

Coastal indigenous forest canopy condition in the Bay of Plenty region

Aerial Monitoring 2007



Prepared by Nancy Willems, Environmental Scientist
Environment Bay of Plenty
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5 Quay Street
P O Box 364
Whakatane
NEW ZEALAND

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Cover Photo:
Looking across Ohope's West End and out to Moutohora (Whale Island)

Photographer – Nancy Willems, March 2007

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– Feedback

Executive Summary

Coastal forest aerial canopy monitoring was established in 2003 as a cost-effective way to monitor for coarse changes in coastal forest canopy health across the region.

The 2007 monitoring episode repeats the 2003 work to identify possible changes.

The monitoring indicated that only 6.3% of sites showed what is considered a genuine decline in condition, and these sites were scattered across the region, showing no clear pattern of distribution. Of most concern are some larger tracts of mixed species coastal forest in the eastern part of the region, and continuing decline of Thornton kanuka.

In my opinion this monitoring does not provide enough information to conclusively state the condition of coastal forest across the region. Cost effectiveness is compromised by the need to do ground monitoring to complement the method, greatly increasing the cost and still not really delivering very good data. Options for future monitoring are discussed and a recommendation made on the option considered to be the best for regional council purposes.

Recommendations

- 1 Implement Option 5 to provide better and more quantitative information about coastal forest condition in the region, particularly in HVES. Investigation into alternative ground assessment methods is currently underway. Mapping the extent of forest in the coastal and semi-coastal bioclimatic zones should be undertaken to determine the full extent and assist in developing a potential sampling strategy.
- 2 Identify and pursue opportunities for active management of pohutukawa and coastal forest along the coast east of Opotiki as part of the Council's biodiversity programme. Efforts should be directed at High Value Ecological Sites and other sites that constitute genuine coastal forest.

As part of this aim to:

- Exclude grazing stock;
 - Assess the need for possum control at individual sites;
 - Assess the need for supplementary planting at individual sites where there is potential to re-establish a forest structure;
 - Establish baseline and outcome monitoring to identify changes as a result of management activities.
- 3 Identify and pursue opportunities for protection and enhancement of Thornton kanuka along the coast between the Tarawera and Whakatane Rivers, also as part of the biodiversity programme.
 - 4 Promote protection and enhancement of pohutukawa stands and coastal forest throughout the Bay of Plenty through media releases and other communications opportunities such as Backyard and our website.

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Part 1: Introduction

1.1 Purpose of report

An aerial survey of the coastal forest canopy along the Bay of Plenty coastline was undertaken in March 2007 as part of Environment Bay of Plenty's Natural Environment Regional Monitoring Network (NERMN). This survey repeated work done in March 2003, using the same methods and scoring system to identify possible changes in the coastal forest canopy condition between 2003 and 2007. Ground monitoring was also undertaken.

The purpose of this report is to present the results obtained in 2007, and compare them with results from 2003. Complementary information gained from ground monitoring (photopoints and general inspections) and trap catch indexing at selected sites will also be discussed.

1.2 Background

Environment Bay of Plenty has responsibilities under the Resource Management Act 1991 to maintain indigenous biological biodiversity (see Appendix 3 for relevant sections of the RMA). The protection of significant indigenous vegetation has been identified as a matter of National Importance. Coastal forest is an increasingly threatened ecosystem type and pohutukawa forest is a significant part of the natural character of the Bay of Plenty. Pohutukawa forest types are generally under threat from land use pressures such as grazing beneath stands, and from pest animals - heavy possum (*Trichosurus vulpecula*) browsing, causes extensive dieback and eventual death.

In order to determine if Environment Bay of Plenty is meeting its obligations under the RMA it is necessary to monitor the extent and condition of coastal forest habitats. Preventing further loss of areas covered by coastal forest is only one aspect of maintaining regional indigenous biodiversity.

At a national level a Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land was released by the Ministry for the Environment and the Department of Conservation in 2007. This document states as National Priority One the protection of indigenous vegetation associated with land environments (defined by Land Environments of New Zealand at Level IV), that have 20% or less remaining in indigenous cover. Areas covered by this survey largely fall within these land environments which often coincide with areas of high population in coastal areas in the Bay of Plenty.

1.3 Coastal forest modification

There has been a long history of vegetation modification and disturbance along the Bay of Plenty coastal zone, primarily by Polynesians in pre-European times. With the arrival of Europeans modification continued and a large amount of the original vegetation cover was either removed or changed by human activity. There are still examples of original coastal forest remaining on hill slopes and headlands, although these are often small and modified, with only a few more substantial examples such as Matata Scenic Reserve and Ohope Scenic Reserve (Wildland Consultants Ltd, 2006).

Vegetation prior to human settlement would have been dominated by pohutukawa (*Metrosideros excelsus*) or mixed coastal forest of pohutukawa, puriri (*Vitex lucens*), karaka (*Corynocarpus laevigatus*), tawa (*Beilschmiedia tawa*), rewarewa (*Knightia excelsa*), kohekohe (*Dysoxylum spectabile*) and some local areas of hard beech (*Nothofagus truncata*). Coastal cliffs would have supported coastal shrubs and herbs including manuka (*Leptospermum scoparium*), wharariki (*Phormium cookianum*), New Zealand ice plant (*Disphyma australe* subsp. *australe*), kanuka (*Kunzea ericoides*) and mingimingi (*Leucopogon fasciculatus*), amongst others (Wildland Consultants Ltd, 2006).

Coastal forest sites in poor condition are likely to suffer higher mortality rates. Often regeneration of trees is prevented by activities such as grazing animals and roadside mowing, and root damage resulting from road formation and general traffic can lead to tree deaths. Incremental losses of individual trees here and there eventually results in the complete loss of a pohutukawa stand. In addition, true pohutukawa forest should include native sub-canopy, understorey and ground cover species. In many sites around the Bay of Plenty exotic grasses and weedy plants replace native species under the main pohutukawa canopy.

Other coastal forest types are also greatly threatened by browsing mammals including possums, goats (*Capra hircus*), deer (*Dama* spp.) and domestic stock. These pest animals interfere with natural processes of regeneration and change the structure and composition of the forest by selective browsing, thus causing non-preferred species to increase in dominance.

1.4 Canopy dieback in coastal forest

Canopy dieback for canopy species such as pohutukawa, mangeao (*Litsea calicaris*) and puriri is easily distinguished from the air, with the general forest canopy having a greyed appearance. Possums heavily browse the upper canopy (new shoots and flowers) of pohutukawa causing progressive dieback. The canopy appears thin with dead branches and twigs showing through. A healthy pohutukawa tree should have a thick pillowy canopy with few twigs and branches visible. Mangeao are also sensitive to possum browse, however they are also susceptible to insect attacks, and may have dieback as a result. Puriri is less sensitive to possum browse than mangeao and pohutukawa, however there is a theory that they may be suffering from a similar phytoplasmic disease as that which killed large numbers of cabbage trees (*Cordyline australis*) throughout the North Island (Beever *et al*, 2004). Although other causes of puriri mortality have been suggested, they relate mainly to the damage caused by stock in pasture killing individuals or small stands of trees by trampling and damaging root systems (Hosking, 1999). However, this does not explain canopy dieback in larger forest blocks where heavy grazing is absent.

In addition to identifying dieback of the main canopy species, aerial monitoring identifies areas of scrub that have been either sprayed deliberately, subject to overspray, converted to forestry or other factors that may reduce coastal forest in the region.

Surveys of coastal forest canopy condition covering the entire Bay of Plenty region's coast were first done in 1988 (Hosking *et al*, 1989) as part of a larger North Island survey. Further assessments of more limited parts of the region's coast were also done in 1989, 1990 and 1991, however results of most of these surveys have since been lost.

Part 2: Methods

The assessment of coastal forest condition uses three complementary methods to give a better overall picture of the condition of these areas. These are detailed below.

2.1 Aerial assessment

Two flights were made on consecutive days between 1100 and 1400 hours in a Cessna aircraft at a flight speed of between 70 and 100 knots. Altitude was generally around 700 feet, but varied with topography and the angles being sought.

The reason for flying in March (late summer) is to avoid periods of spring flush, and flowering in the monitored vegetation.

The areas of indigenous forest were delineated during the 2003 flights. In 2007 these maps were used to ensure that both surveys scored the same areas for canopy condition. No detailed vegetation mapping was undertaken in either survey and boundaries marked on the maps are indicative of extent.

Canopy condition scores were assigned for each site and recorded on the maps. This information was then transferred to an Excel spreadsheet (Appendix 2).

2.1.1 Canopy condition scores

- (i) Good condition with no obvious canopy damage.
- (ii) Condition moderate with limited canopy damage or opening evident.
- (iii) Poor condition with obvious canopy damage, canopy opening, dead branches or trees.

The first flight on 27 March was from Whakatane east to East Cape. The flight path tracked around Kohi Point and across Ohiwa Harbour, sometimes following headlands and coast and also taking in the islands in the harbour. The rest of the outgoing flight followed the coastline to Lottin Point. The return flight path was more variable, tracking inland to provide a view to parts of the sites not seen from the coast, particularly where there are prominent headlands, and from Ohiwa Harbour the flight path went more inland over Ohope Scenic Reserve before crossing the inland end of Kohi Point Reserve to return to the airport.

