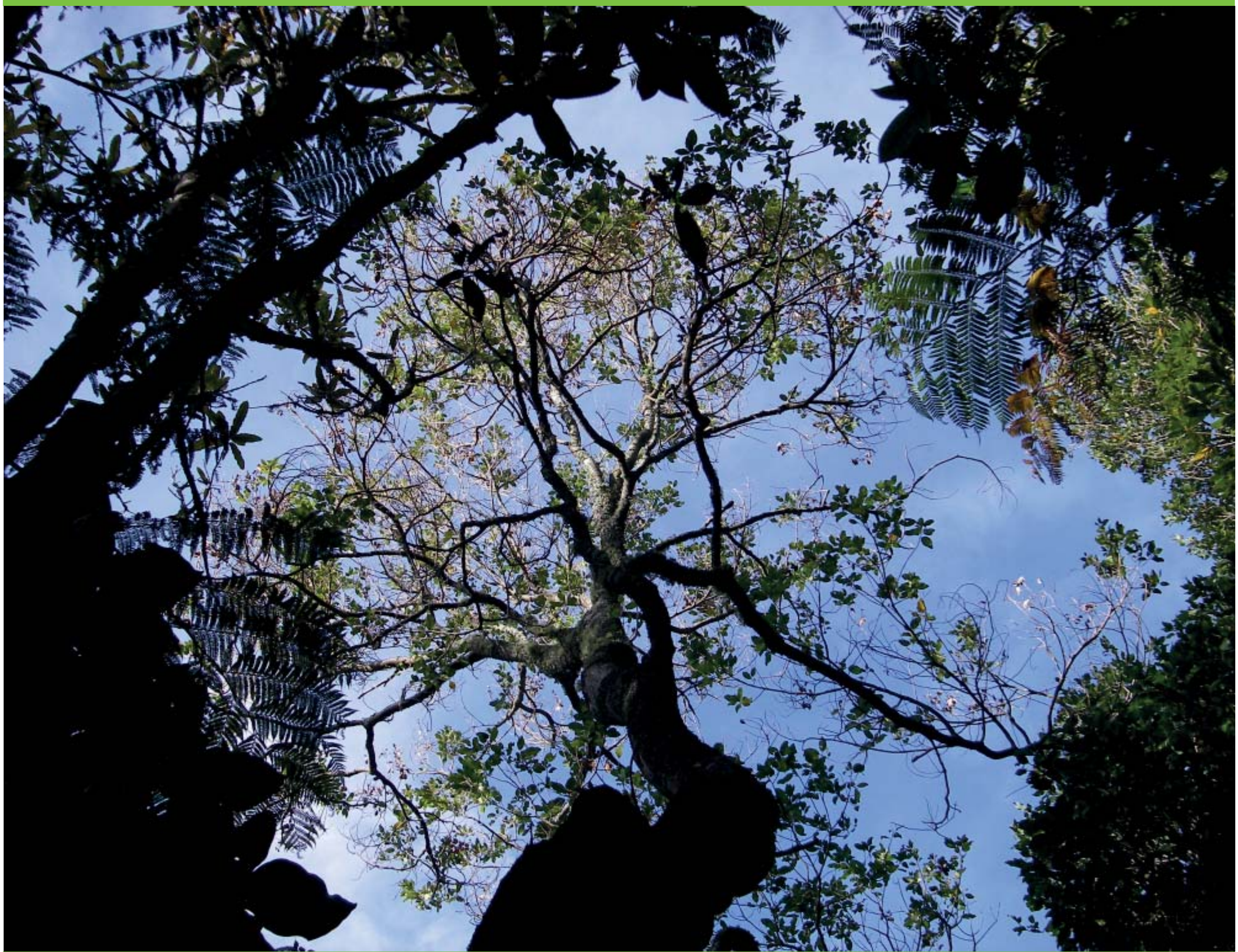
Foliar Browse Index Monitoring Report 2014

Ohope Scenic Reserve



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Cover Photo: Mangeo (*Litsea calicaris*) – Nancy Willems,
Senior Land Management Officer (Eastern), canopy at Plot 6 Line 1

Acknowledgements

Heather MacKenzie and Nancy Willems set up the FBI (Foliar Browse Index) Monitoring Programme in Ōhope Scenic Reserve and developed the methodology used for data analysis in this report. Thank you to the field teams over the monitoring period including: Heather MacKenzie, Nancy Willems, Annabel Beattie, Richard Harris and Mieke Kapa. Thank you to Nancy Willems who gave feedback and comments on this report.

