.36	0.14	0.00	yes
		Tarata	0.25	0.14	0.00	yes
		Timaru	0.09	0.14	0.20	no
	Tarata	Blue Rata	0.11	0.14	0.12	no
		Lucy's Gully	0.11	0.14	0.11	no
		Taramoukou	-0.25	0.14	0.00	yes
		Timaru	-0.16	0.14	0.02	yes
	Timaru	Blue Rata	0.27	0.14	0.00	yes
		Lucy's Gully	0.27	0.14	0.00	yes
		Taramoukou	-0.09	0.14	0.20	no
		Tarata	0.16	0.14	0.02	yes

Dependent Variable	(I) Site	(J) Site	Mean Difference (I-J)	95% Std. Error	Significance value	Difference between sites signif?
stemuse	Blue Rat	Lucy's Gully	-0.09	0.24	0.44	no
		Taramoukou	-0.22	0.25	0.08	no
		Tarata	-0.24	0.25	0.05	no
		Timaru	-0.34	0.24	0.01	yes
	Lucys	Blue Rata	0.09	0.24	0.44	no
		Taramoukou	-0.13	0.24	0.31	no
		Tarata	-0.14	0.24	0.23	no
		Timaru	-0.25	0.24	0.04	yes
	Taramoka	Blue Rata	0.22	0.25	0.08	no
		Lucy's Gully	0.13	0.24	0.31	no
		Tarata	-0.02	0.25	0.88	no
		Timaru	-0.12	0.25	0.32	no
	Tarata	Blue Rata	0.24	0.25	0.05	no
		Lucy's Gully	0.14	0.24	0.23	no
		Taramoukou	0.02	0.25	0.88	no
		Timaru	-0.10	0.24	0.39	no
	Timaru	Blue Rata	0.34	0.24	0.01	yes
		Lucy's Gully	0.25	0.24	0.04	yes
		Taramoukou	0.12	0.25	0.32	no
		Tarata	0.10	0.24	0.39	no
flowers	Blue Rat	Lucy's Gully	0.00	0.10	0.96	no
		Taramoukou	-0.03	0.10	0.62	no
		Tarata	-0.02	0.10	0.67	no
		Timaru	-0.10	0.10	0.04	yes
	Lucys	Blue Rata	0.00	0.10	0.96	no
		Taramoukou	-0.03	0.10	0.58	no
		Tarata	-0.02	0.10	0.63	no
		Timaru	-0.10	0.10	0.03	yes
	Taramoka	Blue Rata	0.03	0.10	0.62	no
		Lucy's Gully	0.03	0.10	0.58	no
		Tarata	0.00	0.10	0.94	no
		Timaru	-0.07	0.10	0.14	no
	Tarata	Blue Rata	0.02	0.10	0.67	no
		Lucy's Gully	0.02	0.10	0.63	no
		Taramoukou	0.00	0.10	0.94	no
		Timaru	-0.08	0.10	0.11	no
	Timaru	Blue Rata	0.10	0.10	0.04	yes
		Lucy's Gully	0.10	0.10	0.03	yes
		Taramoukou	0.07	0.10	0.14	no
		Tarata	0.08	0.10	0.11	no

Dependent Variable	(I) Site	(J) Site	Mean Difference (I-J)	95% Std. Error	Significance value	Difference between sites signif?
fruits	Blue Rat	Lucy's Gully	-0.11	0.29	0.45	no
		Taramoukou	0.30	0.30	0.05	no
		Tarata	0.40	0.30	0.01	yes
		Timaru	0.00	0.29	1.00	no
	Lucys	Blue Rata	0.11	0.29	0.45	no
		Taramoukou	0.41	0.30	0.01	yes
		Tarata	0.51	0.29	0.00	yes
		Timaru	0.11	0.28	0.44	no
	Taramoka	Blue Rata	-0.30	0.30	0.05	no
		Lucy's Gully	-0.41	0.30	0.01	yes
		Tarata	0.10	0.30	0.49	no
		Timaru	-0.30	0.30	0.05	yes
	Tarata	Blue Rata	-0.40	0.30	0.01	yes
		Lucy's Gully	-0.51	0.29	0.00	yes
		Taramoukou	-0.10	0.30	0.49	no
		Timaru	-0.40	0.29	0.01	yes
	Timaru	Blue Rata	0.00	0.29	1.00	no
		Lucy's Gully	-0.11	0.28	0.44	no
		Taramoukou	0.30	0.30	0.05	yes
		Tarata	0.40	0.29	0.01	yes