The second flight on 28 March was from Whakatane west to Waihi, including Homunga and Orokawa Bays. The flight followed the coastline to Mount Maunganui, then entered Tauranga Harbour where sites were scored as they could be seen. The coastline was followed up to and back from Orokawa Bay and on the return trip sites that were missed on the first path through Tauranga Harbour were targeted. Motiti Island was circled to score the pohutukawa growing around the edges of the island before tracking back to Maketu, down the coastline and back to the airport.

Canopy condition was scored on the outgoing and confirmed or adjusted on the return flight where sites were able to be viewed twice. Photographs were also taken, however photographs do not cover the entirety of every site. The purpose was more to provide a diary record of the flight, to get pictures of key sites and those that clearly demonstrate a particular canopy condition score.

Consistency in canopy condition scoring between assessments was improved by having one observer in the 2007 monitor who had scored canopy condition in 2003.

2.2 Photopoint monitoring and ground assessment

Findings from this aerial monitoring are complemented by ground monitoring at Category 1¹ sites along the region's coast and further investigations were carried out at sites with low canopy condition scores.

Sites were chosen for:

- (a) How well they represented coastal forest in the area; and
- (b) How easy it would be to establish a good set of photopoints.

Sixty-nine photopoints were established at seven new sites in March 2007 and existing photopoints were re-measured at three sites previously inspected in 2004. Some new photopoints were added at two sites (see Natural Environments, 2007 a and b for details).

A "Rapid Natural Area Assessment" was completed for each new site. Observations relating to condition, animal activity and other matters of interest were also noted.

2.3 Residual trap catch index (RTC)

The residual trap catch (RTC) index was used at selected sites in an attempt to correlate possum abundance with canopy damage, particularly where ground monitoring identified signs of possum browse as a damaging factor. This method was developed by the National Possum Control Agencies to provide a national standard for possum density monitoring (NPCA, 2008), and uses the percentage of traps catching possums to estimate possum density.

Trap lines are laid using random start points within a defined area, with traps spaced at 20 m intervals. Traps are operated for three fine nights and checked daily to record the number of possums and non-target species caught, the number of escapes, and the number of sprung traps. The index is calculated as follows (for more information see NPCA, 2008):

- $(\text{Number possums} \div \text{Number trap nights}) \times 100$;
- Where: number possums = possums caught + sprung with possum fur (that identifies the trap was sprung by a possum); and
- $\text{Number trap nights} = \text{total trap nights} - (0.5 \times (\text{non target} + \text{sprung traps}))$.

This gives a percentage result. Most control operations aim for a RTC of $\leq 5\%$, which is determined as a level at which canopy recovery occurs. Consequently some areas where high trap catch indices are found may be identified as priorities for possum control. A low trap catch index at a site with low canopy condition may indicate something else is the primary cause of dieback, which may or may not be able to be managed.

¹ Category 1 sites include the best and largest remaining examples of vegetation and habitat in an ecological district. They are assessed under the Protected Natural Areas Programme.

Part 3: Results

Maps showing survey coverage and site numbers are presented in Appendix 1. Scores and notes summarising the observations for 2007 can be found in Appendix 2.

The results gained from the aerial monitoring did not give very definitive results. In comparing change over time, anything less than a full category of change is probably not large enough to be considered real change because the method uses reasonably broad score categories, and is designed to identify large changes over time. A lot of sites are scored as changing, for example, from a score of 1 to a score of 1-2, reflecting a range in the appearance of the canopy and a shift in score of part of that canopy. Most of the changes were of less than one category, and as such are included in the 'no change' group in Figure 1 below.

Figure 1 shows over 90% of sites did not change in condition, based on the interpretation as explained above. Only 1.1% (or 2 sites) improved, and 6.3% declined in condition.

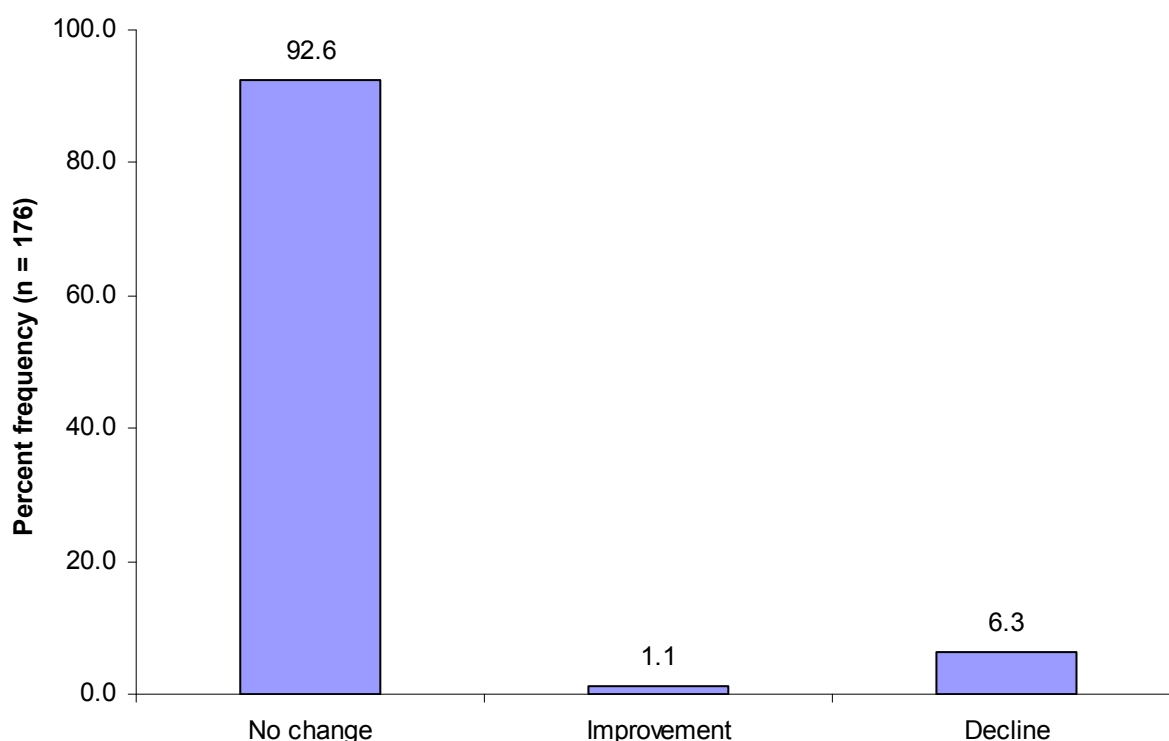


Figure 1 Summary of sites showing no change, improvement, decline in scores, adjusted to show only improving and declining sites that changed by ≥ 1 score category from 2003-2007.

Sites that shifted by at least a whole score category are considered to be a genuine change in condition from 2003 to 2007. See Appendices 4 and 5 for the original site summary and breakdown of sites changing by more or less than one category.

Only one site showed a decline of more than one category (U14/12 – Mauao) and even this is a little ambiguous as the change is from a score of 1 to a score ranging from 1-3.

The sites that showed a decline of one category or more are scattered across the region. Those in the western part of the region are mostly small scattered or isolated stands and as such are more of value for their contribution to landscape character than biodiversity or maintenance of coastal pohutukawa forest.

A small grouping in the far eastern region, however, shows larger areas of coastal forest of mixed species (rather than all pohutukawa dominant forest) that have considerable canopy greying. Also of considerable concern is a decline in the score for Thornton kanuka.

The following sections describe groups of sites across the region and comments on their condition.

3.1 North of Tauranga Harbour (sites T13/1 – T13/6)

Sites in this area were variable with scores across the range of poor to good. Most were considered to be in slightly worse condition than in 2003.

One exception was Orokawa Scenic Reserve. Although aerial scores were the same for both years, ground inspection showed improvements in the general forest condition and puriri trees had regained lost foliage. Some of the photographed pohutukawa trees had also regained foliage and little possum browse or sign was seen (Natural Environments, 2007b). Possums were reduced to 3.6% RTC in 2001, however possum numbers had increased to a RTC of 15% in 2005 (B Angus, DOC *pers. comm.* 2007). Timing of further control is unknown and it will be interesting to see if these trees maintain or begin to decline in condition.

3.2 Bowentown-Otawa – adjacent to Tauranga Harbour (Sites 13/7, U13/1-10, u14/1-25)

These sites are fairly small and many consist of a narrow strip of pohutukawa around escarpments and harbour margins. They generally scored good to moderate condition. Scores of 3 were only applied to scattered individuals. Little or no possum browse or sign was seen at most of these sites (Natural Environments, 2007b), and encroachment of weed species was noted as more of an issue.

3.3 Motiti Island (Site V14/10)

Pohutukawa occur in a narrow strip around the edges of Motiti Island. Most of the trees looked healthy and the score of 1-2 in 2003 did not change in 2007. Some trees at the northern end of the island looked unhealthy.

3.4 Maketu-Matata (sites V14/1-9, V15/1-5)

Canopies at these sites were generally healthy, except V14/7 which includes a shag colony. Scores of 2 were applied to scattered trees throughout. Again, many of these sites are narrow strips of pohutukawa and along Pikowai Straight they tend to occur only on the steep cliff faces. There are several slips along these cliffs from the 2005 storm that caused serious flooding and damage along State Highway 2 and Matata township. Weeds and lack of regeneration were identified as issues for some of these sites, as well as possum impacts.