Contents

Part 1: Introduction

Foliar Browse Index (FBI) monitoring was established in Ōhope Scenic Reserve in February 2008 as part of a monitoring programme to assess the outcome of pest control operations. Re-measures were carried out in 2009, 2010, 2012 and 2014. In 2012 Kamahi *(Weinmannia racemosa)* was added as an extra tree species at existing plots as well as kohekohe *(Dysoxylum spectabile)* trees at plots where none were previously monitored, as recommended in Beattie (2010).

The following report gives an overview of the current levels of possum impacts on selected tree species within Ōhope Scenic Reserve, and looks at changes between the five measures (2008, 2009, 2010, 2012, and 2014) of FBI monitoring lines.

Part 2: Background

Ōhope Scenic Reserve is part of a larger area strategically important for biodiversity protection as it contains a relatively large example of pohutukawa *(Metrosideros excelsa)* dominant forest, a nationally rare vegetation type and supports populations of a number of nationally threatened and regionally uncommon flora and fauna species (Wildland Consultants, 2010). Possum browse alters habitat available for these species, causing canopy dieback and potentially the eventual death of plant species heavily targeted for food. Browsing of flowers and fruit also prevents regeneration of these preferred tree species, altering forest composition. Possums have been controlled sporadically in the Ōhope Scenic Reserve with traps and cyanide from 1991 through to 1997 when bait stations were established and treated with Brodifacoum (Wildland Consultants, 2010). Possum control using a significantly improved bait station network (with two stations per hectare) was undertaken in spring 2008, 2009, 2010 but little control was undertaken during the preceding 5-6 years (David Paine, pers comm). Possums have been consistently recorded at less than 1% since 2011.

In order to determine the level of possum impacts and canopy vegetation response to possum control in the Ōhope Scenic Reserve, the FBI standard methodology (Payton et al., 1999) was used. For a more in-depth discussion of the background to this monitoring programme refer to Blackwell (2008), MacKenzie (2009), Beattie (2010), or MacKenzie (2012).

Part 3: Methodology

FBI monitoring is a ground based method used throughout New Zealand to assess canopy health and possum browse levels on selected tree species. In the Ōhope Scenic Reserve kohekohe, mangeao (*Litsea calicaris)* and kamahi are surveyed. Trees are given scores for foliage cover, stem use, browse, dieback, fruiting and flowering based on an indicator species assessment sheet. For a more detailed explanation of the assessment sheet, and further detail on the FBI method, refer to Payton et al. (1999).

Five lines were established within the Ōhope Scenic Reserve on existing stoat trapping and bait station lines, with a total number of 63 plots, and a maximum of three trees per species at each plot. Two plots are no longer surveyed as the trees are either dead or obscured, and therefore unable to be accurately scored, leaving 61 plots.

Kamahi was added in 2012 as an additional tree species as recommended in Beattie (2010), along with some additional kohekohe at plots where they were not already recorded. This increased the sample size of kohekohe from 29 plots to 31 plots. These additional trees were not used in statistical analyses against previous measures, however they will give an increased sample size for future monitoring to compare. The trees in one kohekohe plot died in 2012 resulting in 28 original plots and the two additional plots to be analysed in this report.

