



# State and trends in the diversity, abundance and distribution of birds in Upper Hutt Reserves

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# State and trends in the diversity, abundance and distribution of birds in Upper Hutt reserves

September 2013

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## **Executive summary**

Five-minute bird counts have been carried out in 2011 and 2012 at 45 bird count stations randomly distributed throughout selected Upper Hutt City parks and reserves. The aim of these surveys is to monitor trends in the diversity, abundance and distribution of native forest birds at these sites over time.

In November and December each year two bird counts were carried out at each of the 45 stations with one count done by each of two experienced observers. The number of counts completed each year provides a sufficient sample size to detect a 25% or more change in the apparent abundance of tui in these reserves.

Twenty-six species of birds were recorded during the 2012 bird counts, including 14 native and 12 introduced species. On average, a higher number of native forest bird species was recorded at each bird count station in Upper Hutt City reserves compared to Wellington City reserves in both 2011 and 2012. This is because 25-30% of the forest bird species recorded in Wellington City reserves had very localised distributions whereas almost all species in Upper Hutt reserves had relatively widespread distributions.

There was a significant reduction in the apparent abundance of both tui and silvereye between the 2011 and 2012 bird counts, and a significant increase in bellbird detection rates over the same period. While this may reflect real changes in the abundance of these three species, these results may also have been caused by differences in the distribution of birds in these reserves that occur in response to changes in the availability of food resources both within the reserves and in the surrounding landscape. Short-term fluctuations in apparent abundance are likely to occur with these more mobile bird species, so monitoring over several years will be required before these short-term fluctuations in distribution can be differentiated from longer-term trends in abundance.

A significant increase in both the apparent abundance and distribution of fantails was detected between 2011 and 2012. This most likely represents a population recovery of this species following one or more heavy mortality events that occurred during two unusually severe snowstorms that occurred in the Wellington Region in July and August 2011.

Both Keith George Memorial Park and Wi Tako Reserve each supported populations of all of the native forest bird species detected during the 2012 bird counts, including populations of species such as tomtit and whitehead that are scarce or absent from all other reserves sampled. Management of these two reserves should be considered a priority to ensure that populations of the full range of native forest bird species present in Upper Hutt City reserves are maintained.



# Contents

<b>Executive summary</b>	<b>i</b>
<b>1. Introduction</b>	<b>1</b>
<b>2. Methods</b>	<b>3</b>
2.1 Field technique	3
2.2 Data analysis	4
<b>3. Results</b>	<b>6</b>
3.1 Species diversity	6
3.2 Index of bird abundance	7
3.3 Bird distribution	10
<b>4. Discussion</b>	<b>21</b>
4.1 Native species diversity	21
4.2 Index of bird abundance	21
4.3 Native bird distribution	22
<b>References</b>	<b>24</b>
<b>Acknowledgements</b>	<b>26</b>
<b>Appendix</b>	<b>27</b>



## 1. Introduction

Annual bird monitoring is carried out in a number of parks and reserves around Upper Hutt with the aim of monitoring changes in the diversity, abundance and distribution of native birds in these reserves over time. Bird monitoring in Upper Hutt reserves began in 2005 when five-minute bird count stations were established in Keith George Memorial Park as part of Greater Wellington Regional Council's Key Native Ecosystem programme. In 2006 and 2007, bird count stations were added to six further parks and reserves around Upper Hutt to provide a more detailed picture of trends in bird distribution and abundance across Upper Hutt (Figure 1.1).

The results of the first six years of bird counts were reported in Stephens et al. (2007), Fea and Moylan (2008) and Govella et al. (2011). These authors reported that native bird diversity and abundance tended to be greater in the larger and better connected parks and reserves with fantail (*Rhipidura fuliginosa*), tui (*Prosthemadera novaeseelandiae*), grey warbler (*Gerygone igata*) and silvereye (*Zosterops lateralis*) being the most frequently recorded species. Keith George Memorial Park emerged as an important habitat for native birds in Upper Hutt because it was the only reserve sampled that supported large populations of both whitehead (*Mohoua albicilla*) and tomtit (*Petroica macrocephala*).

In 2011 this bird monitoring programme was replaced with a new survey designed to monitor changes in the apparent abundance of native forest birds across the entire network of selected reserves, rather than attempt to compare indices of abundance between individual reserves (McArthur et al. 2012). Tui were chosen as a focal species for this new survey design and a sample size of 90 five-minute bird counts was selected to ensure sufficient statistical power to detect a 25% or more change in the apparent abundance of tui from one year to the next.

These new bird count stations were surveyed for the first time in 2011 and results showed that the larger and more well-connected reserves continued to support the greatest diversity of species. In addition, the average number of native forest bird species recorded per bird count station was significantly higher in Upper Hutt reserves compared to the Wellington City parks and reserves network. This was likely to be because around a third of the bird species detected in Wellington City reserves had fairly localised distributions centred on Zealandia's pest-proof boundary fence, whereas the majority of the species recorded in Upper Hutt reserves had more widespread distributions (McArthur et al. 2012).

Silvereye, grey warbler and tui were once again three of the most common bird species recorded in Upper Hutt reserves in 2011. Detection rates for fantail had declined markedly from the previous year, probably as a result of heavy mortality suffered during two unusually heavy snowfall events that occurred during winter 2011. Kakariki (*Cyanoramphus* sp.), bellbird (*Anthornis melanura*) and rifleman (*Acanthisitta chloris*) were all detected in Wi Tako reserve for the first time in 2011, but this may have been a consequence of the improved search effort and coverage that was built into the new survey design,



rather than evidence that recent colonisation events had occurred (McArthur et al. 2012).

These bird counts were repeated again in 2012 and this report provides a summary of the results of these bird counts and makes comparisons with the results of the 2011 counts reported in McArthur et al. (2012).



Figure 1.1: Location of parks and reserves sampled as part of the Upper Hutt bird monitoring programme, 2007-2013

## 2. Methods

### 2.1 Field technique

Forty-five bird count stations were established at random locations in forest habitat in six of seven selected Upper Hutt reserves in November 2011, and were surveyed in both 2011 and 2012 (Figure 2.1). Bird count stations were situated a minimum distance of 200m apart, and no less than 50m from the nearest forest edge. Each station was marked with a blue triangle affixed to a living tree. Due to the random placement of count stations, no station fell within the boundary of the smallest of the seven reserves, Riverstone Park, so no abundance data could be collected at this reserve. Instead, a walk-through survey was carried out each year to collect data on species richness and distribution in this park.

Each year, two five-minute bird counts were carried out at each station, with each count being completed on a different day. All counts were carried out in November or early December each year, and counts were only made on fine, calm days between 1.5 hours after sunrise and 1.5 hours before sunset (approximately 7.30am to 6.30pm). At each station, an observer spent five minutes recording the number of individuals of all bird species seen or heard from the count station (i.e. an unbounded count as per Dawson & Bull 1975 and Hartley & Greene 2012). Care was taken not to record the same bird twice during a count. Two experienced observers were employed to conduct the counts each year with each observer carrying out one count at each station.

Bird conspicuousness can vary in response to a number of variables such as time of year, weather, time of day and change in observer (Bibby et al. 2000). Because of this, every effort was made to either standardise or sample the range of variation in each of these factors to increase the likelihood that any changes in the mean number of birds counted from one year to the next would reflect changes in abundance rather than conspicuousness. Precautions taken include carrying out these counts during the same months each year and in similar weather conditions. Counts were carried out throughout the day, so that any variation in bird conspicuousness that occurs during the day was sampled. The same two experienced observers were used to carry out the counts in 2011 and 2012 to ensure the counts were carried out in a consistent way each year.

Although no five-minute bird counts were carried out in Riverstone Park, a twenty-minute walk-through survey was undertaken by one observer in November 2011 & 2012 and a list was made of all the bird species that were detected. These data were then added to the distribution and species richness data collected from the other six reserves.

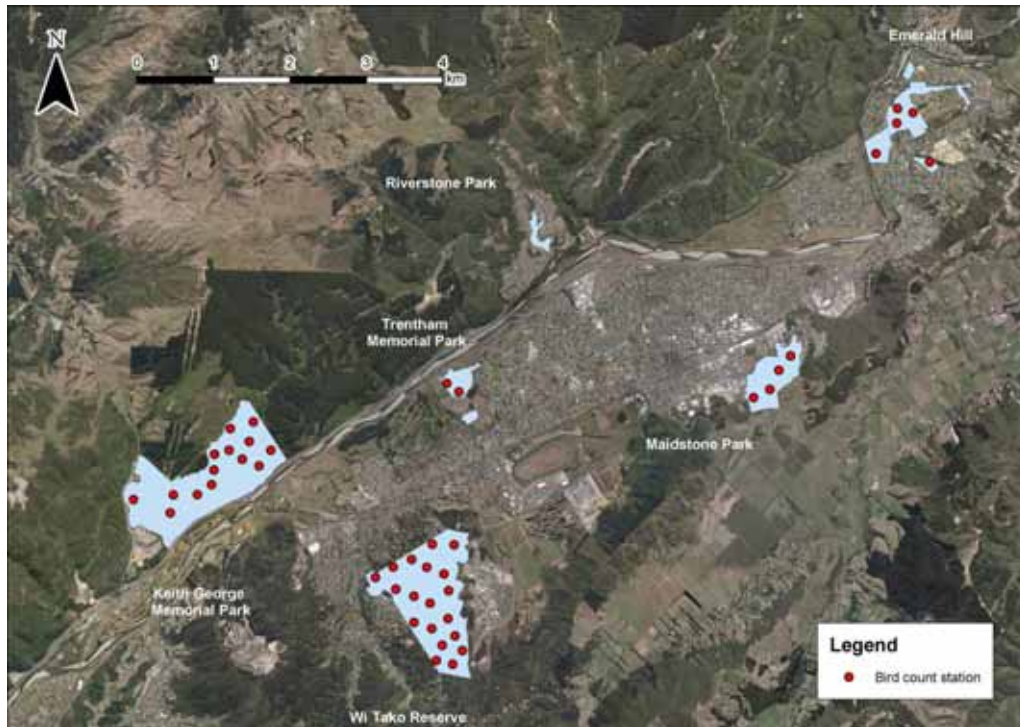


Figure 2.1: Locations of bird count stations surveyed in Upper Hutt reserves in 2011 & 2012 (Note: the single count station in Cloustoneville Park is not shown)

## 2.2 Data analysis

Bird count data were entered into an excel spreadsheet using a standard five-minute bird count data template. This spreadsheet was then used to calculate the total number of native forest bird species detected in each reserve in 2011 and 2012. The mean number of native forest bird species detected per count station in the Upper Hutt reserves was also calculated and compared to the mean number of species detected in Wairarapa and Wellington City reserves that were also surveyed in 2011 and 2012. Two-tailed  $F$ -tests were used to check that the variances of each sample were approximately equal, followed by two-tailed  $z$ -tests to assess whether any differences in the mean number of species detected per station in Upper Hutt, Wairarapa or Wellington City reserves were statistically significant (Fowler & Cohen 1995). This latter test is important, because a statistically significant result indicates that any difference between two means is very unlikely to have occurred due to chance sampling error, so instead likely represents a real difference in the species diversity of native forest bird communities between the three reserves network.