At site V15/5 and V15/6 dieback of mangle at the head of the valleys was evident, as well as dieback of hard beech on the ridges of Matata Scenic Reserve. This area was considered to be in worse condition than in 2003.

3.5 **Matata-Whakatane (site V15/7)**

The condition of the coastal Thornton kanuka stands between the Rangitaiki and Tarawera Rivers were variable. Areas nearer the coast were in better condition and showed a more solid canopy. Greying was more evident away from the coast and around houses. Parts of this site are still being grazed and a drop in the score suggests ongoing decline. A brief visual comparison of aerial photography from 2003 to 2007 shows that while the core block of kanuka appears to be maintaining a thick cover, more isolated patches of kanuka are continuing to thin and collapse.

3.6 **Whakatane-Ohope (sites W15/1-8)**

Most of these areas were in good condition. Area W15/3 was the only site that scored poorly due to a large patch of dead and dying mangeao that was also noted in 2003. Aside from this there was virtually no change from 2003 to 2007. A possum control operation occurred in the intervening time in Ohope Scenic Reserve, Mokorua Bush and Kohi Point, and a further operation is planned for 2008. All the sites showed some canopy greying but were not noted or scored as being worse than 2003.

3.7 **Port Ohope-Opotiki (sites W15/9-21)**

Most of these sites are around Ohiwa Harbour and are predominantly small and fragmented stands of pohutukawa. Scores were mostly the same as in 2003, except for Ohakana Island and Hiwarau, where the scores were slightly lower. Hiwarau in particular was noted as being in worse condition than 2003 and the ongoing decline appears to be due largely to a lack of any form of management on the site. Ground monitoring of mainly coastal stands showed that 10 of 16 photos had more canopy greying, dieback or thinning. Ground monitoring at Whitiwhiti (W15/11) also showed some deterioration in condition. Although there is adequate legal protection of the site, management activities are sporadic and need to be more continuous. Wattle dieback gave a poor impression at some sites, like Uretara Island, but this is part of the dynamics of that species. Given that they are exotic, their presence is of concern and dieback is not. In general the pohutukawa at these sites are for the most part in good condition.

3.8 **Opotiki-Motu River (sites W15/22-23, X15/1-20)**

Many of these sites are narrow strips along the coast. Pohutukawa trees are generally in good condition, however puriri is showing considerable amounts of dieback along the East Cape. A few sites were noted as being in poorer condition in 2007, with some local patches of dead trees. One patch of dead kanuka was noted in 2003 and appears to be have been sprayed with herbicide. Haumiaroa point at Hawaii (X15/14) had a lot of unhealthy trees, and poor health of both pohutukawa and puriri was noted near the Motu River mouth (X15/20). Ground monitoring of several sites at Opape (X15/5-6), Haurere Headland (X15/7) and Houpoto (X15/16-17) confirmed some deterioration of trees already in poor condition.

On a positive note, regeneration is occurring at Houpoto on roadside cuttings and these young trees are in good health.

3.9 Motu River-Kereu River (sites X15/21-37, X14/1-7)

These sites had predominantly the same scores as in 2003, with canopy greying noted at many sites. Pohutukawa stands were in moderate to good health, however puriri was noted as showing considerable dieback at all of these sites.

3.10 Kereu River - Raukokore River (sites X14/8-15, Y14/1-11)

Most of these sites showed canopy greying and a few were given slightly poorer condition scores than in 2003. Both pohutukawa and puriri were noted as showing obvious greying in the canopy. Inland sites seemed to be in slightly worse condition. The coastal strip was often noted as being mostly healthy. Ground monitoring supports observations recorded from aerial monitoring, with more than half the photos showing increased deterioration of tree health.

3.11 Raukokore River - Whangaparaoa River (sites Y14/12-28)

These sites were mostly scored as being in moderate condition, with some moderate to poor sites. At least three sites were noted as being worse than in 2003 and again, puriri was noted as being in worse condition than pohutukawa. Dead crowns were noted as well as general greying of the canopy.

3.12 Whangaparaoa River-Potikirua Road (Sites Y14/29-39)

Along with the Raukokore-Whangaparaoa Rivers sites, this was probably the worst section along the coast. Dead and dying trees were noted and only two sites were scored as being in good condition. Puriri was again noted to be in worse condition than pohutukawa. Many of the pohutukawa are scattered along this section of the coast with few substantial stands.

3.13 Residual Trap Catch Results²

Trap lines were established at some selected sites along the East Coast area. The data is not statistically useful because of the small sample sizes at the coastal forest site level. In some instances only one line was able to be established in the site and the results were by no means comprehensive nor statistically robust for most of the sites targeted. The results are considered in the discussion with the index results presented in Table 1 below.

Table 1 RTC results for each site monitored.

Site	No. of Lines	RTC
X15/21	2	18.49
X15/24a	2	13.45
X15/24b	2	16.03
X15/28	1	13.33
X15/36	2	8.47
Y14/1	1	10.17
Y14/8	1	13.56
Y14/13	1	26.67
Y14/15	5	11.56
Y14/26	5	11.45
	ALL	13.01

² For sites other than Orokawa Bay.

Part 4: Discussion

Most sites experienced little or no change in condition. In general pohutukawa health appears to decrease from west to east, with the worst condition trees tending to occur mostly east of Opotiki.

Possums

Hosking *et al* (1989) concluded that “except where fire has occurred, possums seem to be almost universally associated with dead and dying pohutukawa”. Visible improvement at Orokawa Bay following possum control (sporadic since 2001) illustrates the point that possums are a significant cause of decline and death for pohutukawa. Hosking *et al*'s (1989) study found “extensive and severe possum damage” in “the region of Homunga Bay” at that time. This site includes the site identified as Orokawa Bay in our study.

In terms of possums as a damaging agent, residential areas around Tauranga Harbour and small strips of pohutukawa on the coast surrounded by farmland are less likely to have high possum numbers due to the lack of suitable adjacent habitat. Along the east coast from Opotiki to East Cape, native forest often extends from the ranges to the coast and hosts much larger populations of possums than would be expected in a residential area at Tanners Point, for example. The poorer condition of pohutukawa in the eastern parts of the region supports this suggestion although it is somewhat tenuous and unable to be verified.

RTC indexing was used at some sites with poor condition scores to attempt to relate higher possum densities with higher canopy dieback.

Residual trap catch results are confounded by small sample size because some sites were too small to fit more than one or two lines. All of the RTC work was done in the eastern part of the region. Only two of the coastal forest sites were large enough for 5 RTC lines, which is the recommended minimum number to achieve a robust estimate for a site (NPCA, 2008). Because of this all of the RTC results can only be considered broad estimates that provide a fairly vague indication of possum numbers on site.

At face value, the resulting numbers indicate a moderate to high possum population at all the sites and it is reasonable to assume that some damage is occurring as a result. This was identified by ground monitoring at some sites, however the RTC work added little value to the monitoring work in its current form. Because RTC monitoring could not be established in western sites, the theory that possum numbers in pohutukawa and coastal forest in the eastern Bay of Plenty are higher than in the western sites, thereby explaining the poorer condition of the forest, can not be proved or otherwise. As agents of destruction, it is reasonable to assume that possums are having some impact on pohutukawa throughout the region, but directly attributing the full extent of damage to possums is not possible without individual monitoring of trees for possum browse.

Other damaging agents

Other damaging agents for pohutukawa, aside from fire, do not appear to have the same impact as possums on the trees, in terms of causing canopy dieback and eventual death. Pohutukawa are extremely sensitive to fire, and even slight damage around the base of the tree can cause death (Hosking *et al*, 1989). This impact is most likely to occur on coastal strips with beach access. Although grazing stock prevents regeneration and recruitment of young pohutukawa, they do not appear to be a major cause of canopy dieback and death.

Of more concern at many sites is the encroachment of weed species. While residential areas around Tauranga Harbour may provide some protection in terms of deterring possums, many weed species have spread from garden waste from nearby houses, and this will be an ongoing problem in the future. Damage from strong winds and salt spray exposure is not considered to be a factor that causes serious deterioration of pohutukawa trees themselves, although at Mauao, trees on the sheltered side of the mountain were generally in better condition, while those near the sea (on the western side) had much sparser foliage (Natural Environments, 2007b). Such narrow sites, however, are unlikely to redevelop a coastal forest structure, or promote regeneration of native species, especially pohutukawa, without management intervention.

Thornton kanuka

Kanuka found along the coast around Thornton, and generally between the Tarawera and Rangitaiki Rivers, have been identified as a potentially separate species of kanuka that is unique to the Bay of Plenty, although its taxonomic status is yet to be determined (de Lange *et al*, 2009). This means that these areas are a national priority for protection of a nationally vulnerable (Hitchmough *et al*, 2007 and de Lange *et al*, 2009) species. There is ongoing loss of condition occurring and a lack of regeneration in grazed areas. Fragmentation and incremental losses due to new houses and residential activities (such as tracks to the beach, firewood and other buildings) are also an issue.