For further details on the establishment of the FBI lines in the Ōhope Scenic Reserve, refer to Blackwell (2008), MacKenzie (2009), Beattie (2010) and MacKenzie (2012). Monitoring was carried out in February 2008, February 2009, February/March 2010 and February 2012. Many parameters measured by the FBI methodology vary seasonally so to maintain consistency in scores between years, future measures should be carried out in February.

Data were analysed using the Statistica software package and an Excel spread sheet stored in Objective (Reference Number: A2066000).

Part 4: Results

Results displayed in this report are calculated using plot means, making the plot rather than individual trees the sample unit. The minimum distance between plots of 100 m ensures independence between the samples (Payton et al., 1999).

Below are results for foliage cover, possum browse and canopy dieback for monitored kohekohe, mangeao trees and kamahi (years 2012 and 2014 only) within the Ōhope Scenic Reserve for 2008, 2009, 2010, 2012 and 2014. Dead trees have been excluded from the standard analyses and trees that died between 2010 and 2014 are discussed separately. Thus, the number of mangeao plots has declined from 57 to 53 and the number of kohekohe plots has declined from 29 to 28. Data from previous years has been recalculated to exclude these plots to allow comparison of results between sampling periods; therefore, results may vary from previous year's reports. Wilcoxon Matched Pairs Test was used to test the significance of changes in mean foliage cover, browse and dieback scores for plots over the monitoring period, based on a 95% confidence interval.

4.1 Foliage cover

Table 1 Mean foliage cover (plot) for 2008-2014 of monitored trees in Ōhope Scenic Reserve. With two values for kohekohe from 2012 (additional plots).

Species	Year	n (plots)	Mean foliage cover (%)	Standard deviation
Kohekohe	2008	28	66.43	10.99
	2009		68.75	9.88
	2010		74.82	8.92
	2012	28 (30)	71.19 (70.94)	11.49 (11.15)
	2014		84.58 (84.61)	8.76 (8.45)
Mangeao	2008	53	65.35	10.13
	2009		62.20	12.30
	2010		61.45	12.66
	2012		54.24	18.92
	2014		49.42	22.40
Kamahi	2012	29	58.62	7.59
	2014		59.43	13.34

4.1.1 Kohekohe

Stewart (2000) suggests a realistic benchmark target for kohekohe on mainland New Zealand of 65%. Current mean foliage cover of 85% (Table 1) is good, and indicates that kohekohe in Ohope Scenic Reserve are in good health in terms of foliar cover. Wilcoxon Sign Rank Tests were used to test for significant changes in foliage cover scores. The increase in foliage cover for kohekohe between 2008 and 2014 is significant (P=0.000) and the increase between 2012 and 2014 is significant (P=0.000). This can be seen in Figure 1 where the 2014 kohekohe boxplot is much higher compared to the previous monitoring years.

4.1.2 Mangeao

Current mean foliage cover of 49% for mangeao is moderate. The decrease in foliage cover for mangeao from 2008 to 2014 is significant (P=0.000). This can be seen in Figure 1 where the 2014 mangeao boxplot is visibly lower. Mangeao boxplots in 2012 and 2014 cover a much wider range than both kohekohe and kamahi, showing that the foliage cover score varies more widely across the plots.

4.1.3 Kamahi

Current mean foliage cover of 58% for kamahi is moderate. Figure 1 shows the range of kamahi foliage cover scores cover a much wider range than in 2012.