The bird count data were also used to calculate the mean number of birds of each species recorded per count station across the Upper Hutt reserves in 2011 and 2012. This mean number of birds recorded provides an index of the relative abundance and/or conspicuousness of each bird species in the Upper Hutt reserves surveyed (Dawson & Bull 1975). Two-tailed  $F$ -tests were again used to check that the variances of each sample were approximately equal, followed by two-tailed  $z$ -tests to assess whether the mean number of birds recorded per station in Upper Hutt reserves differed significantly between 2011 and 2012 (Fowler & Cohen 1995).

Patterns in the distribution of native birds among the Upper Hutt reserves sampled were examined by mapping bird distribution using Arcmap version 9.3.1. Although this technique does not take into account changes in abundance (less common species present within sight or earshot of a bird count station are less likely to be detected) or variation in detection probabilities between species (less conspicuous species will also be less likely to be detected), it should be sufficient to detect relatively large changes in species' distributions.

### 3. Results

#### 3.1 Species diversity

Twenty-six species of birds were recorded in Upper Hutt reserves during the 2012 bird counts; three fewer than were recorded in 2011 (see Appendix). Of these 26 species, 14 were native and 12 introduced; a similar ratio to the 17 native and 12 introduced species recorded in 2011. Ten of the native bird species recorded in 2012 were species that are typically found in native forest habitat and it is for these species that trends in relative abundance and distribution have been reported below. The remaining four native species that were recorded were either open country or wetland species such as Australasian harrier (*Circus approximans*) and paradise shelduck (*Tadorna variegata*) and are not included in any further analyses. All of the native forest bird species recorded in 2012 are ranked as “not threatened” under the New Zealand threat classification system (Miskelly et al. 2008).

All ten native forest bird species that were recorded in the seven Upper Hutt reserves surveyed in 2012 were also recorded in both Wi Tako Reserve and Keith George Memorial Park, the two largest reserves sampled (Figure 3.1). Two native bird species detected in Wi Tako reserve in 2011 were not recorded in 2012. These were rifleman (ranked as “at risk, declining”) and kakariki (ranked as “at risk, relict”). Conversely, many of the apparent increases in species richness observed in the five smaller reserves were caused by both fantail and bellbird being recorded in these reserves in 2012, but not in 2011 (Figure 3.1; Appendix).

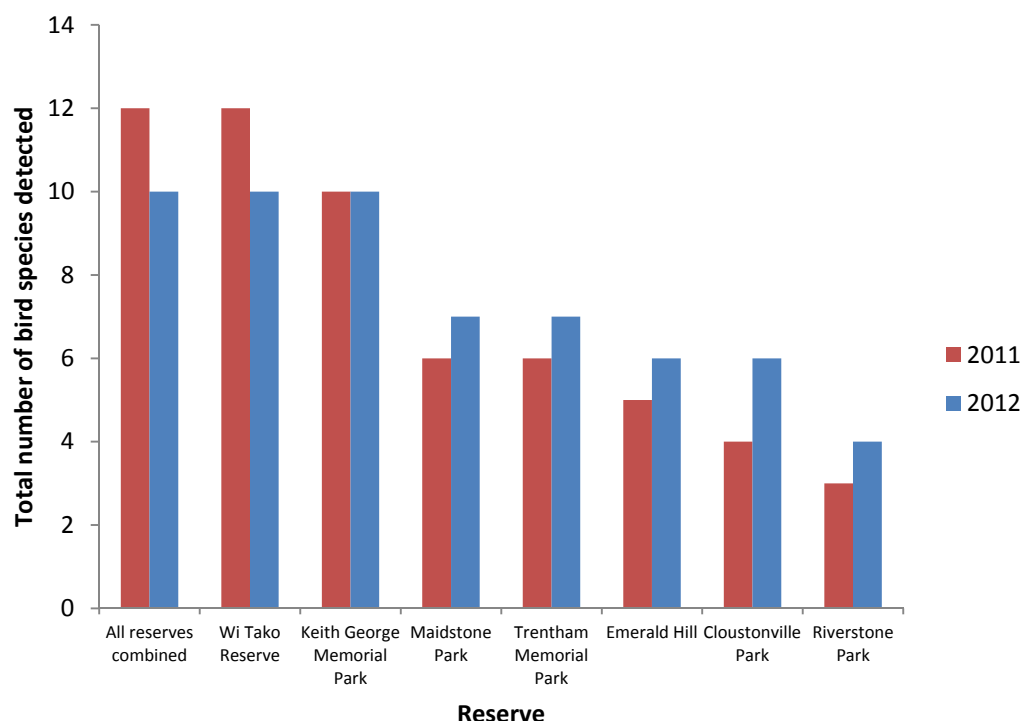


Figure 3.1: Total number of native forest bird species recorded among Upper Hutt reserves in 2011 and 2012

There was no significant difference in the mean number of bird species recorded per bird count station in Upper Hutt reserves between 2011 and 2012 ( $z=1.69$ ,  $p=0.09$ ; two-tailed  $z$ -test) (Figure 3.2). In 2012 the 4.2 native forest bird species recorded per count station in Upper Hutt reserves was once again significantly greater than the 2.8 species recorded in Wairarapa reserves ( $z=5.43$ ,  $p=5.75 \times 10^{-8}$ ; two-tailed  $z$ -test) and the 2.5 species recorded in Wellington City reserves ( $z=10.29$ ,  $p=0.00$ ; two-tailed  $z$ -test).

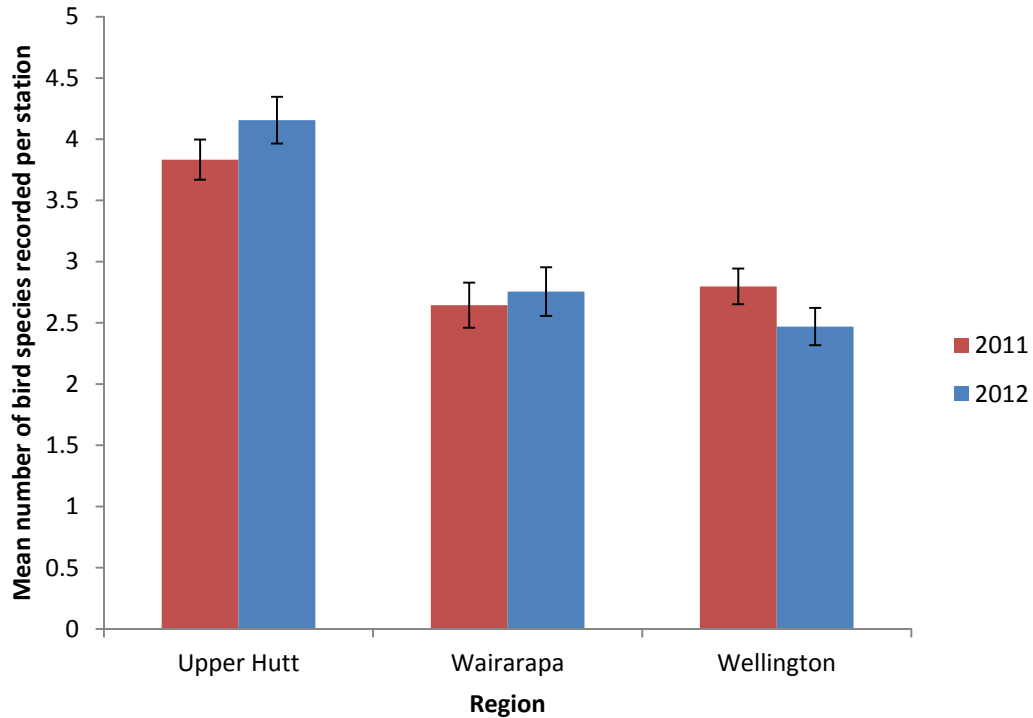


Figure 3.2: Mean number of native forest bird species recorded per count station in Upper Hutt ( $n=90$ ), Wairarapa ( $n=45$ ) and Wellington City ( $n=200$ ) reserves in 2011 and 2012 (error bars show 95% confidence limits)

### 3.2 Index of bird abundance

Silvereye, grey warbler and tui were once again the three most frequently recorded native forest bird species recorded in Upper Hutt reserves in 2012. Silvereye was the most frequently recorded species with a mean of 2.4 birds per count station in 2012; a significant reduction from the 3.0 birds recorded per station in 2011 ( $z=2.34$ ,  $p=0.019$ ; two-tailed  $z$ -test). Grey warbler was the second most frequently recorded species in 2012, with a mean of 2.2 birds per station; similar to the 2.3 birds recorded per station in 2011. Tui was the third most frequently recorded species in 2012; the mean of 1.7 birds recorded per bird count station was a significant reduction from the 2.2 birds per station recorded in 2011 ( $z=2.35$ ,  $p=0.019$ ; two-tailed  $z$ -test) (Figure 3.3).

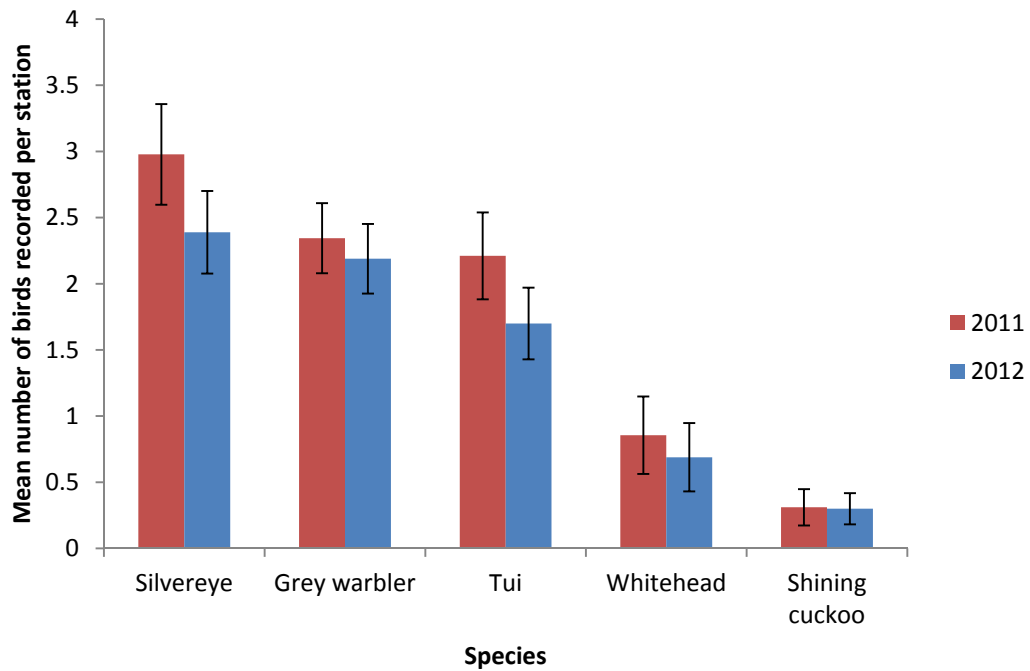


Figure 3.3: Mean number of birds recorded per count station for relatively common or conspicuous native forest bird species detected in Upper Hutt reserves in 2011 and 2012 (error bars show 95% confidence limits)

All other native forest bird species recorded in 2012 were recorded at a rate of <math><1.0</math> birds per count station (Figures 3.3 and 3.4). Of these, the detection rate for bellbird increased significantly from 0.1 birds recorded per count station in 2011 to 0.4 birds per station in 2012 ( $z=3.03$ ,  $p=0.002$ ; two-tailed  $z$ -test). The detection rate for fantail also increased significantly, from 0.07 birds recorded per station in 2011 to 0.28 birds per station in 2012 ( $z=3.00$ ,  $p=0.003$ ; two-tailed  $z$ -test). Detection rates for all other native forest bird species recorded did not differ significantly between 2011 and 2012.

