Foliar Browse Report 2010

Ohope Scenic Reserve

Bay of Plenty Regional Council
Operations Publication 2010/03
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Cover Photo: Kohekohe (*Dysoxylum spectabile*) canopy at Plot 5 on Line 1 (Heather MacKenzie).

Acknowledgements

Heather MacKenzie and Nancy Willems set up the FBI monitoring programme in Ohope Scenic Reserve, and developed the methodology used for data analysis in this report. Heather kindly allowed the use of one of her photos for the cover of this report. Nancy organised the 2010 monitoring work and contributed infinite wisdom to both the data analysis and production of this report. David Paine and Greg Corbett provided helpful comments on the final draft.

Contents

Executive summary

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 and 2010. This report presents results on the current level of possum (*Trichosurus vulpecula*) impacts on possum-preferred tree species within the reserve, and changes over the monitoring period.

Current foliage cover for monitored kohekohe (*Dysoxylum spectabile*) is good and has increased from 2008, while that of monitored mangeao (*Litsea calicaris*) is moderate, with a small decline throughout the monitoring period that is not statistically significant. Very low stem use, and a significant decline in both the number of plots with recorded browse and the percentage of leaves browsed show that current possum levels within the reserve (trap catch index March 2010 = 0.7 ± 0.4%) are not having a large impact on the forest canopy species monitored. A significant increase in mangeao dieback may be linked to environmental factors, such as high winds or salt spray, rather than possum impacts.

The FBI methodology assesses trends in canopy health over long time periods, but does not show finer fluctuations between years while possum numbers remain low. Possum numbers are unlikely to increase significantly under the current management regime so this report recommends reducing FBI re-monitoring frequency to every second year.

1 Introduction

1.1 Purpose of report

Foliar Browse Index (FBI) monitoring was established in the Ōhope Scenic Reserve in February 2008 to measure canopy health as part of a monitoring programme to assess the outcome of pest control operations. The following report gives an overview of the current level of possum impacts on selected tree species within Ōhope Scenic Reserve, and looks at changes between the three measures (2008, 2009 and 2010) of FBI monitoring lines.

2 Background

The 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 (Shaw, 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 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 Brodificoum (Shaw, 2010). Possum control using the bait station network was undertaken in spring 2008 and 2009, but little control was undertaken during the preceding 5-6 years (David Paine, pers comm). 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) or MacKenzie (2009).

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 at a site. In the Ōhope Scenic Reserve kohekohe (*Dysoxylum spectabile*) and mangeao (*Litsea calicaris*) 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 set up within the Ōhope Scenic Reserve on existing stoat trapping and bait station lines, with a total number of 63 plots made up of multiple trees of either species. One plot was not surveyed in 2010, as the trees were either dead or obscured and therefore unable to be accurately scored. For further detail on the establishment of the FBI lines in the Ōhope Scenic Reserve, refer to Blackwell (2008) or MacKenzie (2009). Monitoring was carried out in February 2008, February 2009 and February/March 2010. 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 spreadsheet stored in Objective (Reference Number: A498437).

4 Results

Results displayed in this report are calculated using plot means, making the plot rather than individual trees the sample unit. This allows for independence between samples as there is a minimum spacing of 100 metres between plots. Previous reports have mistakenly calculated individual tree means, although this has not resulted in a significant difference with the recalculated results presented in this report. Below are results for foliage cover, possum browse and dieback for monitored kohekohe and mangeao trees within the Ōhope Scenic Reserve for 2008, 2009 and 2010. Dead trees have been excluded from the standard analyses, and are discussed separately. This has resulted in a decline in the number of mangeao plots from 57 to 55. The 2008 and 2009 data has been recalculated to exclude these two plots to allow comparison of results between sampling periods.

4.1 Foliage Cover

Table 1 Mean foliage cover (plot) for 2008-2010 of monitored mangeao and kohekohe in the Ōhope Scenic Reserve.

Species	Year	n (plots)	Mean Foliage Cover (%)	Standard Deviation
Kohekohe	2008	29	66.72	10.91
	2009		68.28	10.03
	2010		75.52	9.52
Mangeao	2008	55	62.18	13.17
	2009		59.39	14.02
	2010		57.09	26.14

Current mean foliage cover of 76% for kohekohe (Table 1) is good, and 57% for mangeao is moderate. Stewart (2000) suggests a benchmark target for the mainland of 65% as being realistic.