Regeneration

A common theme amongst coastal forest sites which was not specific to species, was the lack of regeneration of coastal forest in general. Pohutukawa require sites that are bare and devoid of other vegetation, hence their dominance of rocky headlands and cuttings exposed by road works (Bergin and Hosking, 2006). Grazing by domestic stock and exotic plants are probably the main inhibiting factors. Development of pasture, residential areas and park like areas also hinders regeneration, simply by not allowing seedlings or saplings to establish. There are sites that could only be considered pohutukawa treeland, because they are mowed or grazed creating a group of trees over grass. Likewise, Thornton kanuka regeneration is hindered by grazing and heavy grass swards. Other general coastal forest species are also prevented from establishing and often coastal areas with native vegetation tend to be extremely depleted in terms of species diversity. There are very few examples of true coastal forest remaining in the Bay of Plenty that demonstrate all the elements of forest structure and composition.

There are many areas included in this survey that will never be able to regenerate into full coastal forest because of their situation. For example, narrow strips of pohutukawa forest and scrub around Tauranga Harbour margins will always be subject to edge effects and weed invasion. They are valued for their contribution to the landscape character of the Bay of Plenty but do not contribute significantly to biodiversity and maintenance of coastal forest. Most of the sites monitored fall into this category of being narrow strips or groups of trees along a narrow section of the coast. Some are part of urban park settings and are subject to urban maintenance programmes, with no natural regeneration likely.

About 55-60 of the sites (of a total of 176) could be considered to be capable of contributing to the maintenance of the coastal forest type in the Bay of Plenty and most of these are in the eastern Bay. Sites in the Western Bay that could be considered genuine coastal forest sites (excluding Thornton kanuka) include Orokawa and Homunga Bays, some of the small islands off Tauranga, and Motiti Island (parts of the fringe will be substantial enough). Moving east, Matata, the group of Kohi Point, Mokorua and Ohope reserves, Hiwarau, Orokawa and a few other small remnants around Ohiwa harbour, and Bryan's Beach would be considered substantial enough to be genuine coastal forest. East of Opotiki there is still a narrow coastal strip that may never be extensive enough in structure or size to be more than pohutukawa treeland, however sites inland of the road are generally substantial blocks of genuine mixed species coastal forest and make up about half of the sites in this category.

Forty of these sites coincide with High Value Ecological Sites (HVES - sites with a private land component) which have been identified as a priority for management under Environment Bay of Plenty's biodiversity programme.

Methodology

As a method for assessing change in coastal forest canopy condition, this aerial method is of low precision, designed only to identify large changes over time, and can not be used for fine scale or short term changes. The data does have a subjective component and scores can vary from observer to observer and from year to year with the same observer. The interpretation of change disregards any change less than a single score category for this reason. Most of the changes in canopy condition identified from the air were able to be verified at sites that were surveyed from the ground, however the results were by no means comprehensive or conclusive in this regard.

There is a lack of recent mapping of most areas so that the proportion of canopy cover that is in the target species is unknown. The aerial survey can only score visible dieback. As trees decay and fall and are no longer visible scores at some sites may improve. Without knowing whether the proportion of canopy cover of the species being scored has declined over time the method does not identify a decline in that species as a result of ongoing dieback and deterioration, and will not identify areas that have undergone significant dieback events in the past.

Ground monitoring methods tend to focus on pohutukawa trees and only those that are easy to access. The Department of Conservation's draft monitoring toolbox for aerial canopy monitoring (Rose, 2009) includes complementary ground monitoring to complete the survey and analysis, however our photopoint data is not comprehensive enough to achieve this fully for the large inland sites and no quantitative ground work was undertaken.

Options for future monitoring

- 1 Discontinue the work, using the results as a stand-alone piece that identifies broad trends in the condition of coastal forest canopy across the region. In considering the usefulness of the comparison between the two years' work there is only a broad indication that canopy condition is declining in some sites and no truly quantitative analyses or firm conclusions can be drawn from the monitoring.

Pros: No more resources spent on a method that appears to be failing to deliver good information.

Cons: Currently the only method that tells us anything about coastal forest condition in the region.

- 2 Continue the work using the same methods, including photopoint monitoring to complement aerial work and accept that there are issues with the data collected and its interpretation. There is some use in continuing the work in that large declines in canopy condition would be a clear indication that there is some urgency to undertake management to prevent the complete collapse of coastal forest, although it could be debated as to whether the changes identified would be so large by the time they are detected that management may be too late. Reducing the frequency of monitoring may give clearer results, but there is the danger that changes in observers will confound the data, and long periods between monitoring would again result in any discovery being too late to rectify through management.

Pros: Data would be comparable. Known method which gives a broad regional overview.

Cons: Data very limited in terms of interpretation.

Will changes be so big that we'll be too late for management?

Is the cost effectiveness of the aerial work negated by the need for ground work?

Doesn't tell us about condition and issues under the canopy.

- 3 The method could be improved by following the Department of Conservation Monitoring Toolbox guidelines (in draft – Rose, 2009) to improve the interpretability of results. This would greatly increase the expense of the work, may create difficulties with comparisons prior to implementing DOC methods, but would potentially provide better information for decision making.

Pros: Better results and more interpretable.

Cons: More time, effort, money required.

Lose comparability with 2003 and 2007

Do we have the information needed to make it a genuine improvement on current state?

- 4 Continue the work using the same or improved methods at targeted sites, rather than a blanket survey of the entire region. Sites that consist of thin strips of treeland could be removed (or continue only photopoint monitoring at these sites) and the focus and effort placed on sites that genuinely contribute to the maintenance of coastal forest in the region. This would also promote a change from fixed wing aircraft to the use of a helicopter which would allow for more manoeuvrability and hovering over areas for closer inspection or marking of trees for attention from ground work.

Pros: Save \$\$ by not wasting efforts on narrow strips and small patches (but we might fly past them anyway).

Able to focus efforts better and more comprehensively at a few sites rather than doing lots of sites with 'looser' information.

Cons: Lose touch with other pohutukawa that contributes to landscape character.

- 5 Use the results to identify priority coastal forest areas for work where mapping units with scores indicating poor canopy condition coincide with HVES. Ground assessment techniques such as the Foliar Browse Index (FBI) method could be made in conjunction with RTC indexing at larger sites to determine with more certainty whether or not possums are the main cause.

In this option FBI transects would target possum preferred species, although there is some difficulty in assessing pohutukawa from the ground using this method, as the canopy is often obscured. For large pohutukawa canopies seeking vantage points or using the aerial FBI method should be considered where pohutukawa are a prominent component. Other methods for pohutukawa monitoring techniques are also being investigated.

This would identify areas that are a priority for possum control, provide opportunity to undertake rapid assessments of the areas concerned and identify other issues for management. FBI (or other ground assessment method) could be complemented by recce plots located on transects to gather information about structure and composition below the canopy. We would gain better information on which to make decisions about further management and monitoring requirements in terms of coastal forest maintenance and enhancement. The aerial monitoring component could then be either discontinued or undertaken at longer intervals to compensate for the lack of precision, or be directed at focus areas using improved methods.

Pros: Efforts focussed on most important sites and ties in with biodiversity programme and HVES.

Get more comprehensive picture of HVES rather than lots of sites done poorly. Potentially even higher costs as comprehensive methods cost more.

Cons: Lose regional overview.

May not be permitted access to many blocks resulting in a biased sample.

Recommended best option:

Of the options presented, number five appears to be the best. This option can provide for canopy survey, complemented by ground survey. The use of a technique for monitoring possum impacts can clearly tie management actions to an outcome. Complementing FBI or other ground assessment with recce plots also provides information about composition and structure of the forest in different tiers, and other monitoring such as permanent plots could be built in at a later stage if necessary.

As part of this, the full extent of forest in the coastal and semi-coastal bioclimatic zones should be mapped to provide an inventory of forest in those zones. This would also allow for a potential sampling strategy to be investigated that could incorporate HVES and managed vs non-managed control sites.

Conclusions

If indigenous coastal forest in the Bay of Plenty region is to be maintained, regeneration and recruitment within coastal forests needs to be at a rate which will result in the replacement of dead canopy trees. For sufficient regeneration to occur the exclusion of stock, reduction in mammalian pest numbers and weed control is required at these sites. Supplementary planting is also going to be necessary at many sites, and natural regeneration should be encouraged.

As a method for identifying change, aerial monitoring provides a coarse measure of change with an element of subjectivity due to the nature of the scale used. It is useful as a cost-effective way of covering the entire region but the data gathered does have its limitations and should at the very least be supplemented by ground work to provide better information. Aerial assessments do not cover the composition of coastal forest from ground cover to canopy, thereby missing issues such as heavy weed infestations and general loss of forest structure over time, failing to provide a complete picture of coastal forest condition. Ongoing improvements in the resolution of aerial photography may eventually remove the need for flights to assess the canopy, however regional coverage (aerial photography) is currently incomplete and the whole region is not always covered in the same year.

This aerial monitoring does not deliver a high enough quality of information to provide conclusive evidence of improvement or decline. Coastal forest monitoring using more quantitative methods must be developed and established in the future to provide a full picture of coastal forest condition, in addition to the canopy. This will provide better information as to whether or not coastal forest is being maintained in the Bay of Plenty region.

Part 5: Recommendations

Implement Option 5 to provide better and more quantitative information about coastal forest condition in the region, particularly in HVES. Investigation into alternative ground assessment methods is currently underway. Mapping the extent of forest in the coastal and semi-coastal bioclimatic zones should also be undertaken to determine the full extent and assist in developing a potential sampling strategy.