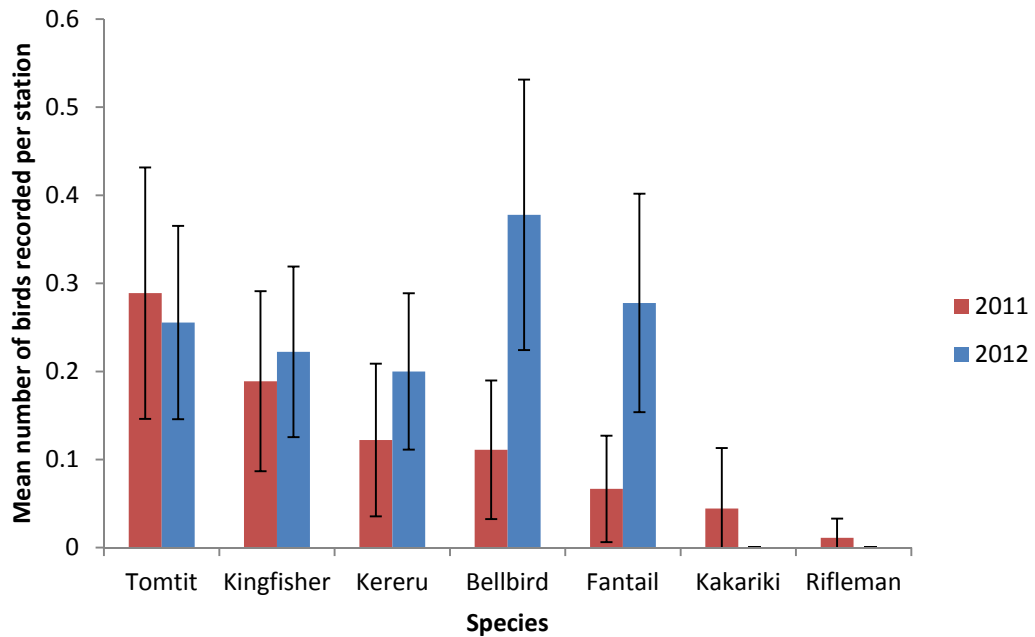


Figure 3.4: Mean number of birds recorded per count station for relatively rare or inconspicuous native forest bird species detected in Upper Hutt reserves in 2011 and 2012 (error bars show 95% confidence limits)

Of the 12 introduced bird species recorded during the 2012 bird counts, blackbird (*Turdus merula*), chaffinch (*Fringilla coelebs*) and eastern rosella (*Platycercus eximius*) were the three most frequently recorded species (Figure 3.5). All other introduced species were recorded at a rate of less than 0.5 birds detected per count station (Figures 3.5 and 3.6). Greenfinch (*Carduelis chloris*) was recorded for the first time in 2012, whereas Australasian magpie (*Gymnorhina tibicen*) and skylark (*Alauda arvensis*) were not detected despite having been recorded in 2011. None of the 12 introduced species recorded in 2012 had detection rates that differed significantly from those recorded in 2011.



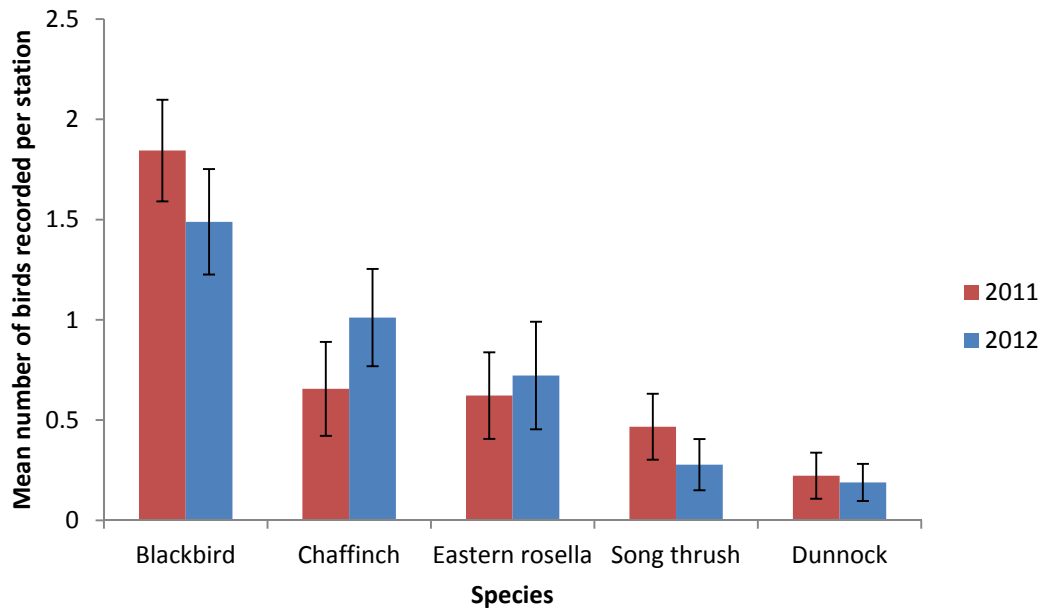


Figure 3.5: Mean number of birds recorded per count station for relatively common or conspicuous introduced bird species detected in Upper Hutt reserves in 2011 and 2012 (error bars show 95% confidence limits)

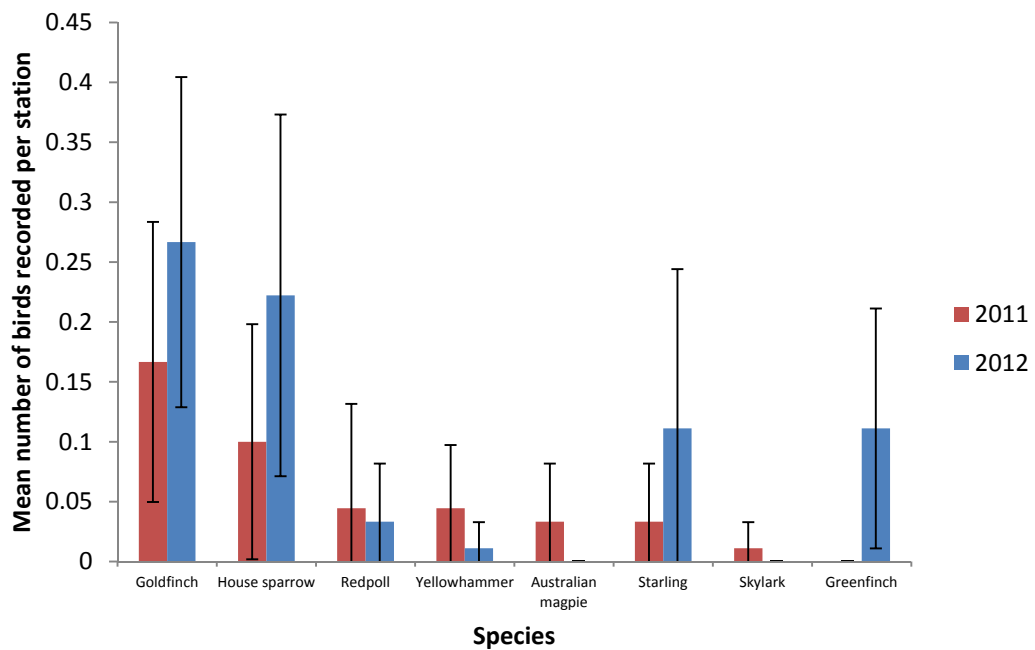


Figure 3.6: Mean number of birds recorded per count station for relatively rare or inconspicuous introduced bird species detected in Upper Hutt reserves in 2011 and 2012 (error bars show 95% confidence limits)

### 3.3 Bird distribution

The distribution of native forest birds in Upper Hutt reserves in 2012 was broadly similar to that found in previous years (Govella et al. 2011; McArthur et al. 2012). Several species including silvereye, grey warbler and tui continued to have a widespread distribution and were recorded at almost all of the bird count stations in 2011 and 2012 (e.g. Figure 3.7). Kereru (*Hemiphaga*

*novaeseelandiae*) on the other hand, was once again less widespread and was mainly restricted to the larger reserves (Keith George and Wi Tako) as well as Maidstone Park in both 2011 and 2012 (Figure 3.8).

Bellbird was recorded in Keith George Memorial Park and Wi Tako Reserve in both 2011 and 2012; but was detected at a greater number of count stations in both reserves in 2012. Bellbird was also recorded in Emerald Hill in 2012, the first time this species had been recorded in this reserve since 2010 (Govella et al. 2011) (Figure 3.9).

The number of bird count stations at which fantail was recorded increased markedly between 2011 and 2012. In 2011 fantails were only recorded in Keith George Memorial Park, Wi Tako Reserve and Trentham Memorial Park. By contrast, fantails were recorded in all reserves with the exception of Cloustonville Park in 2012 (Figure 3.10).

Both tomtit and whitehead continued to be mainly confined to Keith George Memorial Park and Wi Tako Reserve, however tomtits were recorded at Cloustonville Park for the first time since bird monitoring at this reserve began in 2007 (Govella et al. 2011). In Wi Tako reserve, both tomtit and whitehead appear to be largely confined to the southern end of the reserve (Figures 3.11 and 3.12).

Both rifleman and kakariki were recorded in Wi Tako Reserve in 2011, but were not detected in 2012 (Figures 3.13 and 3.14). In contrast, the eastern rosella (a potential competitor and disease vector for kakariki; Wright & Clout 2001; Galbraith 2010) was recorded in most of the reserves surveyed in 2011 and 2012. In Wi Tako Reserve eastern rosellas were recorded at a greater proportion of count stations in 2012 than in 2011 (Figure 3.15).

