



## Waitakere City Biodiversity Monitoring Programme:

1. Avifauna
2. Pest Monitoring
3. Vegetation & Phenology
4. Terrestrial Invertebrates
5. Lizards

Summer 2005/6

 **envirologic**

# **Waitakere City Biodiversity Monitoring Programme:**

- 1. Avifauna**
- 2. Pest Monitoring**
- 3. Vegetation & Phenology**
- 4. Terrestrial Invertebrates**
- 5. Lizards**

**Summer 2005/6**

*Bibliographic Reference:*

Envirologic Limited. 2006. Waitakere City Biodiversity Monitoring Programme: 1. Avifauna, 2. Pest Monitoring, 3. Vegetation & Phenology, 4. Terrestrial Invertebrates, and 5. Lizards - Summer 2005/6. Unpublished report for the Waitakere City Council.

*For:* Waitakere City Council  
Private Bag 93 109, Henderson, Waitakere City  
Phone 836 8000  
Website: [www.waitakere.govt.nz](http://www.waitakere.govt.nz)

*By:* Simon Chapman and Jane Alexander  
Envirologic Limited  
PO Box 21 700, Henderson, Waitakere City, New Zealand  
Email: [info@envirologic.co.nz](mailto:info@envirologic.co.nz)  
Website: [www.envirologic.co.nz](http://www.envirologic.co.nz)

*Date:* October 2006

*Status:* Final

## Project Overview

### Project and Client

The Waitakere City Council (WCC) commenced a biodiversity monitoring programme during 1997. Initially the programme was focused on monitoring the quality and ecological health of five urban habitat remnants and populations of native bird species. During 2003, the programme was expanded into a comprehensive, long-term monitoring programme across 27 sites throughout Waitakere City. Ecological indicators incorporated in to the programme include: avifauna, vegetation, terrestrial macroinvertebrates, lizards and terrestrial pests.

Effective biodiversity monitoring is a critical component of Waitakere City's sustainable future. Monitoring facilitates ongoing evaluation and refinement of WCC's environmental policy and projects, and the pursuit of environmental best practice. Council officers such as park managers, resource managers and consent teams require up-to-date biodiversity information to effectively manage the city's environment in a sustainable manner. The Waitakere City biodiversity monitoring programme provides environmental information for the WCC's state of the environment reporting requirements, Regional Growth Strategy and the Strategic and District Plans.

This report provides the results of avifauna and pest monitoring undertaken during the summer of 2005-6 and where applicable, compares the results with those of previous monitoring. For completeness, the methods and results of the 2004-2005 monitoring of vegetation, terrestrial Invertebrates and lizards are also included in this report.

### Objectives

To monitor biodiversity indicators and determine biodiversity trends across Waitakere City

### Methods

- Five-minute bird counts
- Distance sampling of tui, kereru, fantail and grey warbler populations
- Vertebrate pest monitoring with tracking tunnels and wax tags
- Rapid vegetation and phenology assessments
- Macroinvertebrate pitfall trapping
- Lizard spot-lighting night surveys

### Results

- Tuis were recorded at all of the 27 sampling sites.
- Kereru were rare - they were recorded at eight of the 27 sampling sites (up from three sites in the summer 2004-5 surveys).
- Fantails were present at 24 of the 27 monitoring sites.
- Grey warblers were present at 24 of the 27 monitoring sites.
- Sites where three or more native bird indicator species increased in conspicuousness over the past five years were: Douglas Scenic Reserve, Chorley Reserve, Lowtherhurst Reserve, Oratia Esplanade, Takaranga Reserve and Karaka Park.
- Sites where three or more native bird indicator species decreased in conspicuousness over the past five years were: Huia Reserve and Henderson Valley Scenic Reserve.

- Information about the distribution and abundance of animal pests is required to protect indigenous biodiversity. When used in conjunction with data on indigenous flora and fauna, pest population data can be used to target pests at sites where they pose the greatest threat to indigenous biodiversity.
- Rodents were very abundant at most of the sites. Mustelids were rare but even low numbers of mustelids can have serious adverse impacts on native wildlife, especially birds, lizards and invertebrates.

## Recommendations

- Continue the Waitakere City Biodiversity Monitoring Programme to meet WCC's state of the environment reporting requirements and statutory biodiversity monitoring obligations.
- Initiate a programme to recover kereru and improve other bird populations by controlling rodents and mustelids. Revegetation and weed control projects involve a long-term approach to improving habitat remnants and linkages between them. However, without predator control such initiatives are unlikely to halt biodiversity declines. Increases in populations of kereru, fantail, tui and other native species have been documented at sites in the City where predators are maintained at low levels over a sustained period (e.g., Lone Kauri Forest Restoration Programme and the Ark in the Park project).
- Control rodents and mustelids at the following ten sites:
  - Te Henga Wetland
  - Karaka Park
  - Warner Park
  - Takaranga Park
  - Harbourview - Orangihina Wetland
  - Rahui Kahika Reserve
  - Shona Esplanade
  - Moire Park
  - Lowtherhurst Reserve
  - Kay Road Balefill
- Predator control at the above sites should be undertaken during the breeding season for native birds (November to February).
- Year-round food is lacking at some sampling sites. This can influence breeding success and survival therefore, revegetation projects should increase the focus on providing habitat and year-round food for native birds by including greater proportions of the following species:
  - Kanuka: Grows quickly and provides bird nesting sites and habitat for native geckos.
  - Puriri: Fruits and flowers throughout the year and from a young age.
  - Flax: A combination of NZ flax and mountain flax provides a sustained nectar source for tuis when their energy requirements are highest for breeding. Provides excellent habitat for native lizards and weta.
  - Red matipo: Provides berries throughout much of the year. A good replacement for the privet that occupies many of the Waitakere City parks and reserves. Provides habitat for geckos and nest sites for small native birds.
  - Karamu: A good source of berries throughout much of the year. Fruits from a young age.

- 
- Lacebark: Leaf buds provide a source of food for kereru in early spring when other food sources are scarce.
  - Cabbage tree: A good source of berries for kereru and other frugiverous birds leading into winter.
- 
- Opportunities for large-scale revegetation at the monitoring sites are limited but the focus on the above planting mix should also be applied to other Waitakere City parks and reserves, and at sites where revegetation is included in resource consent conditions.
  - Native birds, lizards and invertebrates can occur at sites that seem degraded or devoid of native vegetation. Rank grassland, industrial areas and weed infested sites are sometimes important refuges for native fauna. Ecological assessments should be required for consent applications even when habitat may appear to be marginal. Ecological assessments for consents need to include information on lizards, bats, and invertebrates.
  - Activities such as large-scale revegetation and weed removal (including associated site clean-ups) can have adverse impacts on native fauna - particularly lizards and invertebrates. Proposals for such activities should be assessed by an appropriate expert to advise on how to minimise negative impacts.
  - Ensure that the information in this report (and previous biodiversity monitoring reports) is provided to council officers such as park managers, resource managers and consent teams.