Identify and pursue opportunities for active management of pohutukawa and coastal forest along the coast east of Opotiki as part of the Council's biodiversity programme. Efforts should be directed at High Value Ecological Sites and other sites that constitute genuine coastal forest.

As part of this aim to:

- Exclude grazing stock;
- Assess the need for possum control at individual sites;
- Assess the need for supplementary planting at individual sites where there is potential to re-establish a forest structure;
- Establish baseline and outcome monitoring to identify changes as a result of management activities.

Identify and pursue opportunities for protection and enhancement of Thornton kanuka along the coast between the Tarawera and Whakatane Rivers, also as part of the biodiversity programme.

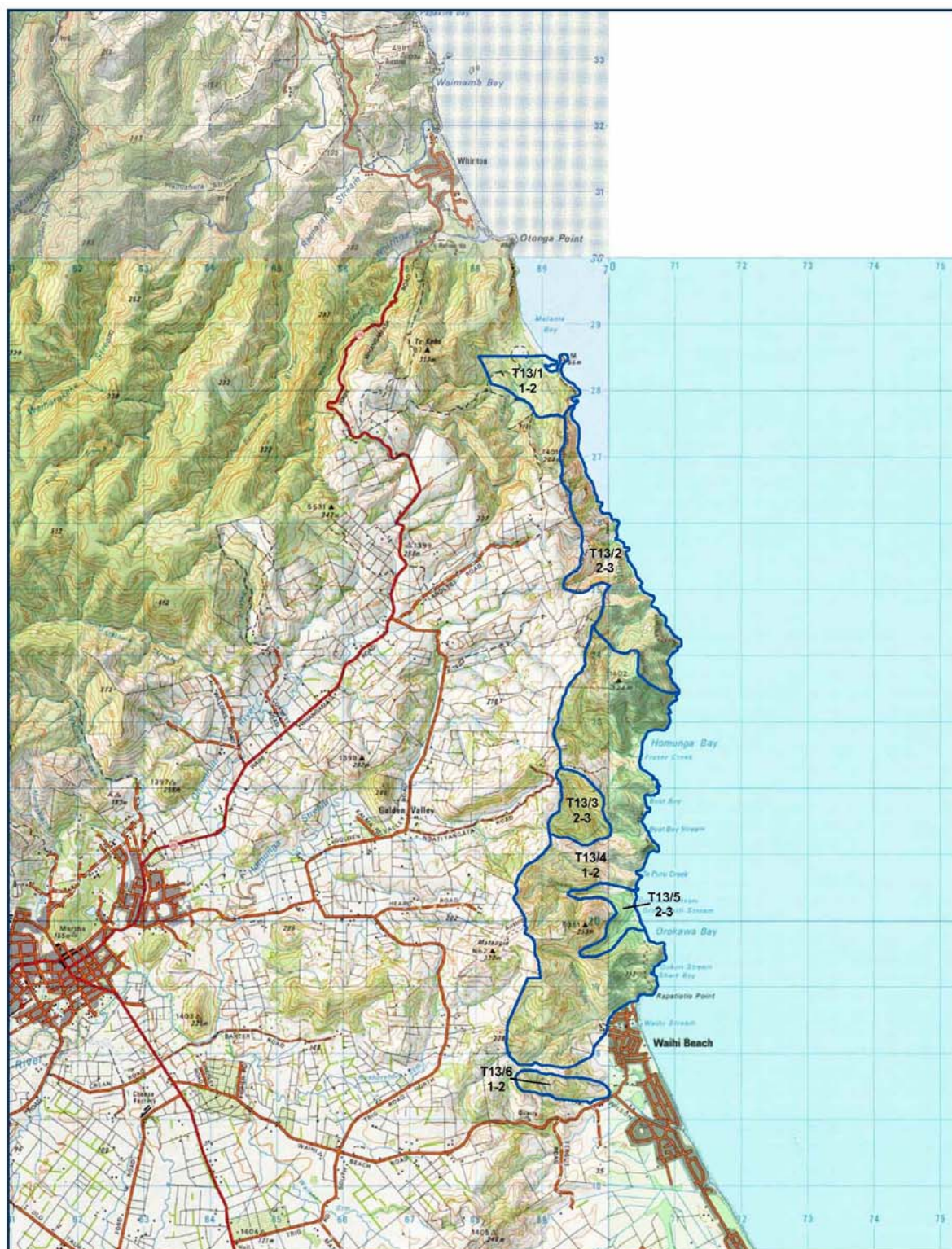
Promote protection and enhancement of pohutukawa stands and coastal forest throughout the Bay of Plenty through media releases and other communications opportunities such as Backyard and our website.

Part 6: References

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Appendices

Appendix 1 – Maps showing survey coverage and site numbers



Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number
1 Condition score
Assessed forest unit

Scale 1:50,000
0 0.5 1 2 km

Plan No.
C 2016
Sheet 1 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number

1 Condition score

Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.

C 2016

Sheet 2 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number
1 Condition score
Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.
C 2016
Sheet 3 of 10





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number

1 Condition score

Assessed forest unit

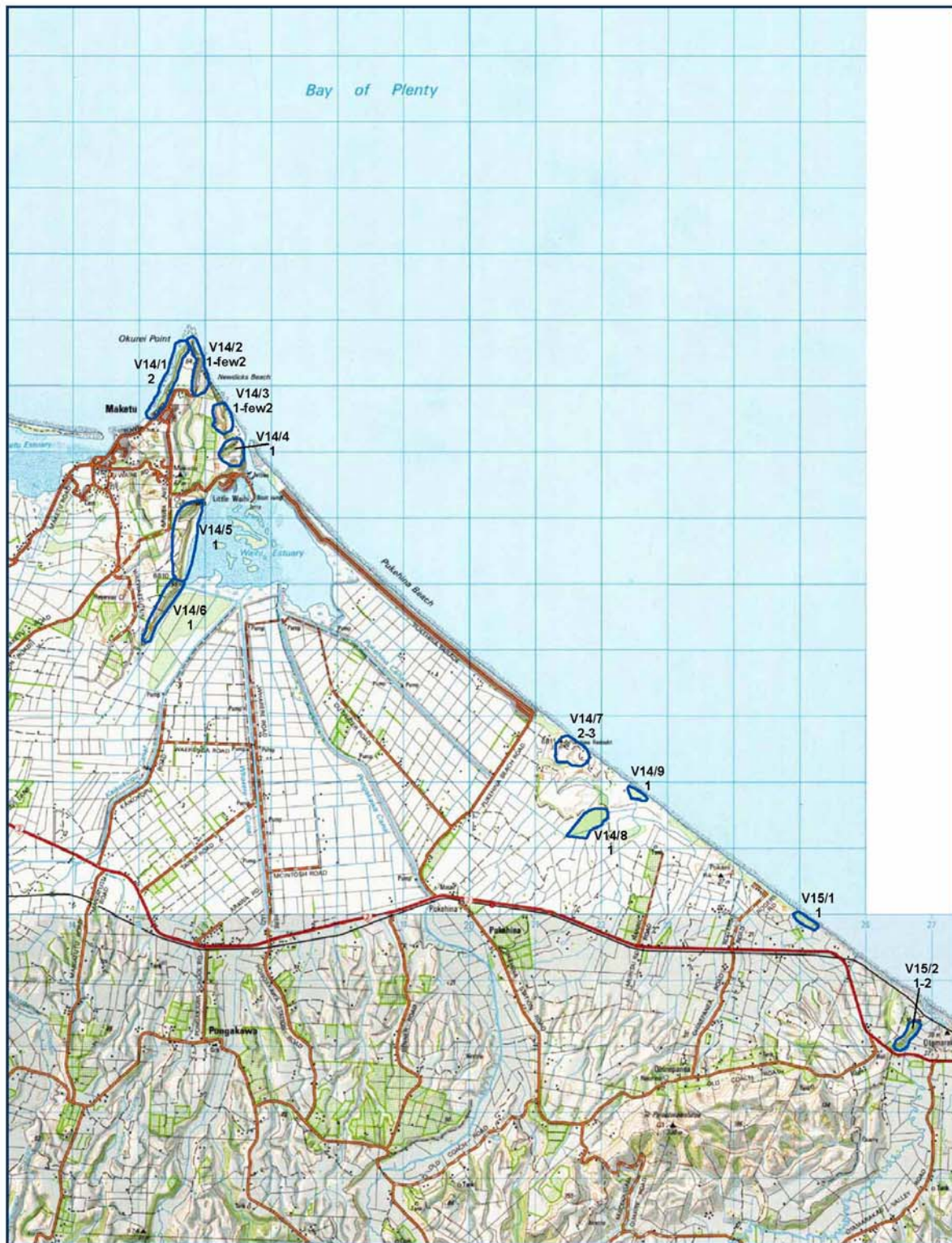
Scale 1:50,000
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Plan No.