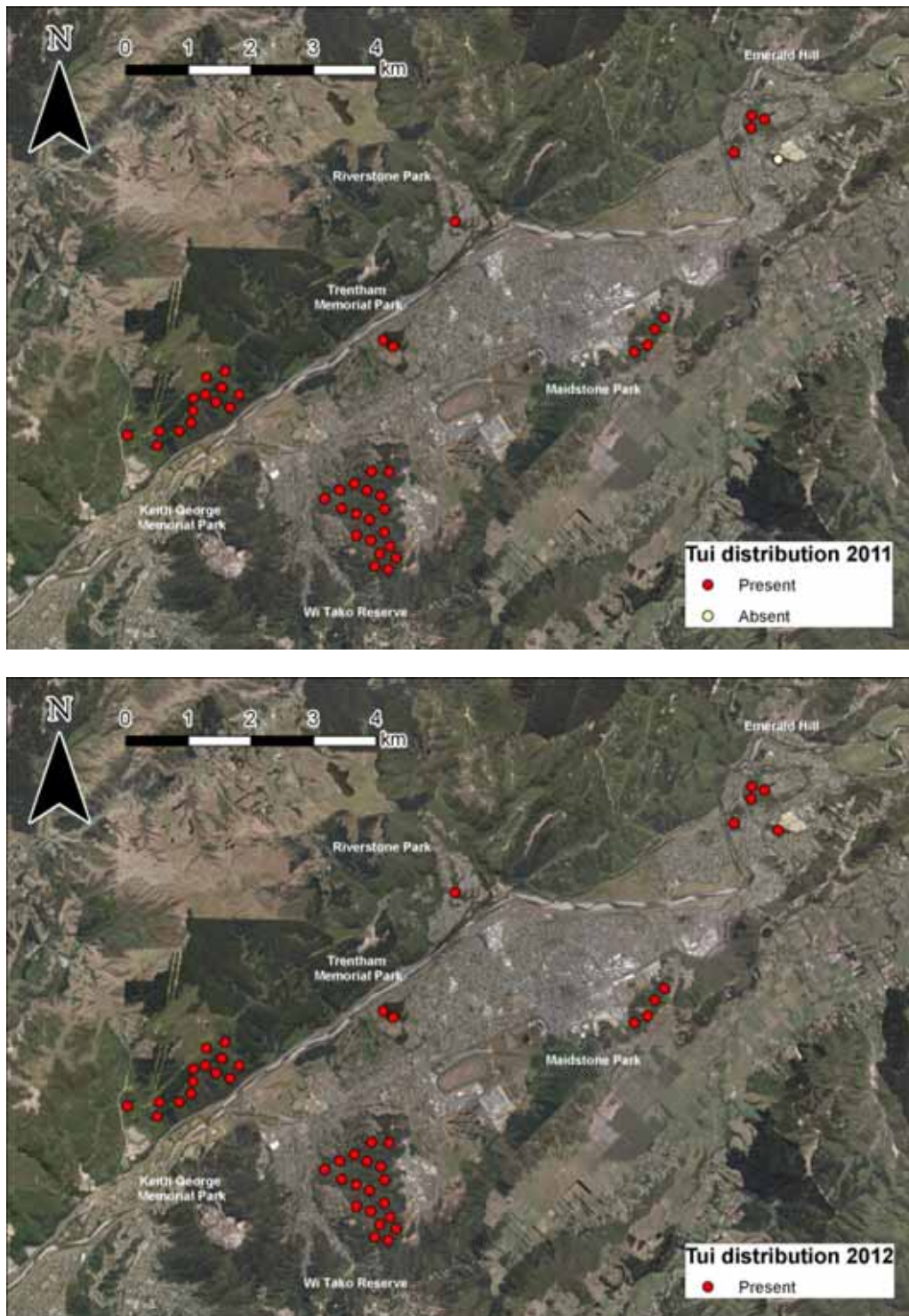


Figure 3.7: Distribution of tui in Upper Hutt reserves in 2011 (top) and 2012 (bottom) (Note: the single count station in Cloustonville Park is not shown, however tui was detected at this site in both 2011 & 2012)

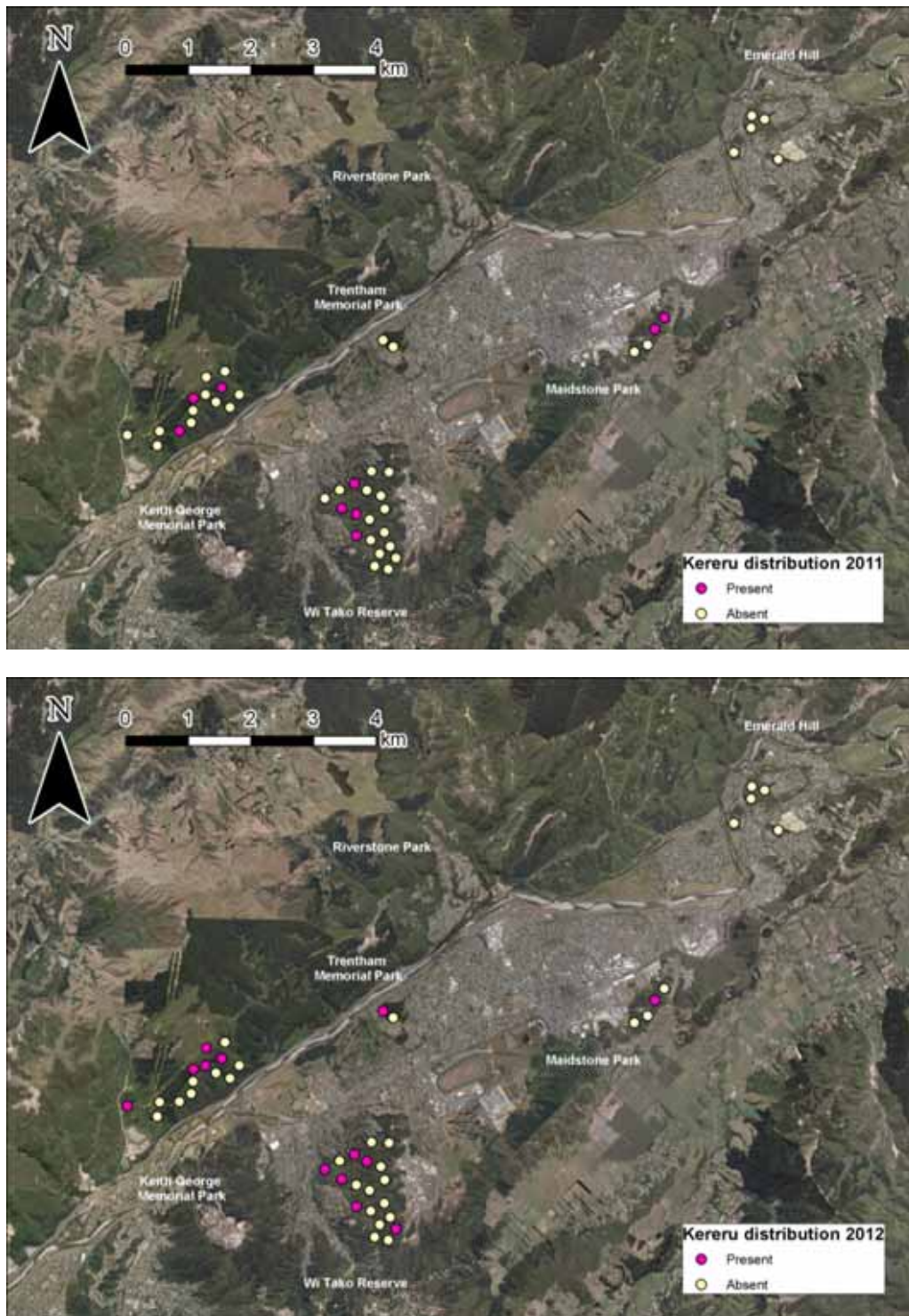


Figure 3.8: Distribution of kereru in Upper Hutt reserves in 2011 (top) and 2012 (bottom) (Note: the single count station in Cloustonville Park is not shown, however kereru wasn't detected at this site in either 2011 or 2012)

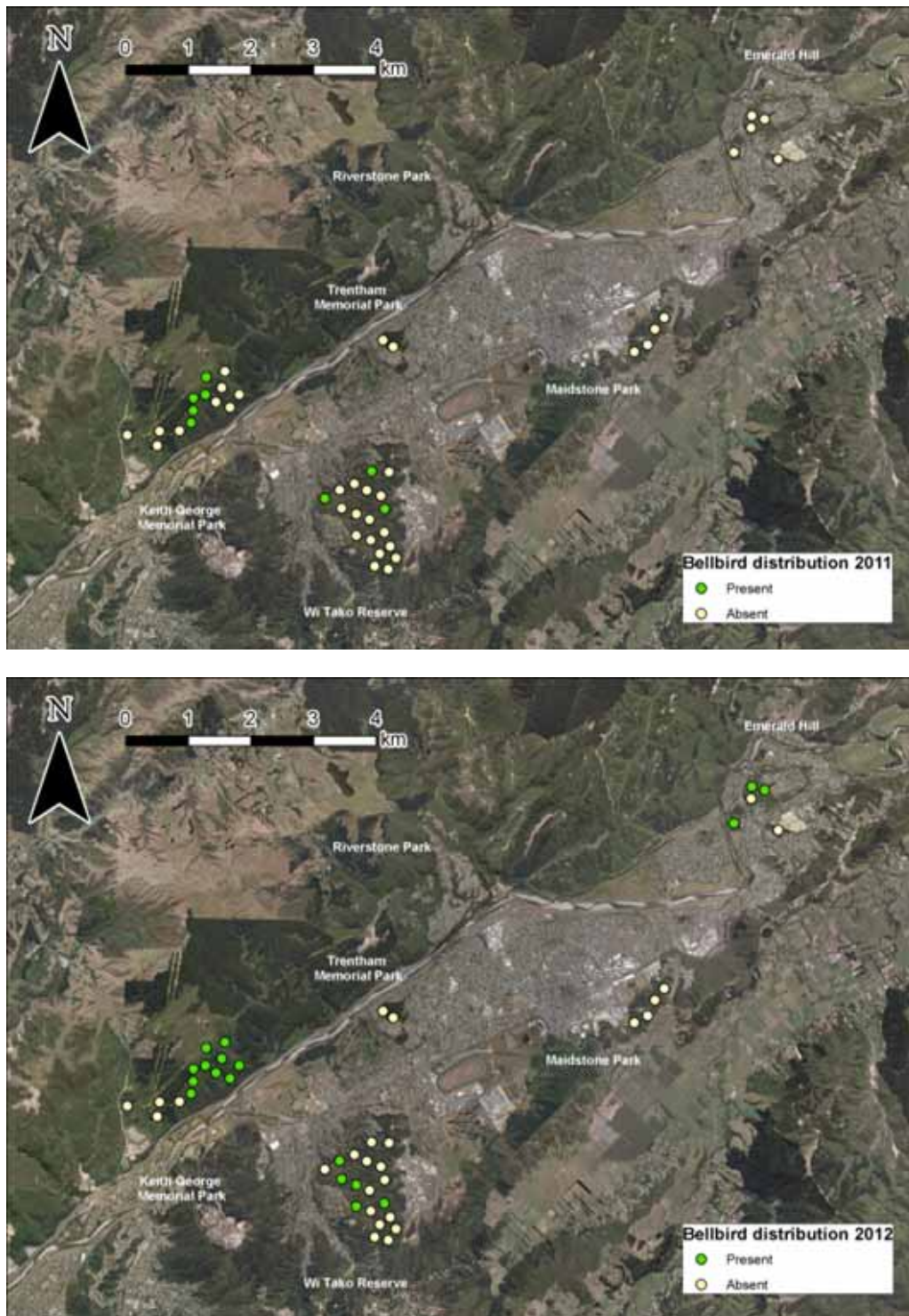


Figure 3.9: Distribution of bellbird in Upper Hutt reserves in 2011 (top) and 2012 (bottom) (Note: the single count station in Cloustonville Park is not shown, however bellbird was detected at this site in 2012, but not in 2011)