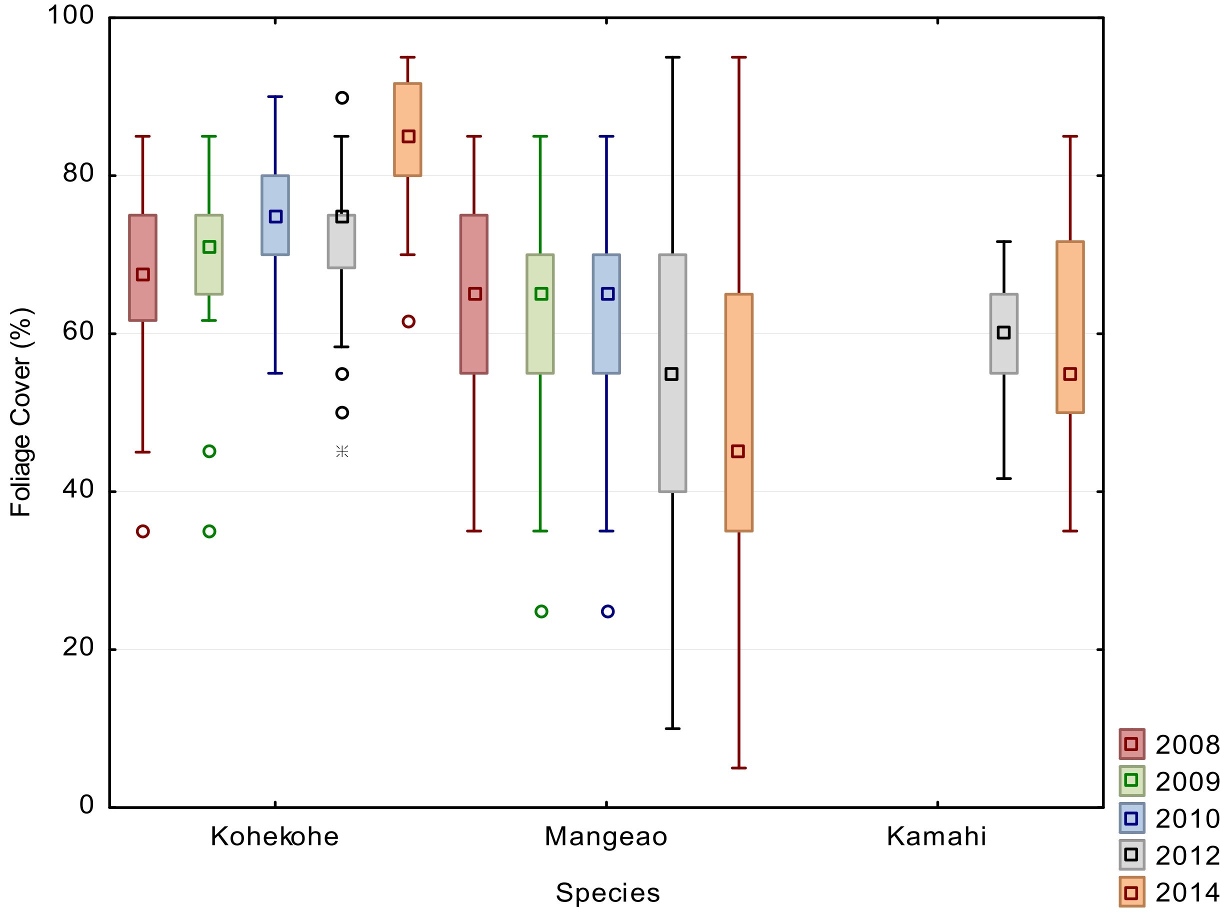

Figure 1 *Boxplot showing mean foliage cover (plot) of monitored trees. The box represents the middle 50% of the data (between lower and upper quartiles), with the whiskers indicating the lowest and highest values. The means are shown as squares and outliers are shown as circles. Extreme outliers are shown as stars.*

4.2 Browse

Table 2 Mean browse whole (plot) and percentage of plots with browse for monitored trees in Ōhope Scenic Reserve. With two values for kohekohe from 2012 (additional plots).

Species	Year	n (plots)	% Mean browse whole	% Plots with browse
Kohekohe	2008	28	5.73	32.14
	2009		1.41	35.71
	2010		0.09	3.57
	2012	28 (30)	0 (0)	0 (0)
	2014		0 (0)	0 (0)
Mangeao	2008	53	0.024	1.89
	2009		0.071	5.66
	2010		0	0
	2012		0	0
	2014		0	0
Kamahi	2012	29	0	0
	2014		0	0

No browse was observed in 2014 on monitored kohekohe, mangeao and kamahi. Browse has not been observed on monitored kohekohe and kamahi since 2012. No browse has been observed on mangeao since 2010.