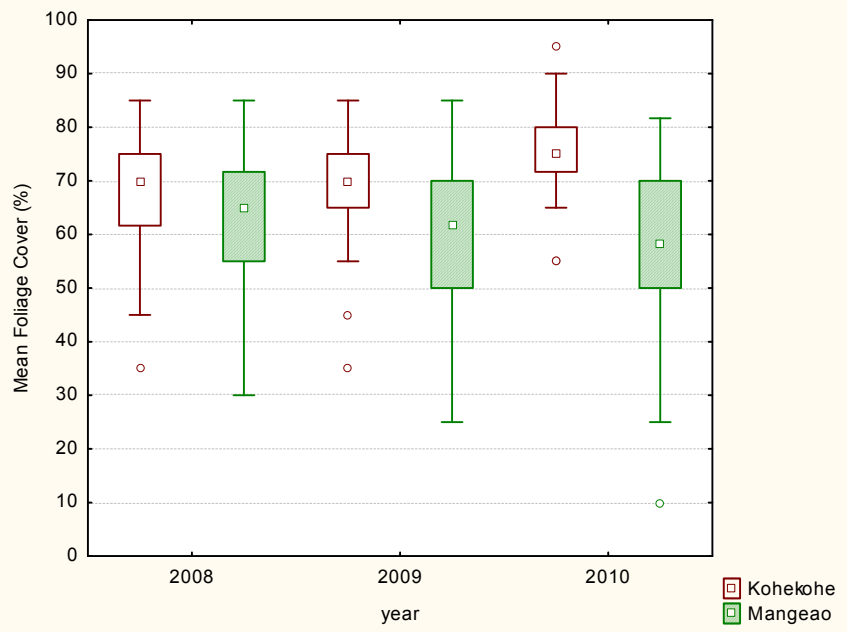

Figure 1 *Boxplot showing mean foliage cover (plot) of monitored mangeao and kohekohe. The box represents the middle 50% of the data, with the whiskers indicating the distance from the lowest value to the lower quartile and from the upper quartile to the highest value. The mean is a square within the box, and outliers are shown as circles.*

Paired t-tests were used to test the significance of changes in mean foliage cover scores over the monitoring period, based on a 95% confidence interval. The small decrease in mangeao cover between 2008 and 2010 is not statistically significant (P=0.073), however the current kohekohe cover is significantly different from both the 2008 mean cover (P=0.002), and 2009 mean cover (P=0.007). This is shown in Figure 1, where the 2010 kohekohe boxplot is visibly higher than the 2008 and 2009 boxplots. Figure 1 also demonstrates the greater variability in foliage cover scores for mangeao, with much longer boxplots than kohekohe.

4.2 Browse

Table 2 *Mean browse whole (plot) and percentage of plots with browse present for monitored kohekohe and mangeao within the Ōhope Scenic Reserve.*

Species	Year	n (plots)	% Mean Browse Whole	% Plots with Browse
Kohekohe	2008	29	5.53	31.03
	2009		1.36	34.48
	2010		0.09	3.45
Mangeao	2008	55	0.02	1.82
	2009		0.11	9.09
	2010		0.00	0

The number of kohekohe plots with recorded possum browse has decreased by more than 25% between 2008 and 2010 (Table 2). The actual browse scores have also significantly decreased over the monitoring period (Figure 2). The highest browse score recorded for kohekohe in 2008 of 3 (51-75% of leaves browsed) dropped in 2009 to 1 (6-25% of leaves browsed) and then in 2010 to 0.5 (<5% leaves browsed). Wilcoxon sign rank tests were used to test the significance in changes in browse scores for both species. Percentage of mean browse whole on kohekohe plots dropped approximately 5% from 2008 to 2010 (Table 2), which is a statistically significant change (P=0.008).