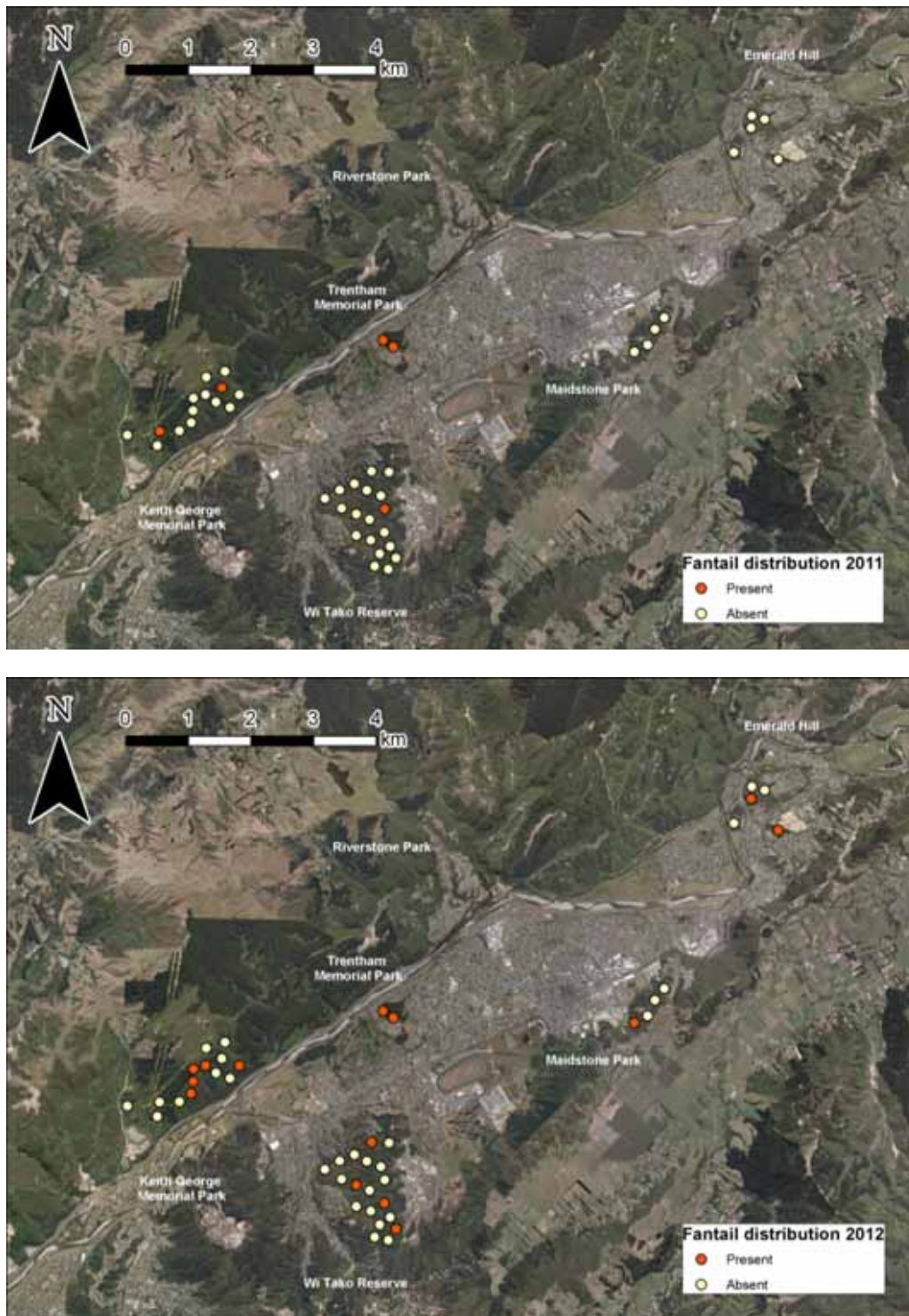


Figure 3.10: Distribution of fantail in Upper Hutt reserves in 2011 (top) and 2012 (bottom) (Note: the single count station in Cloustonville Park is not shown, however fantail wasn't detected at this site in either 2011 or 2012)

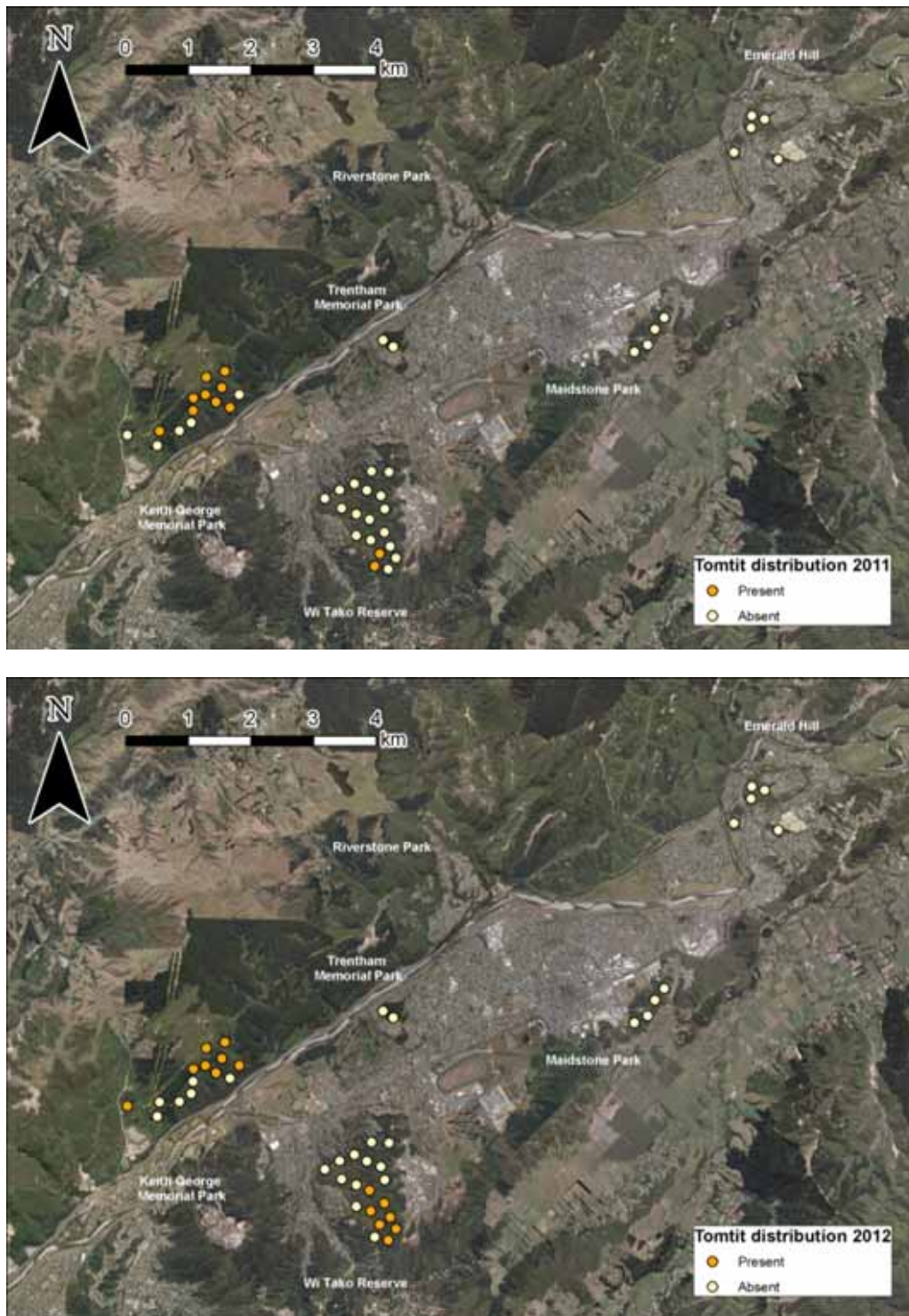


Figure 3.11: Distribution of tomtit in Upper Hutt reserves in 2011 (top) and 2012 (bottom) (Note: the single count station in Cloustonville Park is not shown, however tomtit was detected at this site in 2012, but not in 2011)