4.3 Dieback

Table 3 Mean dieback whole (plot) and percentage of plots with dieback for monitored trees in Ōhope Scenic Reserve. With two values for kohekohe from 2012 (additional plots).

Species	Year	n (plots)	% Mean dieback whole	% Plots with dieback
Kohekohe	2008	28	3.69	14.29
	2009		2.65	3.57
	2010		5.03	28.57
	2012	(28) 30	2.95 (2.92)	3.57 (3.23)
	2014		3.04 (2.67)	28.57 (25.81)
Mangeao	2008	53	9.81	64.15
	2009		9.25	45.28
	2010		20.50	92.45
	2012		14.25	47.17
	2014		28.85	90.57
Kamahi	2012	29	8.10	41.38
	2014		19.07	89.66

4.3.1 Kohekohe

The number of kohekohe plots with dieback recorded increased from 14% in 2008 to 28% in 2010, decreased to 3% in 2012 then increased again to 28% in 2014 (Table 3). Beattie (2010) attributed the increase in dieback from 2009 to 2010 to observer variation, and it is likely the 25% increase from 2012 to 2014 is also due to observer variation.

Wilcoxon Sign Ranked Tests were used to test the significance in changes in mean dieback scores. The change in percentage mean dieback for kohekohe was not statistically significant (P=0.722), mean dieback scores have remained in the "no dieback" category (<5% of canopy) over the monitoring period.

4.3.2 Mangeao

Of the monitored mangeao plots, the number with dieback present has almost doubled from 47% in 2012 to 91% in 2014 (Table 3). The increase in percentage of mean dieback over the monitoring period from 10% in 2008 to 29% in 2014 is significant (P=0.000) and is likely due to observer variation. The increase from 14% in 2012 to 29% in 2014 is also significant (P=0.000).

Eight mangeao trees died between 2010 and 2012. A further 11 mangeao trees died between 2012 and 2014, these have been excluded from the analysis for the whole data series (see 4.4 Dead trees for data analysis).

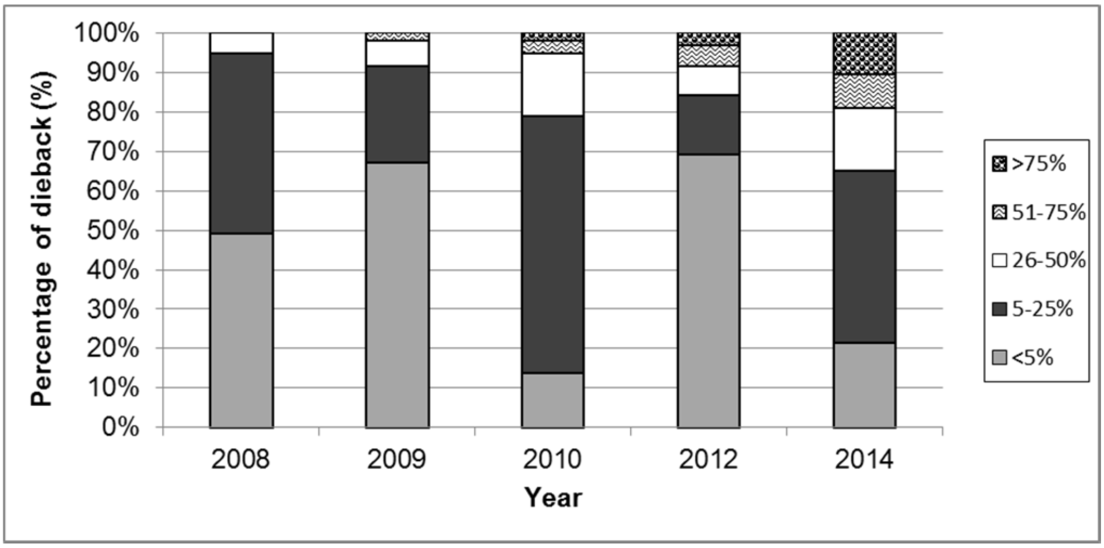

Figure 2 Percentage of mangeao with differing percentages of canopy dieback (whole tree) in Ōhope Scenic Reserve for 2008-2014.