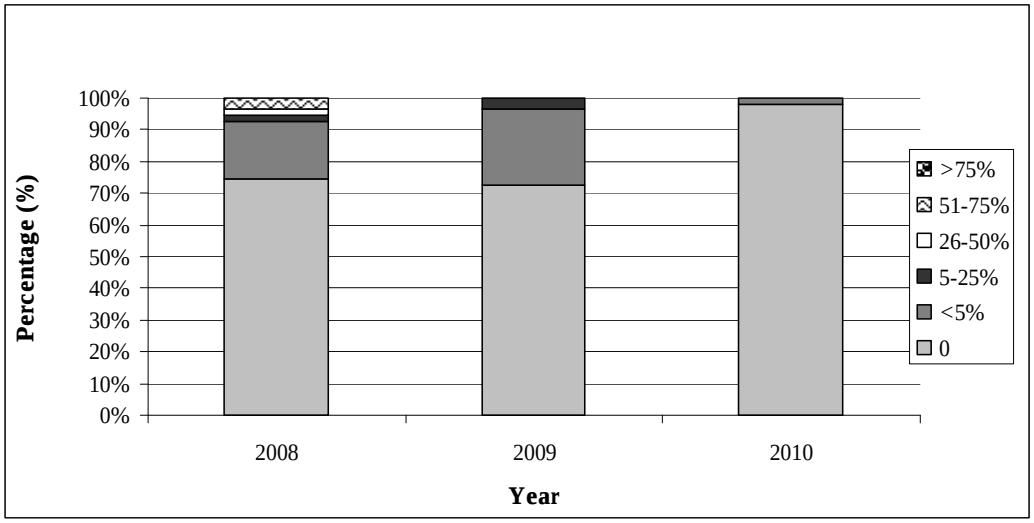

Figure 2 *Percentage of kohekohe with differing percentages of leaves browsed (whole tree) in Ōhope Scenic Reserve for 2008-2010.*

There is no corresponding significant change in browse recorded on mangeao. Of the monitored mangeao trees, at least 96% of trees have not had possum browse present during the FBI measurements, with no browse observed on mangeao in 2010. Percentage of mean browse whole for mangeao has remained at a low level (<1%) throughout the monitoring period. The change over the monitoring period is not statistically significant (P=0.332).

4.3 Dieback

Table 3 *Mean dieback whole (plot) and percentage of plots with dieback present for monitored kohekohe and mangeao within Ōhope Scenic Reserve.*

Species	Year	n (plots)	% Mean Dieback Whole	% Plots with Dieback
Kohekohe	2008	29	3.65	13.79
	2009		2.64	3.45
	2010		4.94	27.57
Mangeao	2008	55	12.08	67.27
	2009		11.43	54.55
	2010		25.13	96.36

The number of kohekohe plots in Ōhope Scenic Reserve with dieback recorded increased 14% between 2008 and 2010 (Table 3). Wilcoxon sign rank tests were used to test for significance in changes over the monitoring period in dieback for both species. Percentage of mean dieback whole for kohekohe increased slightly over the monitoring period (Table 3), but this difference was not statistically significant (P=0.094), and the mean dieback whole score has remained within the "no dieback" category (<5%) described on the indicator species assessment sheet. There is a statistically significant difference between the 2009 and 2010 scores (P=0.011), which is probably due to observer variation. Analysis of individual trees does not show any evidence for the idea that increased dieback could be due to possum-related damage increasingly being recorded as dieback as heavily browsed branches die off.

Of the monitored mangeao plots, the number with dieback present has increased significantly (Table 3), with dieback visible on almost all the mangeao plots in 2010. Percentage of mean dieback whole did not change significantly between 2008 and 2009 (P=0.332), but the 2010 score was significantly different from both 2008 and 2009 (P<0.001) (Figure 3), and corresponds with a change from light (5-25%) to moderate (26-50%) dieback on the indicator species assessment sheet. All four trees that died over the monitoring period and have therefore been excluded from the analysis were mangeao.