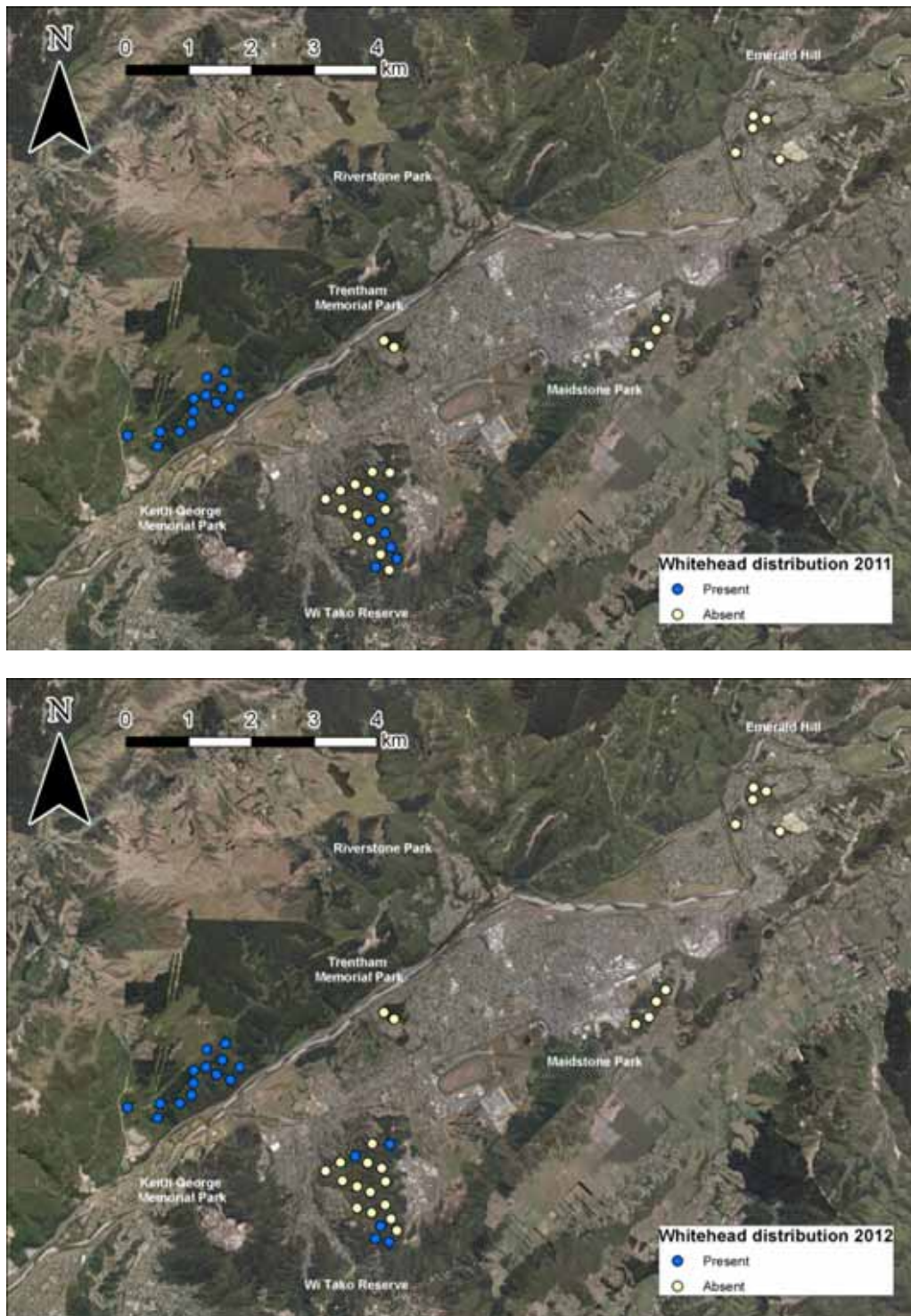


Figure 3.12: Distribution of whitehead in Upper Hutt reserves in 2011 (top) and 2012 (bottom) (Note: the single count station in Cloustonville Park is not shown, however whitehead was detected at this site in 2011, but not in 2012)



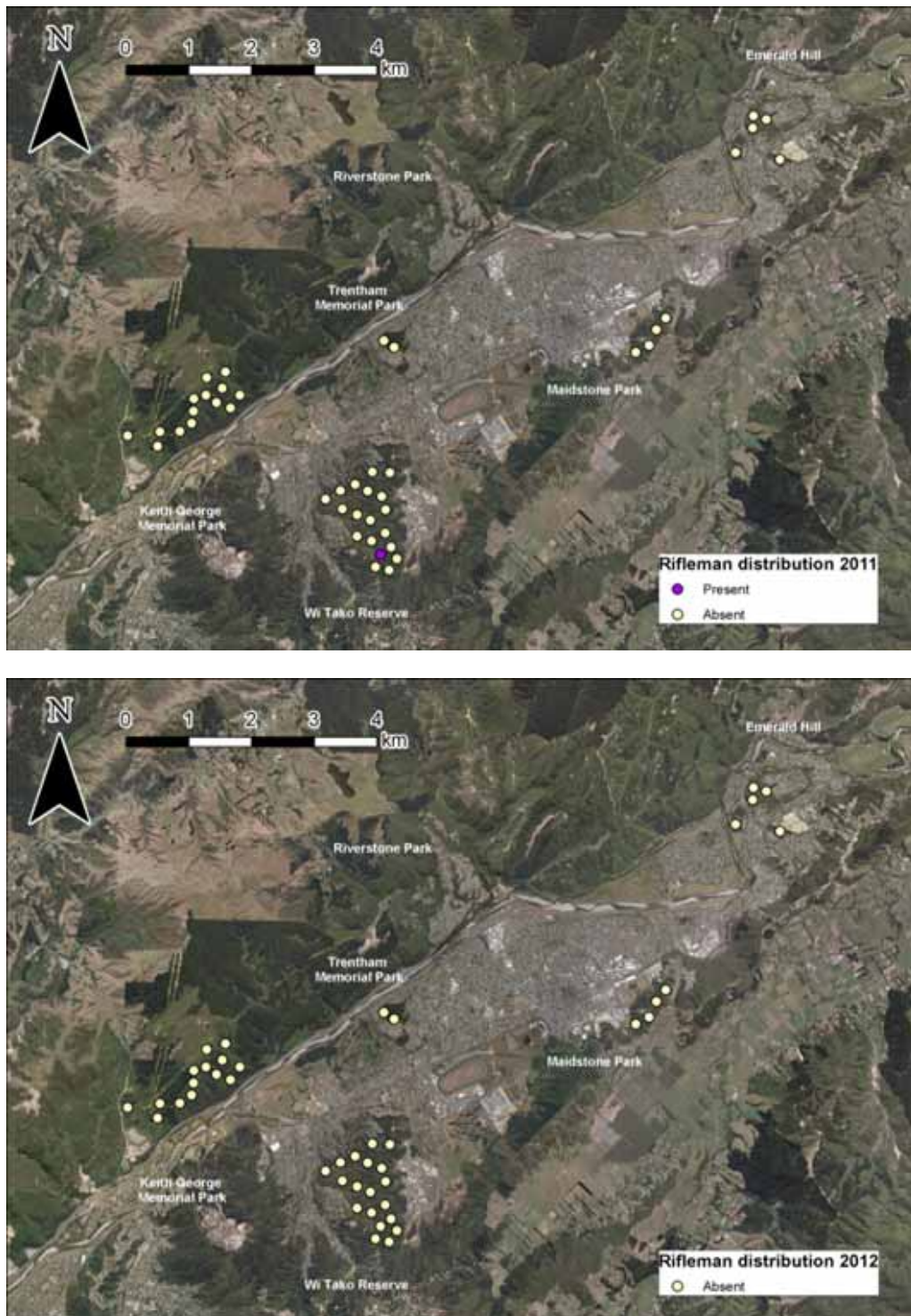


Figure 3.13: Distribution of rifleman in Upper Hutt reserves in 2011 (top) and 2012 (bottom) (Note: the single count station in Cloustonville Park is not shown, however rifleman wasn't detected at this site in either 2011 or 2012)

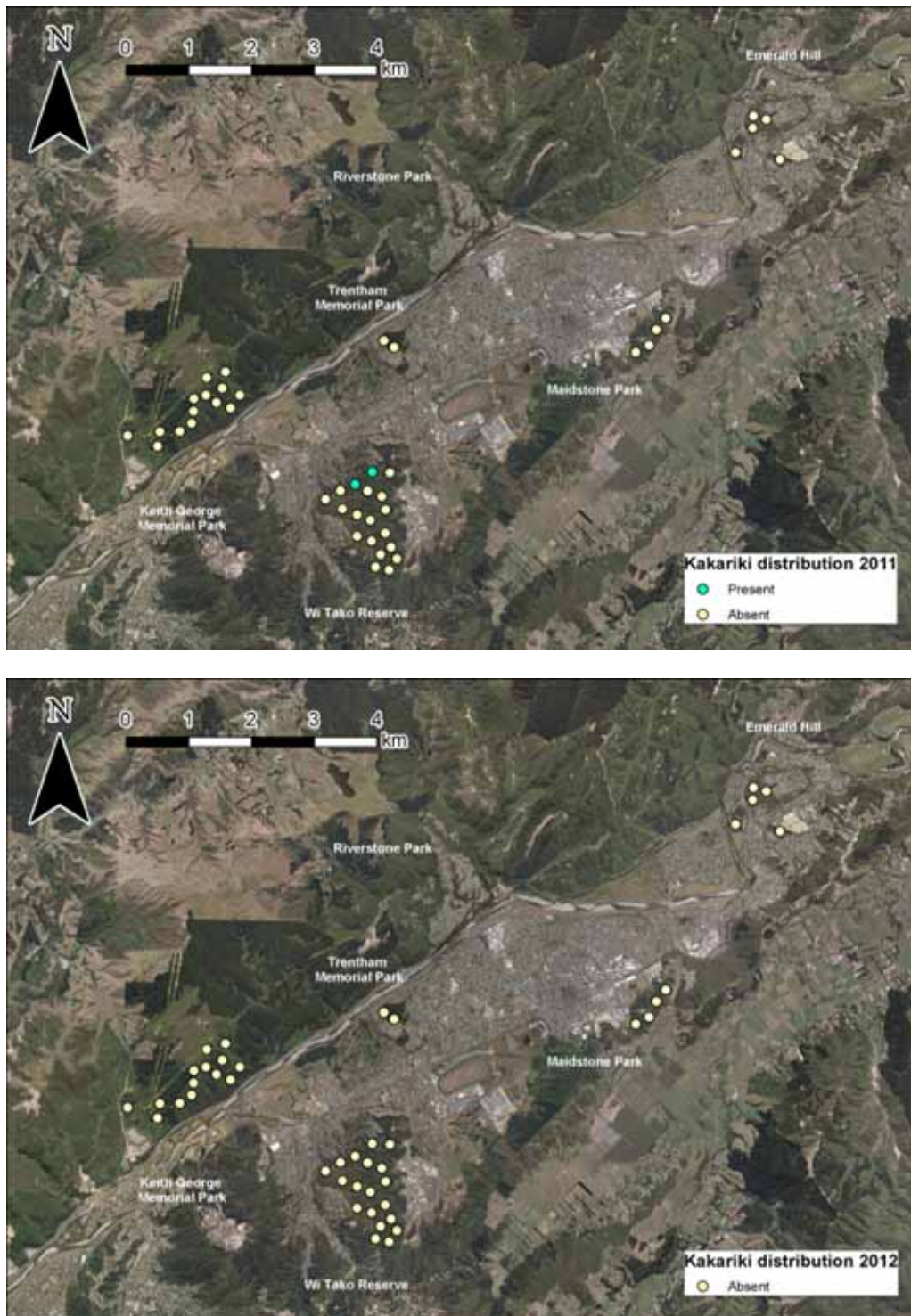


Figure 3.14: Distribution of kakariki in Upper Hutt reserves in 2011 (top) and 2012 (bottom) (Note: the single count station in Cloustonville Park is not shown, however kakariki wasn't detected at this site in either 2011 or 2012)