C 2016

Sheet 4 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number

1 Condition score

Assessed forest unit

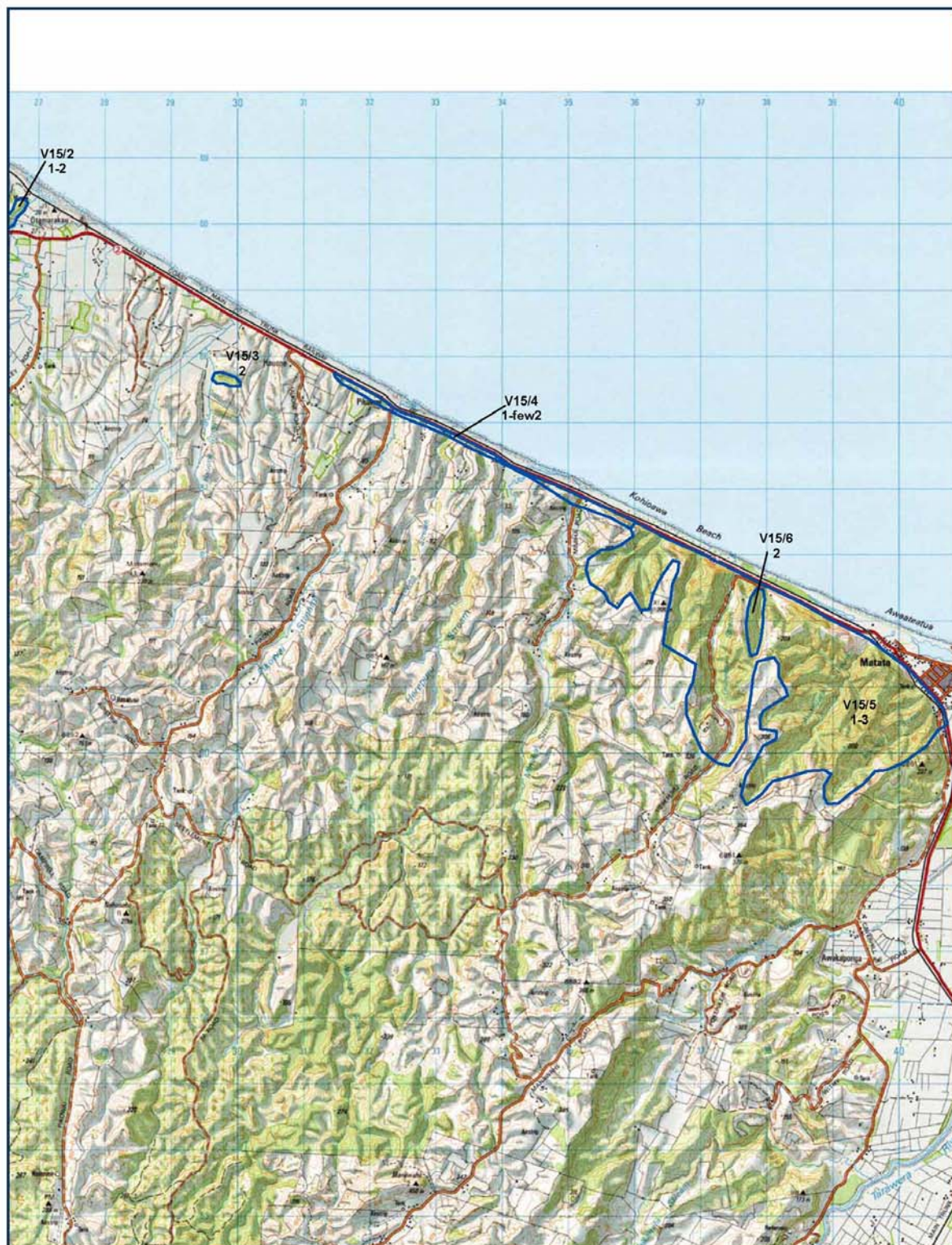
Scale 1:50,000
1 0.5 0 1 2 km

Plan No.

C 2016

Sheet 6 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number
1 Condition score
Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.
C 2016
Sheet 7 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number

1 Condition score

Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.

C 2016

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Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number
1 Condition score
Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.
C 2016
Sheet 9 of 10





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number

1 Condition score

Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.

C 2016

Sheet 10 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number

1 Condition score

Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.

C 2016

Sheet 11 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number

1 Condition score

Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.

C 2016

Sheet 12 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number
1 Condition score
Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.
C 2016
Sheet 13 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number
1 Condition score
Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.
C 2016
Sheet 14 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number
1 Condition score
Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.
C 2016
Sheet 15 of 16





Bay of Plenty Coastal Forest Aerial Monitoring 2007

T13/6 Site number

1 Condition score

Assessed forest unit

Scale 1:50,000
1 0.5 0 1 2 km

Plan No.

C 2016

Sheet 16 of 16



Appendix 2 – 2007 scores and observations recorded for each survey site

KEY		
KUN eri	Kunzea ericoides	kanuka
LIT cal	Litsea calicaris	mangeao
MET exc	Metrosideros excelsus	pohutukawa
VIT luc	Vitex lucens	puriri

Refer to text for condition scores (1-3).

Refer to Appendix 1 for the locations and extent of each site.

Site No.	Map	Score 03	Score 07	Species 07	Notes 07
T13/1	T13	1	1-2	METexc	Pohutukawa on the flats on both sides of Mataora Bay appear healthy. Occasional tree with grey canopy.
T13/2	T13/U13	2-3	2-3	METexc	These pohutukawa are the worst seen west of Whakatane. A large amount of grey foliage is present with many dead trees scattered throughout. Probably slightly worse than 2003.
T13/3	T13	2	2-3	METexc	Worse than 2003 with large amounts grey foliage and some dead trees.
T13/4	T13/U13	1-2	1-2	METexc and VITluc	Most of the pohutukawa around Orokawa Bay is okay with occasional 2's. The puriri at the heads of the gullies is showing signs of canopy greying.
T13/5	T13/U13	2-3	2-3	METexc and VITluc	Orokawa Bay itself. Most of the pohutukawa look healthy with only some trees near the coast with thin grey crowns. The puriri in the gullies is looking very grey with parts of some trees completely dead. Better than 2003.
T13/6	T13	1-2	1-2	METexc	Most pohutukawa looks okay.
T13/7	T13	1-2	1 - few 2	METexc	Most of these pohutukawa look good occasional tree with some canopy greying.
U13/1	U13	1	1 - few 2	METexc	Most of these pohutukawa look good occasional tree with some canopy greying. Slightly worse than 2003.
U13/2	U13	1-(2)	2	METexc	Most trees class 2 with many showing signs of canopy greying and thin canopies. Worse than 2003.
U13/3	T13/U13	1-2	1	METexc	Pohutukawa looks good.
U13/4	U13	1	1 - few 2	METexc	Most pohutukawa looks okay.
U13/5	U13	1	1	METexc	All pohutukawa along harbour margin are healthy.
U13/6	U13	1	1, some 3	METexc	All pohutukawa along harbour margin are healthy apart from some trees which are nearly completely dead. Worse than 2003.

U13/7	U13	1-2	1-2	METexc	Very small patch of pohutukawa next to harbour some trees showing signs of crown dieback.
U13/8	T13/U13	1-2	1-2	METexc	Very small patch of pohutukawa next to harbour some trees showing signs of crown dieback.
U13/9	U13	1-2	1-2	METexc	Very small patch of pohutukawa next to harbour some trees showing signs of crown dieback.
U13/10	U13	1-2	1	METexc	All pohutukawa along harbour margin are healthy.
U14/1	U14	1	1	METexc	Pohutukawa looks good.
U14/2	U14	1-2	1	METexc	Pohutukawa looks good. Slightly better than 2003.
U14/3	U14	1	1	METexc	Pohutukawa looks good.
U14/4	U14	1-2	2	METexc	Pohutukawa are showing signs of crown dieback. Worse than 2003.
U14/5	U14	1	1	METexc	All pohutukawa along harbour margin are healthy.
U14/6	U14	1	1 - few 2	METexc	Pohutukawa along harbour margin most are healthy occasional tree with canopy greying.
U14/7	U14	1	1-2	METexc	Few scattered pohutukawa occasional tree with canopy greying.
U14/8	U14	1	2 - few 3	METexc	Few scattered pohutukawa occasional tree with canopy greying and some that are dead. Worse than 2003.
U14/9	U14	1	1	METexc	Few scattered pohutukawa, all healthy.
U14/10	U14	1	1	METexc	Few scattered pohutukawa, all healthy. Very weedy area.
U14/11	U14	1	1	METexc	Pohutukawa looks good.
U14/12	U14	1	1-3	METexc	Pohutukawa appears to be healthy around the edges of Mauao, but there are some areas especially the western side where there are trees showing signs of canopy greying, crown dieback and some dead trees. Worse than 2003.
U14/13	U14	1	1	METexc	Mt Drury pohutukawa appear to be healthy.
U14/14	U14	1	1	METexc	Moturiki pohutukawa appear to be healthy.
U14/15	U14	1	1-2	METexc	Motuotau pohutukawa are mostly healthy with some starting to show signs of canopy greying and thinning.
U14/16	U14	1	1	METexc	Few scattered pohutukawa around harbour margin look healthy.
U14/17	U14	1	1 - few 2	METexc	Few scattered pohutukawa around harbour most look healthy with occasional 2's.
U14/18	U14	1	1	METexc	Few scattered pohutukawa around harbour margin look healthy.
U14/19	U14	2	1	METexc	Few scattered pohutukawa around harbour margin look healthy.
U14/20	U14	2	2	METexc	Few scattered pohutukawa around harbour trees starting to show signs of canopy greying.