## Table of Contents

1.	Introduction.....	8
2.	Methods.....	9
2.1	Sampling sites .....	9
2.2	Avifauna .....	15
2.3	Pest communities .....	18
2.4	Vegetation structure and phenology .....	20
2.5	Terrestrial invertebrates .....	21
2.6	Lizards .....	23
3.	Results .....	25
3.1	Te Henga Wetland .....	25
3.2	Bethells Beach .....	30
3.3	Mountain Rd Esplanade .....	34
3.4	Douglas Scenic Reserve .....	38
3.5	Huia Reserve .....	43
3.6	Henderson Valley Scenic Reserve .....	46
3.7	Chorley Reserve / Sunline Park .....	51
3.8	Shona Esplanade .....	55
3.9	Tram Valley Road .....	60
3.10	Gill Esplanade .....	64
3.11	Swanson Scenic Reserve .....	68
3.12	Lowtherhurst Reserve .....	73
3.13	Warner Park .....	78
3.14	Catherine Esplanade .....	83
3.15	Waikumete Cemetery .....	87
3.16	Oratia Esplanade .....	91
3.17	Brigham Creek Recreational Reserve .....	95
3.18	Kellys Bridge Esplanade .....	99
3.19	Rahui Kahika Reserve .....	103
3.20	Moire Park .....	108
3.21	Takaranga Reserve .....	112
3.22	Harbourview Park .....	116
3.23	Karekare Beach .....	120
3.24	Claude Abel Reserve .....	124
3.25	Karaka Park / Green Bay Beach .....	128
3.26	Kay Road Balefill .....	133
3.27	Hobsonville Esplanade .....	137
4.	Survey Overview .....	141
5.	General Discussion .....	148
6.	Recommendations .....	149
7.	References .....	151
8.	Appendices.....	153
	Avifauna and Phenology datasheet .....	154

Lizard datasheet ..... 155

Glossary ..... 156

## 1. Introduction

Biodiversity is vital to sustain life and it offers us a unique basis for our culture, heritage and sense of national identity (DoC & MfE 2000). Waitakere City is endowed with a natural heritage that is rich in ecological treasures. The City's biodiversity provides critical ecosystem services, is of immense intrinsic value, and contributes to our quality of life. During the last 1000 years, direct exploitation, predation and competition with introduced species and the effects of habitat loss and fragmentation have devastated our biological diversity. These impacts have led to the local extinction of at least 10 plant species and 11 bird species in Waitakere City and many of Waitakere City's remaining species have an uncertain future (WCC 2001).

During 1993, Waitakere City Council (WCC) adopted Agenda 21 (the only city in New Zealand to do so) and declared the city an eco-city. This commitment involved the voluntary adoption of the International Convention on Biological Diversity (CBD). The WCC, in partnership with the community, embarked on an ambitious biodiversity protection programme (e.g., the Green Network) thus forging a sustainable future (WCC 1999).

The WCC's Green Network or 'healthy habitat for a city' programme during the last decade has utilised a wide range of measures to enhance the City's biodiversity. Measures have included the establishment of regulatory controls, education and advocacy, and numerous weed control and revegetation initiatives, all of which are focused on achieving the 2020 vision:

*"Streams and forests will be full of life. The Waitakere Ranges will be permanently protected and a Green Network will link the Ranges and the sea, connecting the everyday lives of the people of Waitakere with the natural world."*

(Source: WCC 2003)

Effective biodiversity monitoring is a critical component of Waitakere City's sustainable future. Monitoring facilitates ongoing evaluation and refinement of WCC's environmental policy and projects, and the pursuit of environmental best practice. The purpose of this report is to present the results of the avifauna and pest monitoring undertaken during summer 2005-2006 and to compare the results with those of previous WCC biodiversity monitoring. For completeness, the methods and results of the 2004-2005 monitoring of vegetation, terrestrial Invertebrates and lizards are also included in this report.

It is envisaged that the information presented in this report will be used to assist in making informed management decisions with regard to the assessment of localised environmental impacts, the ongoing effects of urbanisation and actions to enhance the City's biodiversity.

## **2. Methods**

### **2.1 Sampling sites**

Terrestrial biodiversity indicators were sampled at 27 sites throughout Waitakere City (Figure 1; Table 1) during summer 2005-2006. WCC staff selected the sites to include the following: a) sites where birds have been surveyed in previous studies; b) a good geographical spread of sites throughout the city; c) sites representative of habitats in Waitakere City; and d) sites where ecological restoration projects have been initiated. All but one of the sites surveyed were on land owned and managed by the WCC.

Where applicable, the monitoring dataset collected during summer 2005-6 was compared with the results of previous monitoring (Table 2 and Table 3) to investigate trends.