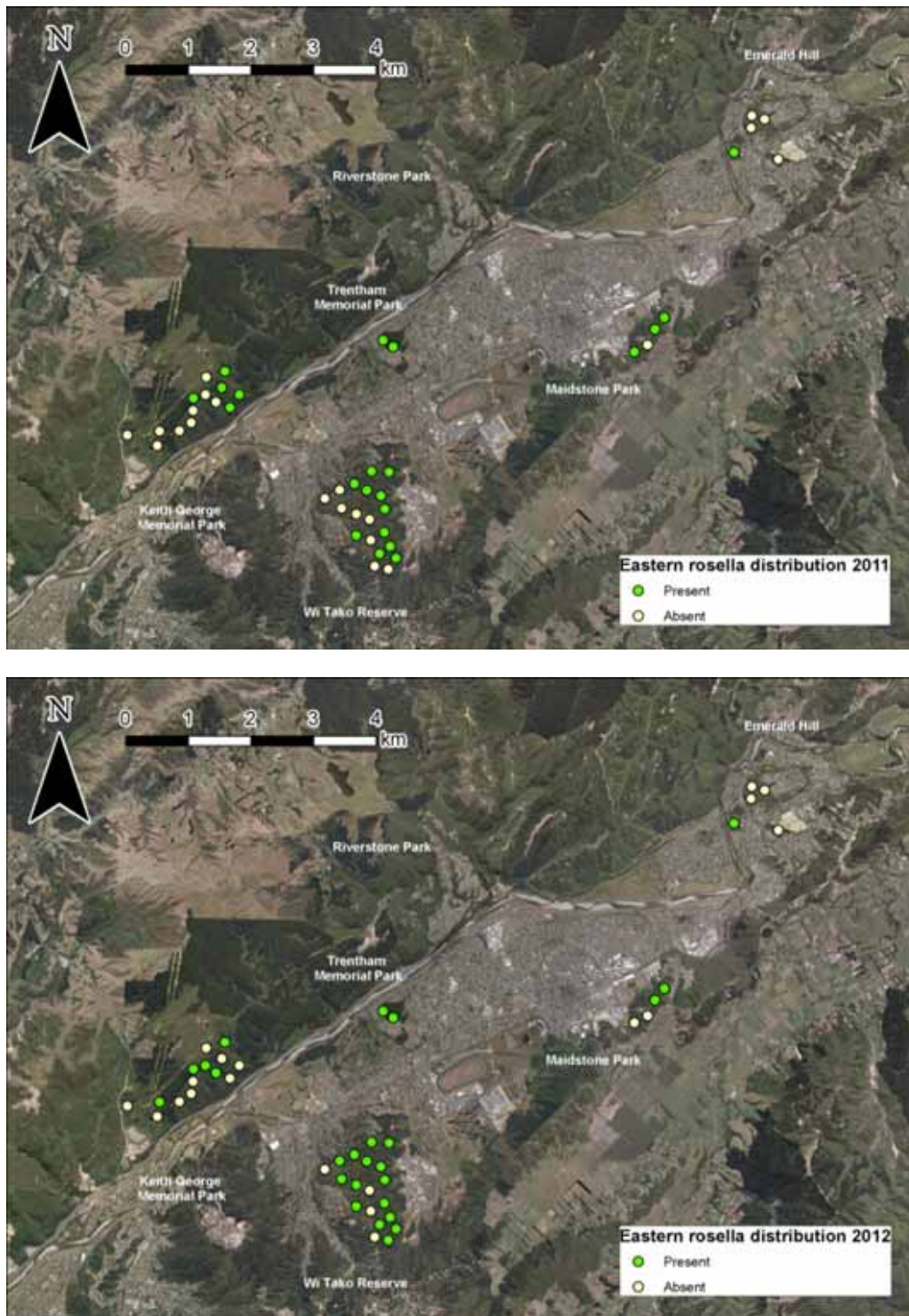


Figure 3.15: Distribution of eastern rosella in Upper Hutt reserves in 2011 (top) and 2012 (bottom) (Note: the single count station in Cloustonville Park is not shown, however eastern rosella was detected at this site in 2011, but not in 2012)

## 4. Discussion

### 4.1 Native species diversity

The small decrease in the number of native forest bird species detected in Upper Hutt reserves between 2011 and 2012 was caused by the non-detection of rifleman and kakariki in Wi Tako reserve during the 2012 survey. Although it is possible that both species have become locally extinct between the two surveys, it seems much more likely that neither were detected in 2012 due to chance alone. Five minute bird counts are not an efficient method for surveying rare or inconspicuous bird species because the probability of detecting such species is relatively low during a five-minute survey period (Hartley & Greene 2012). Both rifleman and kakariki can be relatively inconspicuous in dense native forest (N. McArthur personal observation), and both species had extremely limited distributions in Wi Tako Reserve in 2011 (Figures 3.13 & 3.14). It's possible therefore, that both species were still present in 2012 but were simply not detected. If this is the case, we should expect to see small, short-term fluctuations in apparent species richness in these Upper Hutt reserves from one year to the next depending on whether or not these relatively rare or inconspicuous species happen to be detected.

A total of 10 native forest bird species were recorded in Upper Hutt reserves in 2012, whereas 14 species were recorded in Wellington City parks and reserves (McArthur et al. 2014). This difference can be at least partly explained by differences in “search effort” between the two surveys; while 90 bird counts were carried out in Upper Hutt, 200 counts are carried out in Wellington City each year. When this search effort is standardised between cities (by comparing the mean number of native forest birds recorded per bird count station), a different picture emerges. In both 2011 and 2012 the mean number of bird species recorded per station was significantly higher in Upper Hutt reserves than in Wellington City. This difference was likely caused by the fact that up to 30% of the bird species recorded in Wellington City reserves had very localised distributions centred on Zealandia, a predator-free sanctuary, so were only recorded at a relatively small proportion of the bird count stations surveyed (McArthur et al. 2014). In contrast, almost all of the species recorded in Upper Hutt reserves were more widely distributed and were recorded at a larger proportion of the bird count stations surveyed.

The average number of species recorded per count station in Upper Hutt reserves was also significantly greater than in a selection of Wairarapa reserves surveyed in both 2011 and 2012. This difference was due largely to the presence of tomtit, whitehead and bellbird in several Upper Hutt reserves, species that are either very rare or absent in the Wairarapa reserves surveyed (GWRC unpublished data).

### 4.2 Index of bird abundance

The significant declines in the apparent abundance of tui and silvereye between 2011 and 2012, and the significant increase in the apparent abundance of bellbird may not represent real declines or increases in these species' populations. Each of these species is highly mobile and individual birds are known to move relatively long distances to exploit seasonally- or locally-available food resources (Stewart & Craig 1985; Heather & Robertson 2005;

Robertson 2013). A more likely explanation therefore might be that these changes in apparent abundance have been caused by local movements of birds into or out of these reserves in response to changes in local food availability. Because of their mobility, the distributions of species such as tui, bellbird and silvereye are likely to vary both between and within years, so monitoring over several years will be required before we can expect to differentiate shorter-term fluctuations in distribution and conspicuousness from longer-term trends in abundance.

In contrast, the significant increase in the apparent abundance and distribution of fantails observed in Upper Hutt reserves between 2011 and 2012 does likely represent a real population increase for this species. Fantail abundance and distribution declined significantly in Upper Hutt reserves between 2010 and 2011 and this was mirrored by similar dramatic declines in fantail numbers observed in other Wellington forests such as Akatarawa Forest, Kaitoke Regional Park and the Wainuiomata Water Collection Area over the same period (McArthur et al., 2012; GWRC unpublished data). This sudden and widespread decline was probably a consequence of heavy mortality in local fantail populations suffered during two unusually severe snowfall events that occurred in the Wellington Region between the 24<sup>th</sup>-26<sup>th</sup> July and 14<sup>th</sup>-17<sup>th</sup> August 2011 (NIWA 2012). During these events snow fell to sea-level in Wellington City and record low temperatures were recorded across the region. At Wallaceville in Upper Hutt for example, the maximum recorded temperature on the 15<sup>th</sup> August was the lowest ever observed at this site over the previous 41 years (NIWA 2011). Fantails are known to be particularly susceptible to sudden declines and even local extinction following such severe weather events (Miskelly & Sagar 2008), but populations often quickly recover thanks to this species' high reproductive rate and good dispersal ability (Heather & Robertson 2005; Powlesland 2013). The increase in the apparent abundance and distribution of fantails between 2011 and 2012 in Upper Hutt reserves therefore appears to represent a population recovery in this species following heavy mortality suffered during winter 2011.

#### **4.3 Native bird distribution**

The distribution of the native bird species recorded during the 2012 survey has changed little from that described in Govella et al. 2011 and McArthur et al. 2012.

Both Keith George Memorial Park and Wi Tako Reserve contained all of the native forest bird species detected during the 2012 survey. This is unsurprising, given that these are by far the two largest reserves currently being monitored, and both are relatively well connected to larger blocks of forest such as the Akatarawa Forest and Eastern Hutt hills. Ongoing pest control being carried out by Greater Wellington Regional Council is also likely to be helping to maintain the diversity and abundance of native forest birds in these reserves. While the existing pest control regime in both Keith George Memorial Park and Wi Tako Reserve is mainly aimed at controlling possums, it has also been successful at maintaining rodent tracking rates below an unofficial target of 10% tracking for much of the year in these two reserves between 2003 and 2013 (GWRC unpublished data). Both reserves should

continue to be considered high priorities for habitat management within the Upper Hutt reserves network, as both reserves provide Upper Hutt ratepayers with the opportunity to encounter the full range of native forest bird species that currently exists in the Upper Hutt reserves network.

The new survey design implemented in 2011 now allows us to map patterns in bird distribution in greater detail within these two larger reserves. One pattern that has become apparent as a result of this mapping is that both tomtit and whitehead appeared to be mainly restricted to the southern half of Wi Tako Reserve in both 2011 and 2012 (Figures 3.11 and 3.12). This southern portion of the reserve contains original, mature stands of hard beech (*Fuscospora truncata*) and black beech (*F. solandri* var. *solandri*) whereas the northern portion consists of a mosaic of original and secondary growth mixed beech-broadleaf forest and shrubland (Wassilieff & Clark 1986). It's possible, therefore that the present distribution of both tomtit and whitehead reflects a preference towards the former, more mature forest habitat. However, it may also be possible that birds attempting to occupy habitat near the northern boundary of the reserve experience higher levels of predation due to the proximity of suburban housing, and as a result struggle to maintain a presence in the northern portion of the reserve.

We recommend that this bird monitoring programme be continued on an annual basis so that on-going changes in the diversity, abundance and distribution of native forest bird species in Upper Hutt City parks and reserves can continue to be monitored.

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## Appendix

This appendix contains lists of bird species encountered in each Upper Hutt reserve sampled between 2009 and 2012 (P = present). Threat rankings are as per Miskelly et al. (2008). (DE - Declining; RE - Relict; NT - Not threatened; I - Introduced and naturalised). Species names as per Gill et al. (2010).