U14/21	U14	2	1	METexc	Few scattered pohutukawa around harbour margin look healthy.
U14/22	U14	2	2	METexc	Few scattered pohutukawa around harbour trees starting to show signs of canopy greying.
U14/23	U14	1	1	METexc	A single healthy pohutukawa tree.
U14/24	U14	1	2	METexc	Small pocket of pohutukawa. Canopy greying evident.
U14/25	U14	1	1 - few 2	METexc	Scattered 2's
V14/1	V14	1	2	METexc	Pohutukawa on sea cliffs. Very scattered trees with visible crown dieback and some dead trees.
V14/2	V14	2	1 - few 2	METexc	Most of these pohutukawa are healthy but some are class 2.
V14/3	V14	2	1 - few 2	METexc	Most of these pohutukawa are healthy but some are class 2.
V14/4	V14	1	1	METexc	Pohutukawa look healthy.
V14/5	V14	1	1	METexc	Pohutukawa look healthy. Most of the site is mamaku.
V14/6	V14	1	1	METexc	Pohutukawa look healthy. Most of the site is mamaku.
V14/7	V14	2-3	2-3	METexc	This is a shag colony and most trees look unhealthy.
V14/8	V14	1	1	METexc	This small patch of pohutukawa looks healthy.
V14/9	V14	1	1	METexc	This small patch of pohutukawa looks healthy.
V14/10	U14	1-2	1-2	METexc	Motiti Island. Pohutukawa is present around the islands margins and mostly looks healthy. The northern tip of the island has some unhealthy looking trees and Motuputa island was classed as a 2.
V15/1	V15	1	1	METexc	This small patch of pohutukawa looks healthy.
V15/2	V15	1	1-2	METexc	Most pohutukawa looks okay, some 2's scattered throughout. This site is predominantly grey willow.
V15/3	V15	1-2	2	METexc	Some pohutukawa showing signs of crown dieback.
V15/4	V15	1-(2)	1 - few 2	METexc	Most pohutukawa looks okay, occasional class 2. Many slips are visible from the 2004 flooding.
V15/5	V15	1-2;(3)	1-3	METexc, LITcal, WEIrac and NOTtru	The pohutukawa along here looks healthy with the occasional class 2. The mangeao at the head of the gullies is showing signs of considerable dieback with many class 3 trees. The hard beech on the ridges in Matata S.R. has crown dieback also. Worse than 2003.
V15/6	V15	2	2	METexc	Crown dieback evident.
V15/7	V15	1	2	KUNeri	The trees nearer the coast look healthy but away from the coast many trees showing signs of canopy greying. Site is being grazed in places and houses continue to fragment the area. Worse than 2003.

W15/1	W15	1-2	1-2	METexc	Mokorua S.R. Some canopy greying throughout but most trees healthy.
W15/2	W15	1	1-2	METexc	Most pohutukawa healthy occasional tree with canopy greying.
W15/3	W15	3	2-3	LITcal	Many dead or dying mangero.
W15/4	W15	1	1	METexc	West end of Ohope. Pohutukawa look healthy.
W15/5	W15	1-2	1-2	METexc	Southern part Ohope S.R. Some canopy greying throughout but most trees healthy.
W15/6	W15	1	1	METexc	Coastal cliffs behind Ohope town. Looks good.
W15/7	W15	1-2	1-2	METexc	Northern part of Ohope S.R. Some canopy greying throughout but most trees healthy.
W15/8	W15	1	1	METexc	Coastal cliffs behind Ohope town. Looks good.
W15/9	W15	1-2	1-2	METexc	Local crown dieback evident.
W15/10	W15	1	1-2	METexc	Ohakana Island. Local crown dieback evident.
W15/11	W15	1-2	1-2	METexc	Most trees healthy but some showing signs of canopy greying.
W15/12	W15	1-2	1-2	METexc	Te Kauri Point. Some tree showing signs of canopy greying.
W15/13	W15	1-2	1-2	METexc	Uretara Island. Pohutukawa look okay.
W15/13A	W15	1-(2)	1-2	METexc and wattle	Pohutukawa looks mostly healthy. The wattle make the site look very unhealthy.
W15/13B	W15	2	1-2	METexc and wattle	Pohutukawa looks mostly healthy. The wattle make the site look very unhealthy.
W15/13C	W15	1-2	1-2	VITluc	Many of the puriri here show signs of crown dieback.
W15/14	W15	1-2	2	METexc	Large Hiwarau block. Pohutukawa showing signs of canopy greying and dieback the occasional dead tree. Worse than 2003.
W15/15	W15	1-2	1-2	METexc	Hokianga Is.
W15/16	W15	1-2	1	METexc and KUNeri	Pataua Is. The pohutukawa looks good, the kanuka is showing some signs of canopy greying.
W15/17	W15	1-(2)	1-2	METexc and wattle	Very scrubby area with scattered pohutukawa and wattle.
W15/18	W15	2	2	METexc and wattle	Scattered pohutukawa showing signs of crown dieback, much wattle throughout this area.
W15/19	W15	1-(2)	1 - few 2	METexc	Most pohutukawa healthy occasional tree with canopy greying.
W15/20	W15	1-(2)	1 - few 2	METexc	Most pohutukawa healthy some trees with canopy dieback.
W15/21	W15	1-2	1-2	METexc	Most pohutukawa healthy occasional tree with canopy greying.
W15/22	W15	1-2	2	METexc	Very scattered pohutukawa with canopy dieback.
W15/23	W15	1-2	1	METexc	This small patch of pohutukawa looks healthy.

X14/1	X14	1	1 - few 2	METexc	Narrow strip adjacent to coast. Occasional pohutukawa with grey crown.
X14/2	X14/X15	1-2	2	METexc, VITluc and KUNeri	The southern end of this site has more local crown dieback.
X14/3	X14	1-2	2	METexc	Scattered pohutukawa showing signs of crown dieback.
X14/4	X14	1	1	METexc	Looks good. 1 dead tree.
X14/5	X14	1	1	METexc	Pohutukawa look healthy.
X14/6	X14	1-2	2	Various	Overall canopy greying throughout.
X14/7	X14	1	1	METexc	Narrow strip adjacent to coast.
X14/8	X14	1	1	METexc	Narrow strip adjacent to coast.
X14/9	X14	1	1	METexc	Narrow strip adjacent to coast.
X14/10	X14	2	2-3	Various	Mainly puriri trees looking very unhealthy.
X14/11	X14	1	1-few 2	METexc	Narrow strip on coast. Mostly healthy occasional class 2.
X14/12	X14	1-2	1-2	Various	Class 2 on ridges.
X14/13	X14	2	2	METexc	Canopy dieback evident.
X14/14	X14/Y14	2	2	Various	Large area canopy looks grey throughout.
X14/15	X14	1-2	1 - few 2	METexc	Narrow strip on coast. Mostly healthy occasional class 2.
X15/1	X15	1-2	1	METexc	Pohutukawa looks healthy.
X15/2	X15	3	3	KUNeri	Kanuka at base of hill mostly dead spray damage? Seen in 2003.
X15/3	X15	1-2	2	Various	Overall canopy greying visible.
X15/4	X15	1-2	1-2	Various	Inland from Opape.
X15/5	X15	2	2-3	METexc	Canopy greying evident and the occasional dead tree.
X15/6	X15	1-2	1-2	METexc and VITluc	Most puriri show signs of canopy dieback.
X15/7	X15	1-2	1-2	METexc and VITluc	Most puriri show signs of canopy dieback, also some dead pohutukawa.
X15/8	X15	3	3	?	Area of dead trees. Seen in 2003.
X15/9	X15	1-(2)	1-2	METexc and KUNeri	Steep coastal cliffs most pohutukawa looks healthy, some kanuka has canopy greying.
X15/10	X15	1	1-2	Various	Mostly looks okay, some of the kanuka looks unhealthy.
X15/11	X15	1-2	2	Various	Overall canopy greying visible.
X15/12	X15	1-2	1-2	METexc and VITluc	Pohutukawa looks healthy the puriri has canopy dieback.
X15/13	X15	1-(2)	1-2	Various	Large area overall looks good, some canopy greying on ridges.
X15/14	X15	2	2-3	METexc and VITluc	Most pohutukawa and puriri trees looking unhealthy with dead and dying crowns.
X15/15	X15	1-2	2	Various	Canopy quite grey in many areas. Probably worse than 2003.
X15/16	X15	1-2	1-2	METexc and VITluc	Steep coastal cliffs most pohutukawa looks healthy, but puriri and possibly mahoe look very unhealthy.