4.3.3 Kamahi

The number of kamahi plots with dieback increased from 41% in 2012 to 90% in 2014. The change in percentage mean dieback whole for this period was significant (P=0.000) and is likely due to observer variation.

Two kamahi trees died between 2012 and 2014 and have been excluded from the analysis for the data series (see 4.4 Dead trees for data analysis).

4.4 Dead trees

From 2009 to 2010 four mangeao trees died. Eight mangeao trees died between 2010 and 2012 and a further 11 mangeao as well as two kamahi died between 2012 and 2014. All dead trees were excluded from the whole data series for analyses in 2014.

This small number does not allow for in depth statistical analysis. However, it is interesting to note that prior to 2014, 73% of the trees had canopy scores below 35% and two had a score greater than 55%. Only two trees (Tag 39 and 51) had browse recorded during the monitoring period (2008-2014). Both recorded less than 5% browse in 2009. One of these trees (Tag 39) also had stem use recorded again in 2009. Browse and stem use was not recorded at any other tree over the monitoring period.

It is interesting to note that eight (73%) of the mangeao that died in 2014 showed a decreasing trend prior to death (Figure 3), whereas the other three (27%) showed an increase in foliage cover before dying (Figure 4).

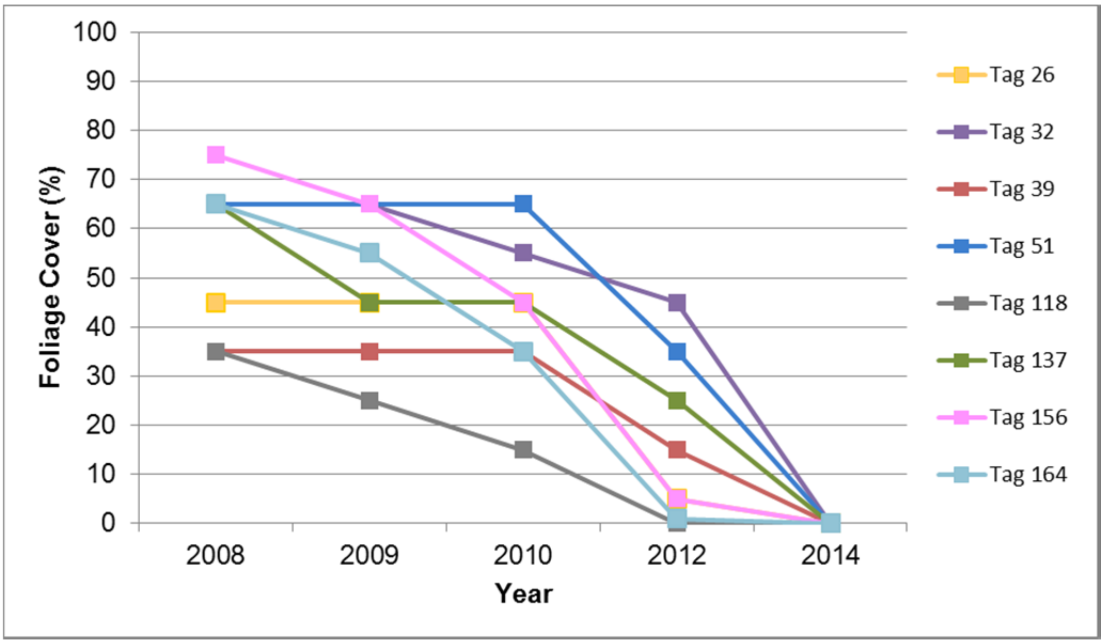

Figure 3 Decreasing foliage cover for eight mangeao trees recorded as dead in 2014.