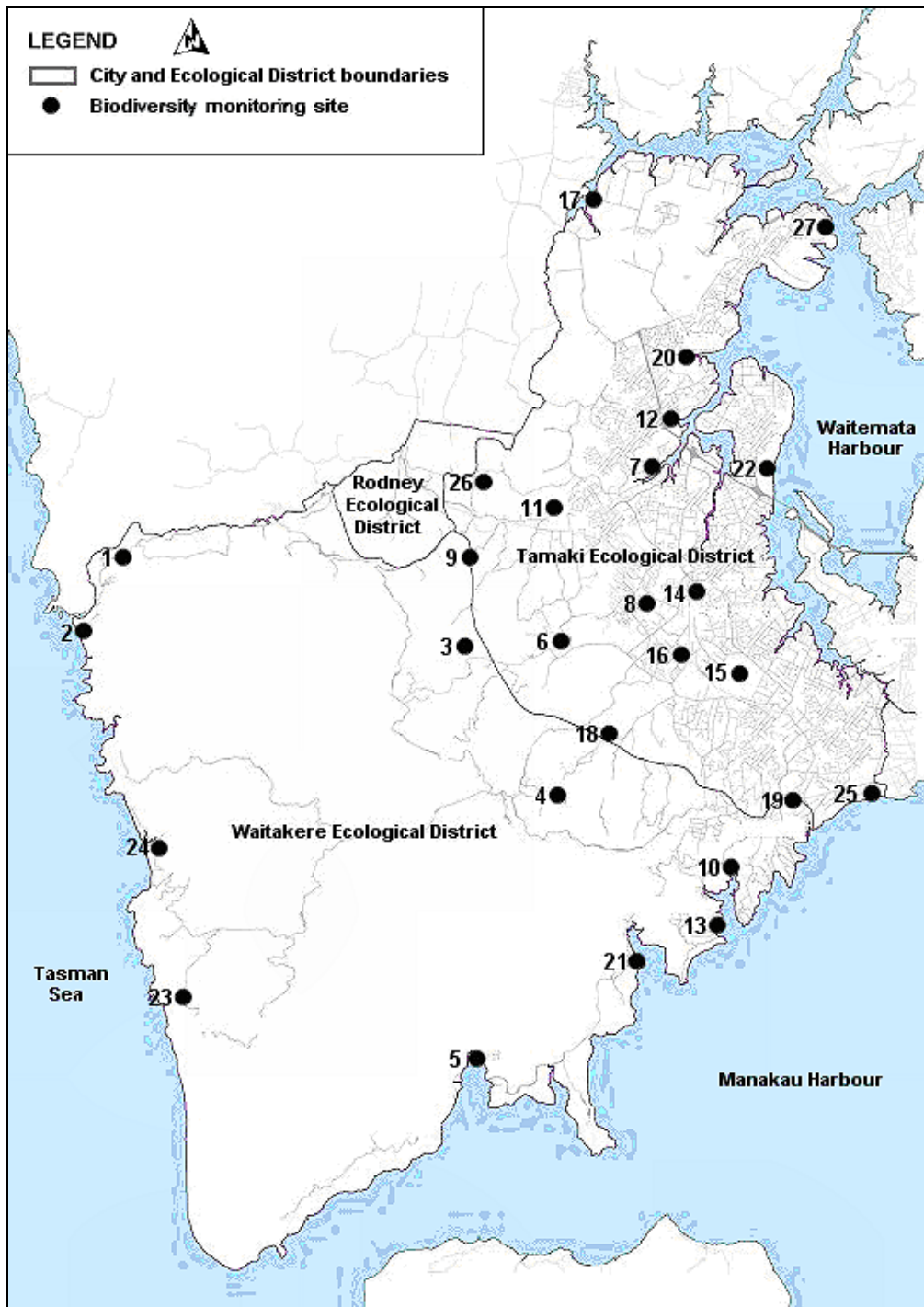


Figure 1. Location of biodiversity monitoring sites throughout Waitakere City (Summer 2005-6; See Table 1 for site names and descriptions).

Table 1. Waitakere City biodiversity monitoring sites (Summer 2005-6).

Site no.	Station	Site Name	Habitat	Location	Management actions
1	1	Te Henga Wetland	Freshwater wetland, raupo reedland	Bethells Road, Te Henga	Weed control
1	2	Te Henga Wetland	Freshwater wetland, raupo reedland	Bethells Road, Te Henga	Weed control
2	1	Bethells Beach	Sand dune	Bethells Road, Te Henga	Revegetation, rabbit control
2	2	Bethells Beach	Sand dune, dune shrubland	Bethells Road, Te Henga	Revegetation, rabbit control
3	1	Mountain Road Esplanade	Regenerating kanuka-podocarp-forest	Mountain Road, Henderson Valley	Possum control
3	2	Mountain Road Esplanade	Lowland stream, regenerating kanuka-podocarp forest	Mountain Road, Henderson Valley	Possum control
4	1	Douglas Scenic Reserve	Mamaku-mixed broadleaf forest	Raroa Terrace, Waiatarua	Possum control
5	1	Huia Reserve	Grassland, marine tidal flats	Huia Road, Huia	Possum control
6	1	Henderson Valley Scenic Reserve	Lowland stream, secondary podocarp-broadleaf forest	Candia Road, Henderson Valley	Possum control
6	2	Henderson Valley Scenic Reserve	Lowland stream, secondary podocarp-broadleaf forest	Candia Road, Henderson Valley	Possum control
7	1	Chorley Reserve / Sunline Park	Pasture/grassland	Sunline Avenue, Massey West	Possum control
7	2	Chorley Reserve / Sunline Park	Mamaku-mixed broadleaf forest	Sunline Avenue, Massey West	Possum control
7	3	Chorley Reserve / Sunline Park	Intertidal mudflats, mangrove shrubland	Sunline Avenue, Massey West	Possum control
8	1	Shona Esplanade	Mature and regenerating podocarp-hardwood forest	Claret Place, Western Heights	Weed control / revegetation
8	2	Shona Esplanade	Mature and regenerating podocarp-hardwood forest	Chardon Place, Western Heights	Possum control
8	3	Shona Esplanade	Mature and regenerating podocarp-hardwood forest	Border Road, Henderson	Possum control
8	4	Shona Esplanade	Mature and regenerating podocarp-hardwood forest	Border Road, Henderson	Possum control
8	5	Shona Esplanade	Mature and regenerating podocarp-hardwood forest	Border Road, Henderson	Possum control
9	1	Tram Valley Road	Secondary podocarp-broadleaf forest	Tram Valley Road, Swanson	Possum control
9	2	Tram Valley Road	Secondary podocarp-broadleaf forest	Tram Valley Road, Swanson	Possum control
10	1	Gill Esplanade	Marine tidal flats, mangrove shrubland	Landing Road, Laingholm	Revegetation
10	2	Gill Esplanade	Marine tidal flats, mangrove shrubland	Landing Road, Laingholm	
11	1	Swanson Scenic Reserve	Secondary kauri-kanuka forest	Swanson Road, Swanson	Possum control
12	1	Lowtherhurst Reserve	Secondary kanuka-broadleaf forest	Lowtherhurst Road, Massey East	
13	1	Warner Park	Marine tidal flats	Laingholm Drive, Laingholm	Possum control
13	2	Warner Park	Marine tidal flats	Laingholm Drive, Laingholm	Possum control
13	3	Warner Park	Puriri composite-pohutukawa forest	Laingholm Drive, Laingholm	Possum control
14	1	Catherine Esplanade	Exotic-regenerating native mix	Vitasovich Avenue, Henderson	Possum control
15	1	Waikumete Cemetery	Exotic-regenerating kanuka mix	Waitakere View Road, Glen Eden	Weed control
15	2	Waikumete Cemetery	Exotic-regenerating kanuka mix	Waitakere View Road, Glen Eden	
15	3	Waikumete Cemetery	Exotic-regenerating kanuka mix	Narcissus Road, Glen Eden	
15	4	Waikumete Cemetery	Exotic-regenerating kanuka mix	Freesia Road, Glen Eden	
16	1	Oratia Esplanade	Mixed bamboo-willow	Newham Road, McLaren Park	

Table 1. (continued)