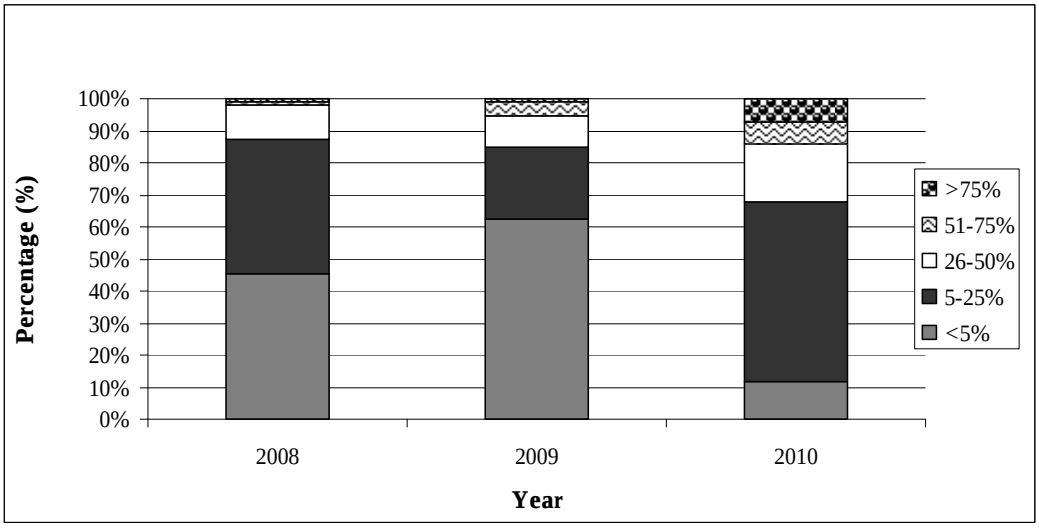

Figure 3 *Percentage of mangeao with differing percentages of canopy dieback (whole tree) in Ōhope Scenic Reserve for 2008-2010.*

4.4 Correlations between monitored parameters

The results described in the previous section show trends such as increased kohekohe foliage cover and decreased browse, which one may assume were related to each other. Figure 4 gives a brief overview of these trends by summarising the mean dieback, browse and foliage cover scores for each species over the monitoring period. Spearman's non-parametric correlation co-efficient was used to analyse the strength of relationships between the measured dieback, browse and foliage cover scores for both species. There is no evidence in the available data for any significant correlations between the observed variables. The only variables this analysis shows as correlated are unlikely to have a causative relationship. For example, kohekohe dieback whole in 2009 would not explain kohekohe browse whole in 2010.

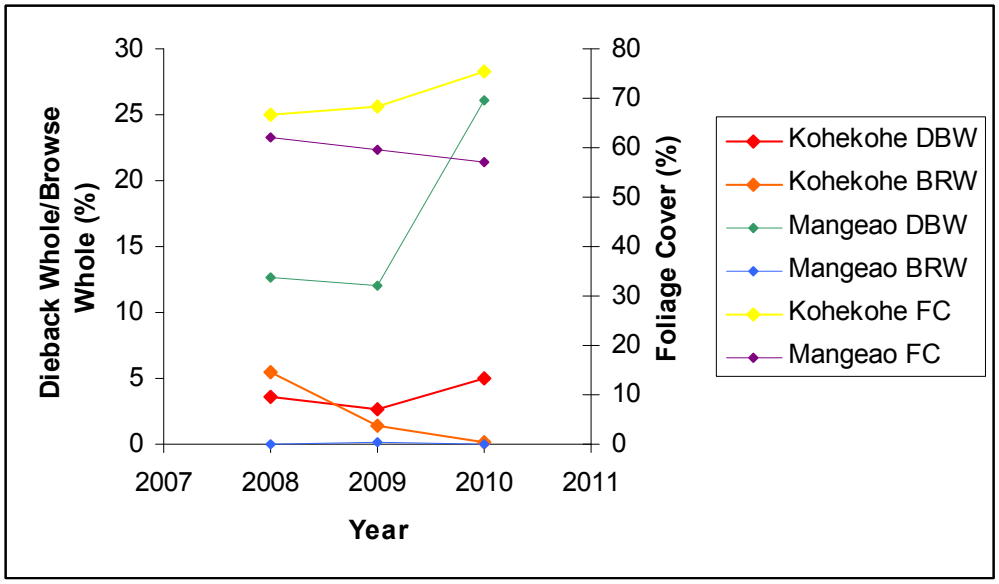

Figure 4 *Mean dieback whole, browse whole and foliage cover for kohekohe in the Ōhope Scenic Reserve for 2008-2010.*

4.5 Dead trees

Four mangeao trees died over the monitoring period and were excluded from the 2010 analysis. This small number does not allow any identification of trends, but it is interesting to note all the trees had become fairly unhealthy in 2009, despite the recorded decrease in dieback for mangeao between 2008 and 2009. Browse was only recorded once in one of the trees (Tag 95), and there was no recorded stem use. The absence of these values being recorded does not mean possum impacts were not a factor in the death of these trees. Possums can jump from canopy to canopy so an absence of stem use does not mean possums are not present in that tree. An unhealthy tree, such as one with no visible browse but which may have been browsed in the past, is more likely to succumb to further impacts from environmental factors. Although possums therefore may have contributed to the death of these trees, the data can not be used to support this theory. Furthermore, mangeao dieback has been noted since the 1970s throughout the Waikato and Bay of Plenty. A systematic study of plots at Lakes Tikitapu and Okareka by the New Zealand Forest Research (Gardner and Dick, 2002) was unable to resolve a cause, but eliminated a number of possibilities including possum browse. Their results suggest mangeao was experiencing physiological stress, which could be related to local environmental changes (Gardner and Dick, 2002), a process which may also be impacting on mangeao in Ohope Scenic Reserve.