X15/17	X15	2	2	METexc	Steep coastal cliffs most pohutukawa looks healthy, but puriri and possibly mahoe look very unhealthy.
X15/18	X15	1-2	2	METexc	Steep coastal cliffs most pohutukawa looks healthy, but puriri and possibly mahoe look very unhealthy.
X15/19	X15	1	1	METexc	Small area of pohutukawa looks good.
X15/20	X15	1-2	2-3	METexc and VITluc	Locally some very unhealthy trees both pohutukawa and puriri, but puriri overall worse. Worse than 2003.
X15/21	X15	1	1	METexc	Motu river mouth.
X15/22	X15	1	1 - few 2	METexc	Most pohutukawa look healthy occasional class2.
X15/23	X15	2	2	VITluc	Puriri with canopy dieback especially on the edges.
X15/24	X15	1-2	1-2	Various	Overall canopy looks good but some canopy greying is evident especially on the ridges.
X15/25	X15	2	1-2	METexc	Steep coastal cliffs most pohutukawa looks healthy.
X15/26	X15	2	2	METexc	Steep coastal cliffs pohutukawa looks okay but canopy greying is evident throughout.
X15/27	X15	1	1	METexc	Steep coastal cliffs most pohutukawa looks healthy.
X15/28	X15	1	1	METexc	Steep coastal cliffs most pohutukawa looks healthy.
X15/29	X15	2	2	METexc	Canopy dieback is occurring.
X15/30	X15	2	1-2	METexc and VITluc	Pohutukawa looks healthy the puriri has canopy dieback.
X15/31	X15	2	1-2	METexc and VITluc	Pohutukawa looks healthy the puriri has canopy dieback.
X15/32	X15	2	1-2	METexc and VITluc	Pohutukawa looks healthy the puriri has canopy dieback.
X15/33	X15	1-(2)	1-2	METexc and VITluc	Occasional pohutukawa and puriri with crown dieback
X15/34	X15	1-(2)	1 - few 2	METexc	Motunui Is.
X15/35	X15	2	2	METexc	Coastal strip.
X15/36	X15	1	1	METexc	Coastal strip.
X15/37	X15	2	2	METexc	Mostly scrub but scattered pohutukawa with some canopy greying.
Y14/1	Y14	1	1	METexc	Small headland trees look healthy.
Y14/2	Y14	2	2	Various	Overall canopy greying throughout.
Y14/3	Y14	2	2	METexc	Many pohutukawa showing signs of canopy greying and some crown dieback.
Y14/4	Y14	1-2	1-2	METexc	Mostly ok but some trees looking grey.
Y14/5	Y14	2	2 - few 3	Various	Inland from Whanarua Bay. Many trees with crown dieback and some dead trees scattered throughout, many are possibly puriri.
Y14/6	Y14	2	2	METexc	Pohutukawa showing signs of canopy greying throughout.
Y14/7	Y14	1-2	2	METexc	Motu Kaimeanui Is. Trees overall showing signs of canopy greying and dieback.

Y14/8	Y14	1	1	METexc	Coastal strip. Looks healthy.
Y14/9	Y14	2	2	Various	Canopy dieback is occurring locally throughout.
Y14/10	Y14	2	1-2	METexc and VITluc	Mostly ok but some trees looking grey.
Y14/11	Y14	2	2	METexc	Pohutukawa showing signs of canopy greying throughout.
Y14/12	Y14	2	2	Various	Canopy greying evident and the occasional dead tree, kanuka is especially evident.
Y14/13	Y14	1	1	Various	Looks healthy.
Y14/14	Y14	2	2	METexc	Small remnant next to road, crown dieback visible.
Y14/15	Y14	1-2	1-2	Various	Stream gully with scrub and some pohutukawa and puriri.
Y14/16	Y14	2	2	Various	Stream gully with scrub and some pohutukawa and puriri.
Y14/17	Y14	2	2	KUNeri	kanuka showing signs of crown dieback.
Y14/18	Y14	1-2	1-2	Various	
Y14/19	Y14	2	2	METexc	Pohutukawa with grey and dead crowns.
Y14/20	Y14	1	2	METexc	Small pohutukawa remnant.
Y14/21	Y14	2	2-3	METexc and VITluc	Pohutukawa with grey and dead crowns, puriri worse.
Y14/22	Y14	2	2-3	METexc	Pohutukawa with grey and dead crowns, some dead trees also.
Y14/23	Y14	2	2	METexc	Pohutukawa with grey crowns.
Y14/24	Y14	2	2-3	METexc	Pohutukawa with grey and dead crowns, puriri worse. Worse than 2003.
Y14/25	Y14	2	3	METexc and VITluc	Pohutukawa class 2, puriri class 3. Worse than 2003.
Y14/26	Y14	2	3	Various	Lots of canopy greying and crown dieback and some dead trees. Worse than 2003.
Y14/27	Y14	2	2	METexc	
Y14/28	Y14	2	2 - few 3	Various	Overall canopy greying and some crown dieback.
Y14/29	Y14	3	2-3	METexc and VITluc	Pohutukawa canopy greying and puriri canopy dieback and dead trees.
Y14/30	Y14	2	2	METexc	
Y14/31	Y14	2-3	2-3	METexc	
Y14/32	Y14	1-2	1-2	METexc and VITluc	Patches of pohutukawa along coast. Puriri look bad.
Y14/33	Y14	1	1	METexc	Mainly scrub with scattered pohutukawa, all look healthy.
Y14/34	Y14	1	1	Various	
Y14/35	Y14	1-2	2-3	Various	Mainly rewarewa and kanuka looks unhealthy with much canopy greying.
Y14/36	Y14	1-2	1-2	Various	
Y14/37	Y14	1-2	2 - few 3	METexc	Scattered pohutukawa along coast. Some dead and dying trees.
Y14/38	Y14	2	2	Various	
Y14/39	Y14	1-2	1-2	Various	

Appendix 3 – Legislative mandate for monitoring coastal forest canopy condition

Part II

Section 6: Matters of national importance

In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

- (c) The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development
- (d) The protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development
- (e) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.

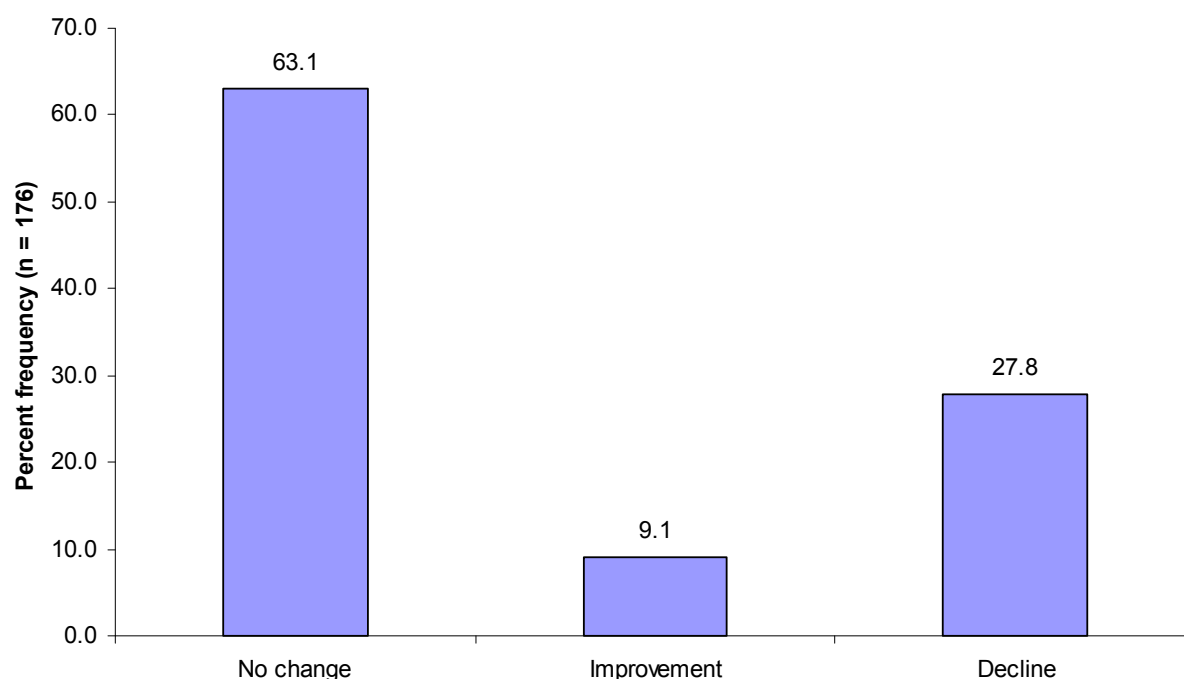
Section 30: Functions of regional councils under this Act

- (1) Every regional council shall have the following functions for the purpose of giving effect to this Act in its region—
 - (a) The establishment, implementation, and review of objectives, policies, and methods to achieve integrated management of the natural and physical resources of the region.
 - (b) The preparation of objectives and policies in relation to any actual or potential effects of the use, development, or protection of land which are of regional significance.
 - (ga) The establishment, implementation, and review of objectives, policies, and methods for maintaining indigenous biological diversity. [Resource Management Amendment Act 2003 (2003 No 23)].

Section 35: Duty to gather information, monitor, and keep records

- (2) Every local authority shall monitor—
 - (a) The state of the whole or any part of the environment of its region or district to the extent that is appropriate to enable the local authority to effectively carry out its functions under this Act; and
 - (b) The efficiency and effectiveness of policies, rules, or other methods in its policy statement or its plan. [Resource Management Amendment Act 2003 (2003 No 23)]

Appendix 4 – Summary of sites showing no change, improvement or decline in scores between 2003 and 2007 – before adjusting for magnitude of change in score



Appendix 5 - Sites showing improvement (left) and declining (right) scores and the proportion of scores that changed by < 1 category or ≥ 1 category