### Cloustonville Park

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Anas platyrhynchos</i>	mallard	I	P	P		
<i>Anthornis melanura</i>	bellbird	NT		P		P
<i>Chrysococcyx lucidus</i>	shining cuckoo	NT	P		P	P
<i>Circus approximans</i>	harrier	NT		P		
<i>Fringilla coelebs</i>	chaffinch	I	P	P	P	P
<i>Gerygone igata</i>	grey warbler	NT	P	P	P	P
<i>Gymnorhina tibicen</i>	Australian magpie	I		P		
<i>Hemiphaga novaeseelandiae</i>	kereru (New Zealand pigeon)	NT	P			
<i>Hirundo neoxena</i>	welcome swallow	NT			P	
<i>Petroica macrocephala</i>	tomtit	NT				P
<i>Platycercus eximius</i>	eastern rosella	I	P		P	
<i>Prothemadera novaeseelandiae</i>	tui	NT	P	P	P	P
<i>Prunella modularis</i>	dunnock	I				P
<i>Rhipidura fuliginosa</i>	fantail	NT	P	P		
<i>Sturnus vulgaris</i>	starling	I	P			
<i>Todiramphus sanctus</i>	New Zealand kingfisher	NT	P			
<i>Turdus merula</i>	blackbird	I	P	P	P	P
<i>Zosterops lateralis</i>	silvereye	NT	P	P	P	P

### Emerald Hill

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Anthornis melanura</i>	bellbird	NT		P		P
<i>Carduelis carduelis</i>	goldfinch	I			P	P
<i>C. chloris</i>	greenfinch	I				P
<i>C. flammea</i>	redpoll	I			P	P
<i>Chrysococcyx lucidus</i>	shining cuckoo	NT	P	P	P	P
<i>Emberiza citrinella</i>	yellowhammer	I				P
<i>Fringilla coelebs</i>	chaffinch	I	P	P	P	P
<i>Gerygone igata</i>	grey warbler	NT	P	P	P	P
<i>Gymnorhina tibicen</i>	Australian magpie	I		P	P	
<i>Passer domesticus</i>	house sparrow	I		P	P	P
<i>Platycercus eximius</i>	eastern rosella	I	P	P	P	P
<i>Porphyrio melanotus</i>	pukeko	NT			P	

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Prothemadera novaeseelandiae</i>	tui	NT	P	P	P	P
<i>Prunella modularis</i>	dunnock	I			P	P
<i>Rhipidura fuliginosa</i>	fantail	NT	P	P		P
<i>Sturnus vulgaris</i>	starling	I	P	P	P	P
<i>Todiramphus sanctus</i>	New Zealand kingfisher	NT	P	P	P	
<i>Turdus merula</i>	blackbird	I	P	P	P	P
<i>T. philomelos</i>	song thrush	I		P	P	P
<i>Vanellus miles</i>	spur-winged plover	NT	P	P		
<i>Zosterops lateralis</i>	silveryeye	NT	P	P	P	P

### Keith George Memorial Park

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Anthornis melanura</i>	bellbird	NT	P	P	P	P
<i>Carduelis carduelis</i>	goldfinch	I			P	P
<i>Chrysococcyx lucidus</i>	shining cuckoo	NT		P	P	P
<i>Cyanoramphus</i> sp. ( <i>novaezealandiae</i> ?)	kakariki	RE		P		
<i>Emberiza citrinella</i>	yellowhammer	I			P	
<i>Fringilla coelebs</i>	chaffinch	I		P	P	P
<i>Gerygone igata</i>	grey warbler	NT	P	P	P	P
<i>Hemiphaga novaeseelandiae</i>	kereru (New Zealand pigeon)	NT	P	P	P	P
<i>Larus dominicanus</i>	black-backed gull	NT	P	P	P	P
<i>Mohoua albicilla</i>	whitehead	NT	P	P	P	P
<i>Petroica macrocephala</i>	tomtit	NT	P	P	P	P
<i>Platycercus eximius</i>	eastern rosella	I		P	P	P
<i>Prothemadera novaeseelandiae</i>	tui	NT	P	P	P	P
<i>Prunella modularis</i>	dunnock	I			P	P
<i>Rhipidura fuliginosa</i>	fantail	NT	P	P	P	P
<i>Tadorna variegata</i>	paradise shelduck	NT	P			
<i>Todiramphus sanctus</i>	New Zealand kingfisher	NT		P	P	P
<i>Turdus merula</i>	blackbird	I	P	P	P	P
<i>T. philomelos</i>	song thrush	I			P	P
<i>Vanellus miles</i>	spur-winged plover	NT			P	
<i>Zosterops lateralis</i>	silveryeye	NT	P	P	P	P

### Maidstone Park

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Alauda arvensis</i>	skylark	I			P	
<i>Anthornis melanura</i>	bellbird	NT		P		
<i>Callipepla californica</i>	California quail	I		P		
<i>Carduelis carduelis</i>	goldfinch	I			P	P

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Chrysococcyx lucidus</i>	shining cuckoo	NT			P	P
<i>Emberiza citrinella</i>	yellowhammer	I			P	
<i>Fringilla coelebs</i>	chaffinch	I	P	P	P	P
<i>Gerygone igata</i>	grey warbler	NT	P	P	P	P
<i>Gymnorhina tibicen</i>	Australian magpie	I	P		P	
<i>Hemiphaga novaeseelandiae</i>	kereru (New Zealand pigeon)	NT			P	P
<i>Larus dominicanus</i>	black-backed gull	NT			P	
<i>Passer domesticus</i>	house sparrow	I				P
<i>Platycercus eximius</i>	eastern rosella	I	P	P	P	P
<i>Prothemadera novaeseelandiae</i>	tui	NT	P	P	P	P
<i>Prunella modularis</i>	dunnock	I			P	P
<i>Rhipidura fuliginosa</i>	fantail	NT	P	P		P
<i>Todiramphus sanctus</i>	New Zealand kingfisher	NT	P	P	P	P
<i>Turdus merula</i>	blackbird	I	P	P	P	P
<i>T. philomelos</i>	song thrush	I			P	P
<i>Zosterops lateralis</i>	silvereye	NT	P	P	P	P

### Riverstone Park

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Alauda arvensis</i>	skylark	I			P	
<i>Callipepla californica</i>	California quail	I	P			
<i>Carduelis carduelis</i>	goldfinch	I			P	P
<i>C. flammea</i>	redpoll	I				P
<i>Chrysococcyx lucidus</i>	shining cuckoo	NT	P	P		
<i>Fringilla coelebs</i>	chaffinch	I	P	P	P	P
<i>Gerygone igata</i>	grey warbler	NT	P	P	P	P
<i>Passer domesticus</i>	house sparrow	I			P	P
<i>Prothemadera novaeseelandiae</i>	tui	NT	P	P	P	P
<i>Prunella modularis</i>	dunnock	I			P	P
<i>Rhipidura fuliginosa</i>	fantail	NT	P	P		P
<i>Sturnus vulgaris</i>	starling	I				P
<i>Turdus merula</i>	blackbird	I	P	P	P	P
<i>Zosterops lateralis</i>	silvereye	NT	P		P	P

### Trentham Memorial Park

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Carduelis carduelis</i>	goldfinch	I	P			P
<i>Chrysococcyx lucidus</i>	shining cuckoo	NT			P	P
<i>Fringilla coelebs</i>	chaffinch	I	P	P	P	P
<i>Gerygone igata</i>	grey warbler	NT	P	P	P	P

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Gymnorhina tibicen</i>	Australian magpie	I	P	P		
<i>Hemiphaga novaeseelandiae</i>	kereru (New Zealand pigeon)	NT	P	P		P
<i>Larus dominicanus</i>	black-backed gull	NT	P	P		
<i>Passer domesticus</i>	house sparrow	I	P	P		P
<i>Platycercus eximius</i>	eastern rosella	I	P	P	P	P
<i>Prothemadera novaeseelandiae</i>	tui	NT	P	P	P	P
<i>Prunella modularis</i>	dunnock	I			P	P
<i>Rhipidura fuliginosa</i>	fantail	NT	P	P	P	P
<i>Sturnus vulgaris</i>	starling	I	P	P	P	P
<i>Tadorna variegata</i>	paradise shelduck	NT		P		
<i>Todiramphus sanctus</i>	New Zealand kingfisher	NT	P	P	P	P
<i>Turdus merula</i>	blackbird	I	P	P	P	P
<i>T. philomelos</i>	song thrush	I	P	P	P	P
<i>Vanellus miles</i>	spur-winged plover	NT	P			
<i>Zosterops lateralis</i>	silvereve	NT			P	P

### Wi Tako Reserve

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Acanthisitta chloris</i>	rifleman	DE			P	
<i>Anas platyrhynchos</i>	mallard	I	P			P
<i>Anthornis melanura</i>	bellbird	NT			P	P
<i>Carduelis carduelis</i>	goldfinch	I			P	P
<i>C. chloris</i>	greenfinch	I				P
<i>Chrysococcyx lucidus</i>	shining cuckoo	NT	P	P	P	P
<i>Circus approximans</i>	harrier	NT	P			P
<i>Cyanoramphus sp. (novaeseelandiae?)</i>	kakariki	RE			P	
<i>Fringilla coelebs</i>	chaffinch	I	P	P	P	P
<i>Gerygone igata</i>	grey warbler	NT	P	P	P	P
<i>Gymnorhina tibicen</i>	Australian magpie	I	P	P		
<i>Hemiphaga novaeseelandiae</i>	kereru (New Zealand pigeon)	NT	P	P	P	P
<i>Larus dominicanus</i>	black-backed gull	N	P	P	P	P
<i>Mohoua albicilla</i>	whitehead	NT			P	P
<i>Ninox novaeseelandiae</i> <sup>1</sup>	morepork	NT				
<i>Passer domesticus</i>	house sparrow	I			P	P
<i>Petroica macrocephala</i>	tomtit	NT	P	P	P	P
<i>Platycercus eximius</i>	eastern rosella	I	P	P	P	P
<i>Porphyrio melanotus</i>	pukeko	NT	P	P	P	P

<sup>1</sup> Morepork was not detected during these surveys, but was recorded as present on the 14/02/2013 (<http://ebird.org/content/newzealand/>; accessed 24/09/2013)

Scientific Name	Common Name	Threat Ranking	2009	2010	2011	2012
<i>Prothemadera novaeseelandiae</i>	tui	NT	P	P	P	P
<i>Prunella modularis</i>	dunnock	I			P	P
<i>Rhipidura fuliginosa</i>	fantail	NT	P	P	P	P
<i>Sturnus vulgaris</i>	starling	I	P	P		
<i>Tadorna variegata</i>	paradise shelduck	NT	P	P	P	
<i>Todiramphus sanctus</i>	New Zealand kingfisher	NT	P	P	P	P
<i>Turdus merula</i>	blackbird	I	P	P	P	P
<i>T. philomelos</i>	song thrush	I	P	P	P	P
<i>Vanellus miles</i>	spur-winged plover	NT	P			P
<i>Zosterops lateralis</i>	silveryeye	NT	P	P	P	P

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