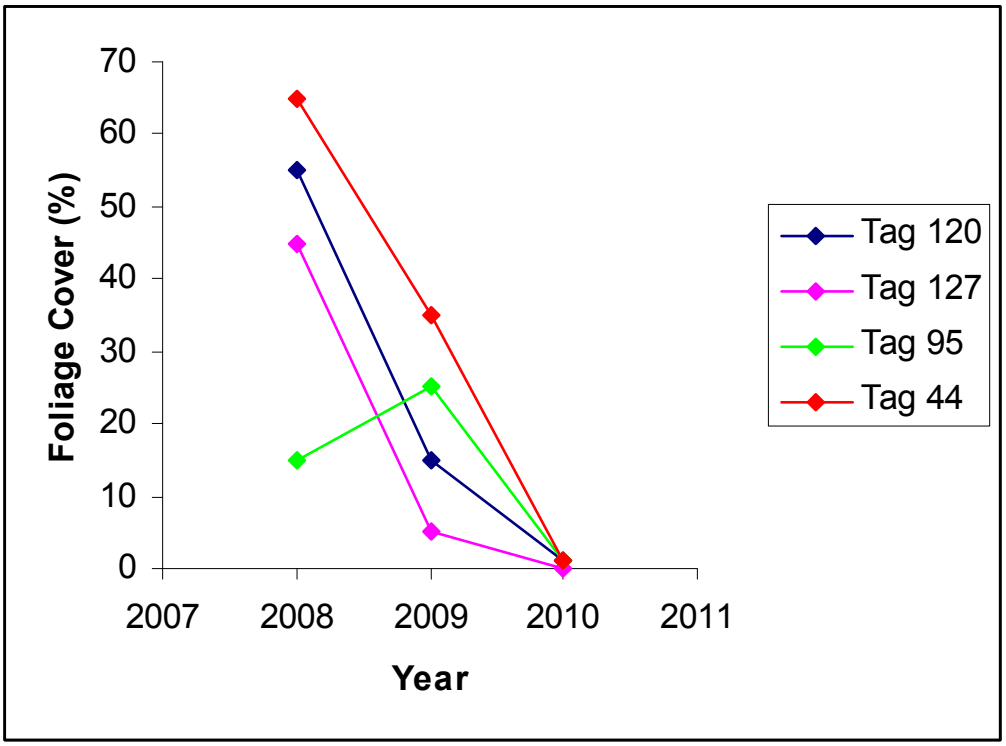

Figure 5 *Decreasing foliage cover for the four mangeao trees recorded as dead in 2010.*

6 Discussion

6.1 Kohekohe

Mean foliage cover of kohekohe in the Ōhope Scenic Reserve is similar to that measured on Red Mercury Island (Stewart 2000), a possum free island in the Coromandel. This score shows at their current density possums are not having a significant impact on kohekohe canopy within the reserve. This is further supported by the low dieback and decreasing browse scores recorded over the monitoring period. It is important to maintain possum numbers at their current low levels, as kohekohe is a preferred species for possums, so increased numbers are likely to cause canopy damage and interfere with regeneration and recruitment processes.

The small sample size (29) for kokekohe is the result of the restricted kohekohe distribution throughout the reserve, which could be due to historical possum impacts reducing kohekohe recruitment (MacKenzie, 2009). The small sample size reduces the ability of statistical analyses to detect changes within the population. Trials have shown a sample size of 50 is needed to reliably detect whether a 10% change in foliage cover score is statistically significant (Payton *et al*., 1999). MacKenzie (2009) suggested the small population size may mean increasing the sample size may not be required as the sample may be approaching a census, becoming more accurate. It is difficult to know whether this is a fair assumption without a detailed study of the kohekohe population throughout the reserve. If a reliable estimation of the population was available, there is a modification to the standard variance calculations described in Payton *et al*. (1999) that would allow for a reduced sample size. Either using this modification to reduce the required sample size, or increasing the sample size would benefit the statistical robustness of FBI monitoring. Increasing the sample size would require subjective plot placement to target kohekohe, and this type of sampling strategy would have implications on data

analysis. Sustained possum control may also lead to a long-term increase in kohekohe recruitment, thereby increasing the population size.