Site no.	Station	Site Name	Habitat	Location	Management actions
17	1	Brigham Creek Reserve	Marine tidal flats, mangrove shrubland	Dale Road, Whenuapai	
18	1	Kellys Bridge Esplanade	Regenerating kanuka forest	West Coast Road, Oratia	
19	1	Rahui Kahika Reserve	Secondary kauri-kanuka forest	Pendlebury Street, Green Bay	Possum control
19	2	Rahui Kahika Reserve	Secondary podocarp-broadleaf forest	Pendlebury Street, Green Bay	Possum control
19	3	Rahui Kahika Reserve	Secondary puriri composite forest	Pendlebury Street, Green Bay	Possum control
20	1	Moire Park	Marine tidal flats, mangrove shrubland	Lorena Place, West Harbour	Possum control
20	2	Moire Park	Grassland-exotic mix	Granville Drive, Massey East	Possum control
20	3	Moire Park	Regenerating kanuka forest	Granville Drive, Massey East	Possum control
21	1	Takaranga Reserve	Marine tidal flats	Armour Road, Parau	
21	2	Takaranga Reserve	Marine tidal flats, mangrove shrubland	Staley Road, Parau	
22	1	Harbourview Park	Marine tidal flats	Te Atatu Road, Te Atatu Peninsula	Weed control
22	2	Harbourview Park	Constructed wetland	Danica Esplanade, Te Atatu Peninsula	
23	1	Karekare Beach	Puriri composite forest	Lone Kauri Road, Karekare	Possum control
23	2	Karekare Beach	Pohutukawa forest	Watchmans Road, Karekare	Possum control
24	1	Claude Abel Reserve	Wetland, pohutukawa forest	Garden Road, Piha	Possum control
25	1	Karaka Park / Green Bay Beach	Marine tidal flats	Portage Road, Green Bay	Weed control
25	2	Karaka Park / Green Bay Beach	Original pohutukawa coastal forest	Harrybrook Road, Green Bay	Possum control
26	1	Kay Road Balefill	Regenerating kauri-kanuka forest	Kay Road, Swanson	Weed control / revegetation
26	2	Kay Road Balefill	Regenerating kauri-kanuka forest	Kay Road, Swanson	Possum control
26	3	Kay Road Balefill	Secondary kauri-tanekaha-rimu forest	Kay Road, Swanson	Possum control
27	1	Hobsonville Esplanade	Regenerating kanuka forest	Hudson Bay Road, Hobsonville	
27	2	Hobsonville Esplanade	Intertidal mudflats, mangrove shrubland	Hudson Bay Road, Hobsonville	

Table 2. Summary of annual Waitakere City five-minute bird count monitoring effort (1997-2006).

Site #	Site name	Summer 97 <sup>1</sup>	Summer 98 <sup>2</sup>	Winter 98 <sup>1</sup>	Summer 99 <sup>1</sup>	Summer 01 <sup>1</sup>	Summer 02 <sup>1</sup>	Summer 03 / 04 <sup>3</sup>	Summer 04 / 05 <sup>3</sup>	Summer 05 / 06 <sup>3</sup>
1	Te Henga Wetland							✓	✓	✓
2	Bethells Beach							✓	✓	✓
3	Mountain Rd Esplanade						✓	✓	✓	✓
4	Douglas Scenic Reserve						✓	✓	✓	✓
5	Huia Reserve							✓	✓	✓
6	Henderson Valley Scenic Reserve		+				✓	✓	✓	✓
7	Chorley Reserve / Sunline Park <sup>4</sup>	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	Shona Esplanade						✓	✓	✓	✓
9	Tram Valley Road <sup>5</sup>	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	Gill Esplanade						✓	✓	✓	✓
11	Swanson Scenic Reserve	✓	✓	✓	✓	✓	✓	✓	✓	✓
12	Lowtherhurst Reserve <sup>6</sup>	✓	✓	✓	✓	✓	✓	✓	✓	✓
13	Warner Park							✓	✓	✓
14	Catherine Esplanade						✓	✓	✓	✓
15	Waikumete Cemetery		+				✓	✓	✓	✓
16	Oratia Esplanade						✓	✓	✓	✓
17	Brigham Creek Recreational Reserve							✓	✓	✓
18	Kellys Bridge Esplanade						✓	✓	✓	✓
19	Rahui Kahika Reserve						✓	✓	✓	✓
20	Moire Park <sup>7</sup>	✓	✓	✓	✓	✓	✓	✓	✓	✓
21	Takaranga Reserve							✓	✓	✓
22	Harbourview Park		+					✓	✓	✓
23	Karekare Beach							✓	✓	✓
24	Claude Abel Reserve							✓	✓	✓
25	Karaka Park / Green Bay Beach		+					✓	✓	✓
26	Kay Road Balefill		+					✓	✓	✓
27	Hobsonville Esplanade							✓	✓	✓

Surveys conducted by L. Eve; <sup>2</sup> Sites marked with "+" surveyed by A. Julian, A. Davis, and M. Tyrrell; <sup>3</sup> Surveys conducted by J. Alexander and S. Chapman; <sup>4</sup> Site named Massey or Triangle by L. Eve; Site named Waitakere by L. Eve; <sup>6</sup> Site named Lincoln by L. Eve; <sup>7</sup> Site named Royal Heights by L. Eve.

Table 3. Overview of Waitakere City ecological monitoring indicators since Summer 01.

	Summer 01-02	Summer 02-03	Spring 03	Summer 03-04	Winter 04	Summer 04-05	Summer 05-06
Avifauna	✓	✓	✓	✓	✓	✓	✓
Vegetation			✓		✓	✓	
Invertebrates	✓	✓					
Lizards				✓		✓	
Pests							✓

Note: As the standard invertebrate monitoring method involves kill-based trapping, the interval between invertebrate surveys is at least two years to enable invertebrate populations to recover.

## 2.2 Avifauna

### 2.2.1 Introduction

Of the 60 bird species present within Waitakere City, 65% are native (Julian *et al.* 1998). Of these, 23 species are classified as rare, threatened or uncommon (Chapman and Alexander 2003). Fifteen native species that are found in the Waitakere Ranges are absent from the city's urban and foothill zones and at least seven others are in serious decline (WCC 2001).

Ongoing monitoring since 1997 has indicated a decline in ecologically important species such as kereru (*Hemiphaga novaeseelandiae*) and tui (*Prosthemandera novaeseelandiae*) in habitat remnants (Chapman and Alexander 2003). As well as acting as pollinators and seed dispersers (kereru is the only species capable of dispersing the larger native fruits (Clout and Hay 1989)), species such as these are also useful bioindicators of ecosystem health (Froude 1998).

### 2.2.2 Five-minute bird counts

Five-minute bird counts were undertaken to determine the relative conspicuousness of birds (the ease with which birds are seen and/or heard). Changes in the conspicuousness of certain species are used as indicators of trends in the health of ecosystems. The five-minute bird count technique has been used extensively to monitor bird populations in New Zealand (Spurr and Powlesland 2000). While other more accurate methods are available (e.g., mist-netting based mark-resight studies, distance sampling), 5-minute bird counts offer the best balance of cost-effectiveness, compatibility with previous studies, and ease of repeatability for future monitoring.