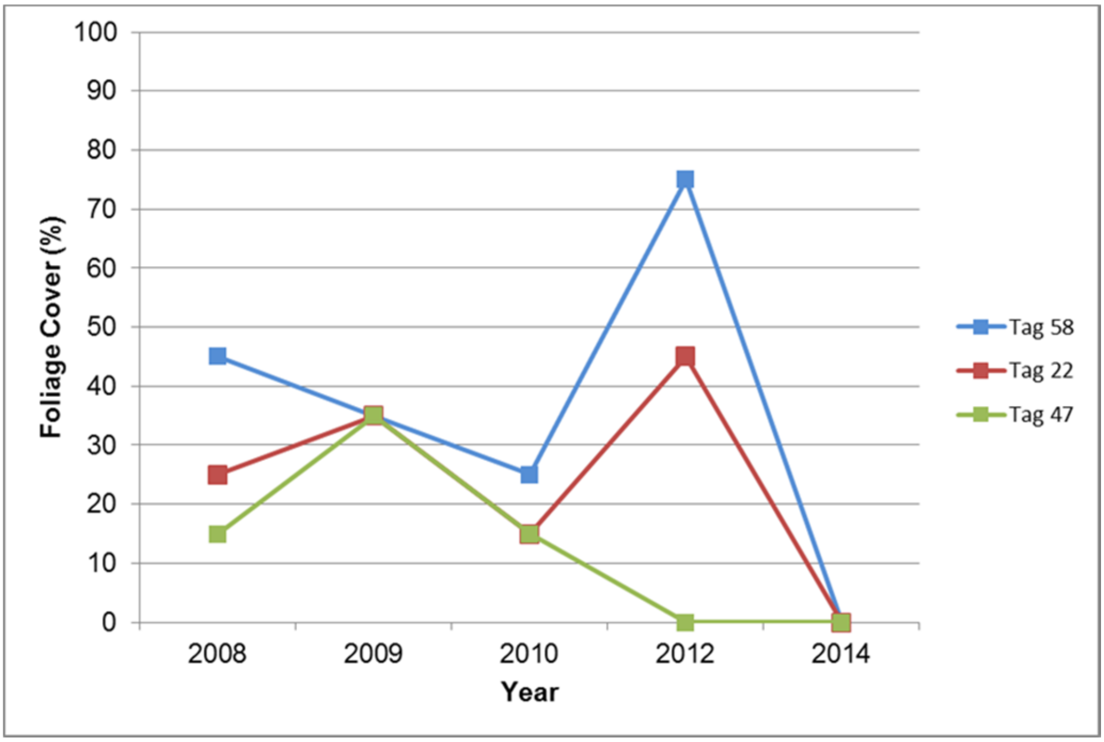

Figure 4 *Foliage cover for three mangeao trees recorded as dead in 2014 whose foliage cover increased before dying.*

Part 5: Discussion

5.1 Kohekohe

Mean foliage cover of kohekohe in Ōhope Scenic Reserve is similar to that measured on Red Mercury Island (Stewart, 2000), a possum free island in the Coromandel. This score shows that possums at their current density are not having a significant effect on kohekohe within the reserve. This is further supported by no observed browse in 2012 and 2014, as well as low canopy dieback scores. It is important to maintain low possum numbers as kohekohe is a preferred species for possums, and increased possum numbers are likely to directly affect kohekohe. The canopy, regeneration and recruitment processes are all likely to be affected.

The small sample size (29 plots) may be the result of historic possum impacts reducing the recruitment of kohekohe, which has restricted the distribution within Ohope Scenic Reserve (MacKenzie, 2009). The sample size (28) was increased in 2012 with the addition of trees at two plots (three trees). The increased sample size still does not reach the ideal 50 to reliably detect whether a 10% change in foliage cover is statistically significant (Payton et al., 1999), but it still provides information on the condition of these trees and the impact of possums across the sample. Because kohekohe is one of the most preferred species for possums, it is often one of the first to show impacts when possum numbers begin to increase, and although small, the sample should be maintained and monitored at regular intervals.