6.2 Mangeao

Average mangeao foliage cover scores have declined over the monitoring period, but the decrease is not statistically significant (P=0.073). Dieback on mangeao trees has increased significantly (P<0.001), with dieback being recorded on almost all the plots in 2010. The low level of mangeao browse throughout the monitoring period, and the fact that stem use has only ever been recorded once during the duration of the study means this dieback cannot be conclusively linked to possum impacts. This is further supported by work by the Forest Research Institute into regional mangeao dieback which found no association with possum browse (Gardner and Dick, 2002). Foliage cover estimates, which are closely linked to dieback scores, changed by up to 15% between measures on possum-free Waiheke Island (Payton *et al*., 1999), indicating that foliage condition and dieback variation can be due to a wide range of environmental factors such as insects, fungi, wind or salt spray (Stewart, 2000). The observed decrease in foliage cover and increase in dieback therefore do not provide evidence for increased possum impacts, and illustrate the variability inherent within the FBI methodology. These results suggest that the use of another indicator species should be considered. There are several other species present in Ōhope Scenic Reserve that could be used as an indicator species, notably five finger, pohutukawa or kamahi. Browse is not visible on five finger most of the time as possums pull the entire leaf off, chew the stems then drop it, making this a difficult species to survey. Pohutukawa would also be difficult to survey as individual trees are very scattered throughout the reserve, and it is difficult to observe their canopies. Unless it can be confirmed there is a kamahi population large enough to generate the required sample size, monitoring of mangeao should continue, as the data do still provide information on canopy health in the reserve.

6.3 General discussion

Possum levels are currently very low in Ōhope Scenic Reserve. The most recent residual trap catch index (RTCI) was carried out in January 2010, following control in spring 2009, with a result of 0.7 ± 0.4% using raised sets. These low levels are reflected in the very low browse (kohekohe <2%, mangeao <1%) and stem use scores (0%) recorded by FBI monitoring in 2010. Observed browse may be due to browse still being visible from higher possum numbers prior to the current control operations. An extended period of low possum numbers makes it unlikely significant improvement of the canopy will occur (Broekema, 2007). As the canopy was in fairly good health at the beginning of monitoring, with foliage cover scores of 66.72% for kohekohe and 62.18% for mangeao, there is unlikely to be changes in canopy health significant enough for the FBI methodology to record.

The FBI methodology shows significant changes in forest canopy health, but is not sensitive enough to show smaller fluctuations between years, particularly while possum numbers remain low. Possum browsing is frequently concentrated on a few trees, which may be heavily defoliated while neighbouring individuals of the same species remain unaffected (Payton, 2000). This leads to a small overall response in the forest canopy, limiting the sensitivity of any monitoring method.

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 can not be eliminated entirely.

These limitations mean some trends in the data, notably the increased mangeao dieback, cannot be conclusively linked to possum impacts. While possum numbers remain low, the low sensitivity and inherent variability mean the FBI monitoring is limited in its ability to show forest canopy response. However, it is still useful to understand forest processes on shorter timescales, as the vegetation plot monitoring also conducted in the reserve takes at least five years to give feedback. Continuing FBI monitoring also helps retain skills within the organisation and does demonstrate the maintenance of canopy health which is still useful for outcome monitoring, so it is still worthwhile continuing monitoring. The limitations in the method mean this report recommends reducing the re-measuring frequency and reviewing its contribution to outcome monitoring after the next re-measure.

7 Recommendations

- The frequency of FBI monitoring is reduced to every second year, and the contribution it makes to outcome monitoring is assessed with the next re-measure. The methodology is not sensitive enough to show possum impacts at their current low levels, but the maintenance of canopy health demonstrated by the data is still useful for outcome monitoring.

- Before the monitoring is repeated, the sample size for kohekohe should be increased to improve statistical robustness. Alternatively, a detailed survey should be conducted to gain a good estimation of population size so the standard variance calculations can be modified to reduce the required sample size.

- Before the monitoring is repeated, a survey for an alternative species to mangeao should be undertaken.

- 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.

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