At each site, counts were undertaken at between one and five counting stations, depending on the geographical size of the site being surveyed. A handheld GPS unit (Garmin eTrex) was used to ensure that counts were undertaken at the same counting stations established during previous bird monitoring. To maximise the independence of counts, counting stations were at least 200m apart and counts were undertaken at least 15 minutes apart. In order to increase the reliability of the data and as recommended by FORMAK (Handford 2004), three rounds of counts were undertaken at each station during December 2005 and January 2006. To avoid changes in bird conspicuousness during dawn and dusk, counts were undertaken between 7:30 am and 5:30 pm. Counts were not made during strong winds or rain. If adverse weather conditions developed partway through a day's counts, then that day's surveying was abandoned until weather conditions were suitable.

A list of all bird species seen or heard during each five-minute count was compiled. The number of each species seen and / or heard was recorded. If an individual was seen and / or heard after having been recorded, it was not counted again. This is to avoid pseudo-replication (counting the same individual more than once). If there was any doubt about whether an individual had already been counted, it was included in the count. While this approach may have led to an overestimation of conspicuousness in some cases, it was applied consistently and is compatible with other surveys in which the five-minute point count method was used. A pair of binoculars was used to aid in the identification of birds. Data were recorded using a standardised format on specially designed data sheets (see appendix). Data were then transferred to a spreadsheet (Microsoft Excel) for analysis. While all bird species recorded during monitoring were included in the analyses, six native species were selected as indicator species: tui, fantail, grey warbler, kereru, silvereye, and kingfisher.

While there are problems associated with comparing bird count studies undertaken by different observers (i.e. observer bias), three previous studies undertaken in Waitakere City have utilised the same or very similar methods at some of the same monitoring sites utilised in the current monitoring programme. Five-minute bird count results from the current monitoring programme were compared with the following previous bird surveys:

1) *Urban Forest Fragment Native Bird Survey Nov 1996 - Jan 1997*

Lisa Eve (1997) conducted bird surveys for her thesis on the ecological aspects of urban forest fragments. Five forest remnants were investigated. These included: Chorley Reserve / Sunline Park, Lowtherhurst Reserve, Moire Park, Swanson Scenic Reserve and Tram Valley Road. These same five sites are part of the current biodiversity monitoring programme.

Five-minute bird point counts were used to index the relative conspicuousness of birds in each remnant. At each of the five remnants, two counts at six sites were undertaken. Overall, ten bird species were recorded, of which six were native species. It is unclear whether only ten bird species were detected or whether other species were present but ignored. Lisa Eve's research was funded by the Waitakere City Council. Despite potential compatibility issues arising from observer bias the results have been incorporated into the WCC Biodiversity Monitoring Program.

2) *Bird Communities and Habitat Survey Summer 1997 - 1998*

Julian *et al.* (1998) undertook bird surveys as part of a relatively detailed ecological investigation of Waitakere City lowlands. Seven sites representative of natural areas throughout Waitakere City were surveyed to monitor trends in birds and vegetation (see Table 2 for surveyed sites). The bird counts were undertaken during optimal climatic conditions (fine and calm) at sunrise for 2-2.5 hours. At each of the seven sites, ten stations were established and all birds seen and heard within 20 metres of each station were recorded. While the methods used by Julian *et al.* (1998) differ slightly from other five-minute counts, the results are assumed to provide a reliable record of relative bird species conspicuousness at the time and have therefore been incorporated into the long-term five-minute count dataset.

3) *Waitakere City Council bird monitoring programme 1998, 1999, 2001 & 2002 - 2006*

In 1998 WCC initiated an annual programme of native bird monitoring. The surveys were not undertaken in 2000, the reasons for this are unclear. The purpose of the programme was to measure the conspicuousness of native bird species at selected sites over time. Conspicuousness of bird species was utilised by WCC to indicate the state of urban forest fragments and urban bird populations. From 1998 to 2001, bird populations at five sites across the city were monitored using the five-minute point count method. During these surveys, the conspicuousness of six native bird species was recorded. The species monitored were: silvereye, fantail, tui, grey warbler, kingfisher and kereru. In 2002, a further ten sites were added to the monitoring programme and an additional native bird species, pukeko, was included in the surveys. From 2003, a total of 27 sites were monitored.

### 2.2.3 Distance sampling

Tui, kereru, grey warblers and fantail populations were surveyed at 27 sites spread throughout Waitakere City during December 2005 and January 2006. Three rounds of distance sampling counts were undertaken. The sites were those where five-minute bird counts have been undertaken as part of the Waitakere City Biodiversity Monitoring Programme. The sites were also the same sites where distance sampling was undertaken previously. Nearly all of the sites are WCC reserves.

Forest bird variable-length transects (Handford 2002) were used to estimate the density of tui and kereru populations at the survey sites. Transects were between 100 m and 500 m in length depending on the area of the survey site. Transects were walked slowly and the following data were recorded for all tui, kereru, fantail and grey warblers seen or heard: species, number of tui / kereru / fantail / grey warblers, distance along transect, distance from transect, angle/bearing from transect. A hand-held GPS unit was used to measure the length of transects and to determine the distance of bird sightings along transects. Distance away from transect was estimated to the nearest metre and bearings/angles from transects were estimated to the nearest 5°.

Additional data were collected to facilitate future analyses based on distance sampling models. Such analyses were not attempted during this study because baseline datasets do not allow for the valid application of distance sampling analyses. To allow population densities to be calculated in the short term, the number of indicator birds per hectare was calculated by only including sightings of birds within 20 m from either side of the transect in the analysis. Population densities were calculated by multiplying the length of the transect (variable) by the width of the transect (40 m in total) in which birds were recorded.

To avoid bird activity peaks at dawn and dusk, transects were walked between 7:30 am and 5:30 pm. Surveys were not conducted during strong winds or rain. If these weather conditions developed partway through a day's counts, then that day's surveying was abandoned to continue on another day.

## 2.3 Pest communities

### 2.3.1 Introduction

Revegetation and weed control projects involve a long-term approach to improving habitat remnants and linkages between them. However, without predator control such initiatives are unlikely to halt biodiversity declines. Increases in populations of kereru, fantail, tui and other native species have been documented at sites in the City where predators are maintained at low levels over a sustained period (e.g., Lone Kauri Forest Restoration Programme and the Ark in the Park project).

Information about the distribution and abundance of animal pests is required to protect indigenous biodiversity. When used in conjunction with data on indigenous flora and fauna, pest population data can be used to target pest at sites where they pose the greatest threat to indigenous biodiversity.

### 2.3.2 Methods

Up to five tracking tunnels (Trakka Kits - manufactured by Connovation Limited) and 10 wax tags (Possum Detectas) were set at each of the 27 biodiversity monitoring sites during February - March 2006. Coordinates for each tracking tunnel were obtained using a handheld GPS unit. The tunnels were baited with peanut butter. The tunnels were set at 50m spacings along transects of up to 200m in length. The tunnels remained in the field for two weeks after which time they were collected and the ink pads assessed for the presence and relative abundance of rodents, mustelids and other small animals (Figure 2). The proportion of tunnels with tracks provides an indication of the distribution and abundance of pests across the sites. Wax tags were assessed for chewing by pests. Teeth marks were identified and the numbers of wax tags chewed by each pest were recorded.