5.2 Mangeao

Average mangeao foliage cover scores have declined over the monitoring period (2008-2014) and the number of mangeao deaths has increased since 2010 despite low levels of possum impacts (browse and stem use). Only three trees that died over the monitoring period had browse observed as well as three trees that had stem use. It is not possible to conclusively link possum impacts to the subsequent death of mangeao trees within Ohope Scenic Reserve. This theory is supported by the New Zealand Forest Research Institute into regional mangeao dieback which found no link between possum browse and mangeao dieback (Gardner and Dick, 2002). Dieback of native trees such as mangeao can be caused by a range of biotic and abiotic factors. For example a study of plots at Lake Tikitapu and Okareka suggests dieback of mangeao was due to physiological stress, which could be related to local environmental changes (Gardner and Dick, 2002). This process may also be impacting mangeao at Ohope Scenic Reserve. Mangeao are also susceptible to insect damage which can cause dieback (Willems, 2009).

Mangeao should continue to be monitored, as signs of possum browse will still provide some indication of possum impacts, however it is not a good indicator in terms of showing a decline and dieback response that can be directly linked to possum impacts.

5.3 Kamahi

The small sample size of kamahi (29 plots) is below the required sample size of 50 to reliably detect whether a 10% change in foliage cover is statistically significant (Payton et al., 1999).

Average dieback of kamahi trees have more than doubled between 2012 and 2014. Since 2012 two kamahi trees have died of which both have had no browse observed. There is no evidence to suggest that possum browse is linked to the increased dieback in kamahi and the increase is likely due to observer variation. A study (Bellingham et al., 1999) into the long term effects of possum browse on conifer/broad-leaved forests showed the cause of kamahi dieback is unknown and can proceed over a long period. The study also found that the possum control occurring was having little effect in alleviating the decline in vulnerable species such as kamahi. Kamahi in Ōhope Scenic Reserve should continue to be monitored as kamahi are susceptible to possum browse and will provide an indication of possum impacts and abundance where browse is detected. Repeated monitoring is also needed to build on understanding whether kamahi dieback is related to possum browse.

5.4 General discussion

There is inherent variability in the FBI methodology due to observer and seasonal variability, and background noise, discussed in detail by Payton et al. (1999). This was demonstrated through the use of a non-palatable species in FBI monitoring by Nugent et al. (2010). Efforts were made throughout the monitoring period to minimise this variability, such as having multiple observers and scoring the tree from exactly the same position, but the subjective nature of the scoring system means it cannot be eliminated entirely.

Observer variation has influenced the dieback scores which can be clearly seen from the scores in 2010 and 2014. Heather MacKenzie was the common experienced observer for the years 2008, 2009, and 2012, whereas in 2010 and 2014 there was a completely different pair of observers. It is likely the experienced observer of 2008, 2009, and 2012 were able to differentiate between the current season's dieback and historic dieback. Observers for future measurements should work to reduce observer variation by excluding historic dieback from the score. Maintaining at least one common observer from one year to the next is also important.

Although dieback of some species can't be directly linked to possums, and sample sizes are not ideal, this monitoring does still provide some indication of impacts of possums on the canopy where browse is identified. This is done by scanning the canopy with binoculars from beneath and from any vantage point available. The fact that no browse has been identified, despite reasonably thorough scanning for a distinctive browse pattern on leaves, indicates that possums are not in high enough numbers to be affecting extensive areas of canopy on the species and individual trees monitored. Regardless of any ability to determine statistical significance for a 10% change in scores, this is a positive result and a positive reflection on the maintenance of possum numbers to low levels.

Part 6: Recommendations

- Carry out FBI monitoring in 2017 (every three years), using as an indicator for control if possum browse is observed.
- Possum control operations should continue to be undertaken regularly to maintain low possum numbers and ensure canopy health and forest processes are maintained over time.

Part 7: References

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