**The Trakka Kit** tracking tunnel was originally developed to determine what types of pests (including rats, mice, stoats and hedgehogs) were lurking in our forests & backyards but has been found to reveal just as much about the presence of native animals such as lizards, wetas & other insects.

**Why use a tracking tunnel?** If the species you detect are regarded as pests that destroy native animals and plants, then appropriate plans and strategies can be developed to get rid of them. And once the pests are removed, the Trakka allows you to confirm that animals such as lizards, weta and other insects have returned to the area.

**How does it work?** It consists of a lightweight polypropylene tunnel, a pre-inked tracking card for small animals (up to ferret size) and two U shaped pins to secure the tunnel. Lures are placed on the ink free section in the centre of the card. While an animal eats the lure, it stands on the inked section, and ink is transferred from their feet to either end of the card where the tracks of the animal are recorded on the absorbent area of the card. The tracks on this section of the card do not smudge allowing for easy identification using the sample prints provided.

Source: [www.connovation.co.nz](http://www.connovation.co.nz)

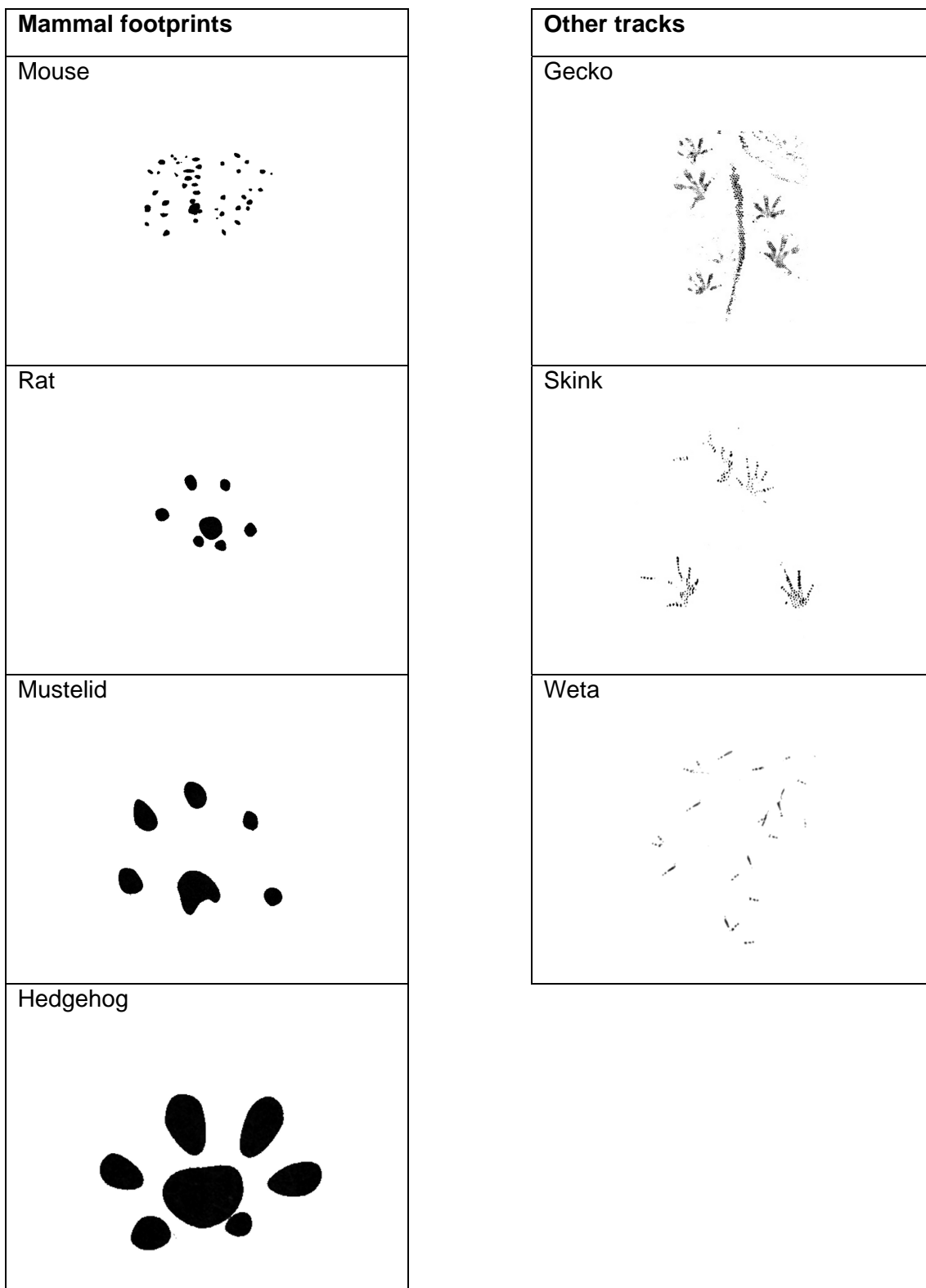


Figure 2. Tracks of animals recorded in tracking tunnels.

## 2.4 Vegetation Structure & Phenology

### 2.4.1 Introduction

The presence and abundance of native avifauna within a given area can be directly related to the vegetation structure and phenology (timing and duration of flower and fruit production) of the native trees, shrubs and climbers present. Flowers and fruit provide food for nectarivorous (e.g., tui) and frugivorous species (e.g., kereru) (Heather & Robertson 1997); they also influence the local invertebrate community, thus potentially affecting food availability for insectivorous birds such as fantail (*Rhipidura fuliginosa*). Native lizard species may likewise be attracted to flowering and fruiting plants (Whitaker 1987). Vegetation structure and phenology is therefore an important modifier of local faunal biodiversity. Understanding the phenology of the plant community at a given site is an essential step towards maintaining or (through targeted revegetation) establishing a year-round local food supply for native fauna.

### 2.3.2 Rapid assessment vegetation surveys

Rapid assessment vegetation surveys were undertaken during previous monitoring at each of the 27 monitoring sites. The surveys involved slowly walking a 100 m transect at each site.

The structure and composition of the vegetation was described by estimating the relative abundance of each species present in each tier of the vegetation (seedling/groundcover, sapling, shrub, subcanopy, canopy and emergent) using the following scale:

- 1 = <10% (rare)
- 2 = 11-30% (occasional)
- 3 = 31-60% (common)
- 4 = 61-90% (very common)
- 5 = >90% (dominant)

The phenology of native plant species was assessed by recording the species which were flowering or fruiting. The following details were recorded for each species that was flowering and / or fruiting:

- Estimated abundance of flowers and / or fruit as a percentage of total capacity (1 = <30%, 2 = 30-70%, 3 = >70%)
- Maturity of the flowers and / or fruit (1 = immature, 2 = mature, 3 = shed)
- Estimated proportion of plants with flowers and / or fruit (1 = <30%, 2 = 30-70%, 3 = >70%)

**Note:** Vegetation structure and phenology monitoring was not undertaken during summer 2005-6 but the results of the monitoring undertaken during spring 2003, winter 2004 and summer 2004-5 are included for completeness.

## 2.4 Terrestrial Invertebrates

### 2.4.1 Introduction

Invertebrates play an important role in ecosystem function (Anderson *et al.* 2004) and provide food for many native bird and lizard species. A range of vegetative and environmental variables, such as plant species present, canopy structure, litter composition and soil quality, influence the local composition of terrestrial invertebrate communities. Due to their responsiveness to changes in these variables, terrestrial invertebrates are useful bioindicators of ecosystem health, as shown in a study at the Waitakere Quarry (Te Henga Rd) which used invertebrate community composition to evaluate the relative success of several revegetation techniques (Curtis 2003). The Auckland Regional Council has used invertebrate monitoring to measure the success of mammalian pest control in the Waitakere Ranges, and invertebrate monitoring is being undertaken by the Greater Wellington Regional Council as part of their Key Native Ecosystems Programme (J. Lambie pers. comm.). For the present study, monitoring of invertebrate community composition provides baseline data against which future ecological rehabilitation and management can be assessed.

### 2.4.2 Invertebrate Sampling

An invertebrate pitfall trap line (Green 2000) was established at each of the 27 sampling sites. Each line consisted of up to 5 traps at 10 m intervals resulting in a total length of up to 40 m per line. Trap lines followed the route of a stream or gully but were at least 10 m from the stream bed or gully-bottom. Wherever possible, steep sites were avoided.

Each trap consisted of a plastic cup buried so that the rim of the cup was level with the soil, and a 20 x 20 cm untreated plywood cover held down with a nail in each corner (Figure 3). Cups were filled to approximately 30% of their total capacity with a solution of 30% ethylene glycol and 70% water. A dessert spoon of non-iodised salt was added to super-saturate the solution. When holes were dug for traps, unused earth was discarded at least 5 m away from traps and any bare earth was covered with leaf litter. Individual traps were situated at least 1 m from trees and logs. Stones or small sticks were used to maintain a 10-20 mm gap between the cover and the level of the ground (Figure 3).

Traps were installed during March 2005 and samples were collected during May 2005 at which stage the traps were removed giving a sampling period of approximately two months. Samples were collected from pitfall traps and placed into small sealed canisters labelled with trap number, location and date. Each sample was processed by sorting the invertebrates into twelve groups (carabid beetle, other beetle, weta, spider, harvestman, slater, snail, slug, millipede, centipede, litterhopper, and other invertebrate). Reference samples were stored for use in future research projects. Four groups were selected for analysis as indicator groups: carabid beetle, other beetle, weta, spider. Carabid beetles and weta are most abundant in intact forest environments therefore the sites where they were most abundant were assumed to be those with highest quality habitat and least environmental degradation.

The capture rate of each invertebrate group was used to provide indices of abundance at each site. Indices (captures per trap-night) for each invertebrate group were calculated as follows: the total number captured across all traps per site divided by the number of traps multiplied by the number of nights the traps were set at that site.

Capture rates were classified on the following scale:

- Not detected: 0 captures per trap night
- Scarce: 0-1 captures per trap night
- Common: 1-4 captures per trap night
- Abundant: 4-8 captures per trap night
- Very abundant: 8+ captures per trap night

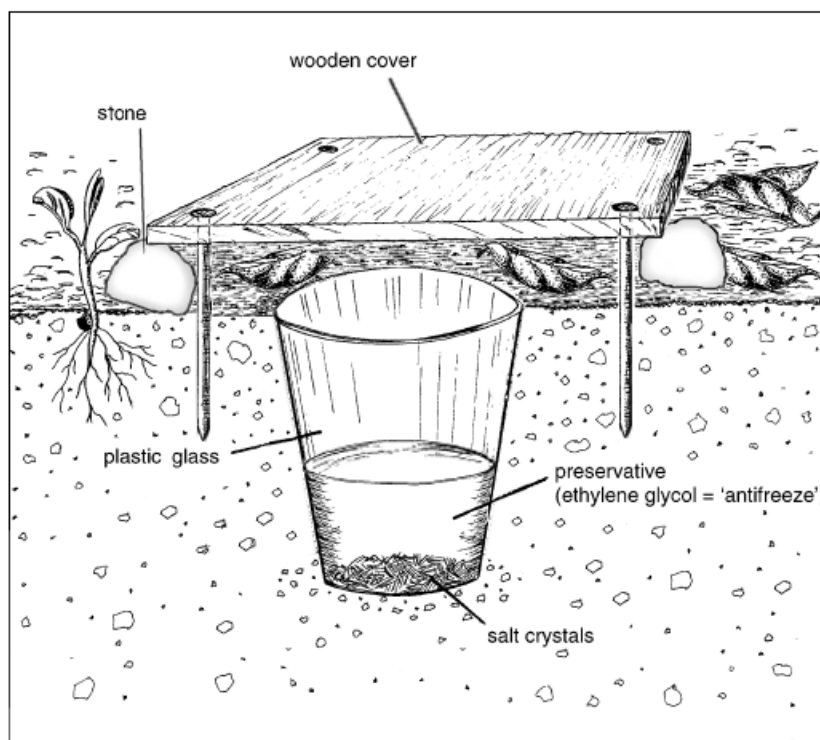


Figure 3. A set pitfall trap (wooden cover offset to show trap entrance clearly; adapted from Green 2000).

**Note:** Terrestrial vertebrate monitoring was not undertaken during summer 2005-6 but the results of the monitoring undertaken during March-May 2004-5 are included for completeness.

## 2.5 Lizards

### 2.5.1 Introduction

Five native lizard species and one introduced species are recorded as being present in Waitakere City. The native lizard fauna consists of three gecko and two skinks species (see Table 4). A third native skink species, the striped skink (*Oligosoma striatum*) was recorded in the early 1900s but has not been seen since (Chapman and Alexander 2003). Native lizard populations are face increasing pressure from habitat degradation and predation by introduced mammals (Gill and Whitaker 1996). The rainbow skink (*Lampropholis delicata*), accidentally introduced into New Zealand from Australia in the 1960s, is well established in Waitakere City and at some sites may be the most common lizard species present (pers. obs.). It has been suggested that, where abundant, this species has the potential to compete with the smaller native skink species (Peace 2004).

Table 4. Lizard fauna recorded in Waitakere City

<b>Native geckos:</b>	Forest gecko <i>Hoplodactylus granulatus</i> Pacific gecko <i>H. pacificus</i> Auckland green gecko <i>Naultinus elegans elegans</i>
<b>Native skinks:</b>	Copper skink <i>Cyclodina aenea</i> Ornate skink <i>C. ornata</i> (Striped skink <i>Oligosoma striatum</i> presumed locally extinct)
<b>Introduced skinks:</b>	Rainbow skink <i>Lampropholis delicata</i>

### 2.5.2 Lizard Sampling

Seven of the 27 sampling sites were visited on fine evenings during April 2005 and searches for lizards (geckos and skinks) were undertaken. Two of the sites were among those surveyed during 2003, one where lizards were present and another where lizards are thought to be present but were not detected during the 2003 survey. At each of the seven sampling sites, the suitable lizard habitat was systematically surveyed by a team of two people using spot-lights. Where possible, searching routes followed linear landscape features (e.g., forest edge, stream, habitat boundaries). A GPS unit was used to plot the search route and to precisely record coordinates of locations where lizards were found. Because the area of suitable lizard habitat (e.g., manuka and kanuka forest for geckos, bush edge and natural debris for skinks) varied between sites, search effort was greatest in areas where it was anticipated that lizards were likely to be present. A total of 14 hours of lizard surveys was conducted.

Results were recorded as encounter rates (number of lizards encountered per person per hour of searching; Whitaker 1994). This enabled lizard populations to be categorised as low, medium or high lizard density / diversity. Encounter rates were compared with those recorded in other studies to determine which sites are suitable for use in a long-term monitoring programme. Species and distribution data were recorded on the Department of Conservation's Amphibian and Reptile Distribution Scheme (ARDS) cards and in addition to their use in the data analysis, these will be submitted for inclusion in DOC's national herpetofauna (reptiles and amphibians) database (access to this database is restricted to relevant authorities and approved herpetologists with a valid reason to access the information).

**Note:** Lizard monitoring was not undertaken during summer 2005-6 but the methods of the monitoring undertaken during summer 2004-5 are included for completeness.

The results of the lizard surveys have been provided to the Waitakere City Council in a separate document. This was necessary because native lizard communities have been decimated by wildlife collectors. Adams (2001) highlighted in a Department of Conservation publication that offenders are almost certainly using central and local government reports, publications and news / media releases to locate native gecko populations.

### 3. Results

#### 3.1 Te Henga Wetland

**Location:** Bethells Road, Te Henga

**Habitat:** Freshwater wetland, raupo reedland, regenerating manuka/kanuka forest

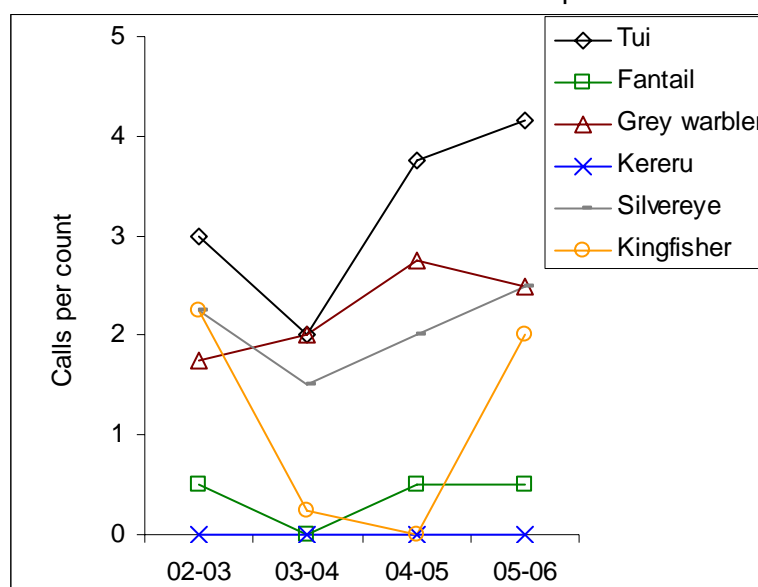
**Recent ecological management actions:** Weed control - particularly willows

#### Avifauna:

*Five-minute bird counts:*

- Kereru were not recorded during any five-minute bird count surveys
- Kingfishers declined in conspicuousness during 03-04 and 04-05 but returned to 02-03 levels during 05-06
- Silvereve and fantail conspicuousness remained relatively stable
- Tui conspicuousness has increased

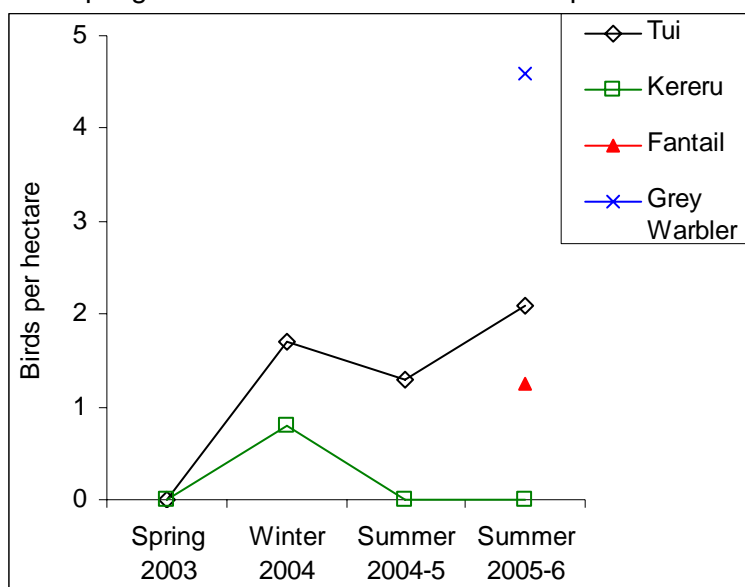
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Kereru recorded in winter 2004
- Tui conspicuousness has increased
- Grey warblers were common
- Fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	5	100
Possum	0	0
Mustelid	0	0
Hedgehog	1	20

- Number of wax tags = 9

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	2	22
Mouse	5	56
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 20 species was recorded across all vegetation tiers
- There is good natural regeneration of vegetation communities

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Carmichaelia arborea</i>			2			
<i>Coprosma crassifolia</i>			2			
<i>Coprosma lucida</i>			3			
<i>Coprosma rhamnoides</i>		2	3			
<i>Coprosma robusta</i>	2	3	3			
<i>Cordyline australis</i>			3	4		
<i>Coriaria arborea</i>			2			
<i>Cyathea medullaris</i>			2			
<i>Dicksonia squarrosa</i>			3	2		
<i>Gahnia</i> sp.			2			
<i>Geniostoma rupestre</i>	3	3	4			
<i>Kunzea ericoides</i>				2	4	
<i>Leptospermum scoparium</i>		2	3			
<i>Melicytus ramiflorus</i>		2	3			
<i>Myrsine australis</i>			2	2		
<i>Olearia furfuracea</i>			2			
<i>Phormium tenax</i>			3			
<i>Pseudopanax crassifolius</i>			2	2		
<i>Rhopalostylis sapida</i>			2	2		
<i>Sophora fulvida</i>			2	2	3	

*Phenology:*

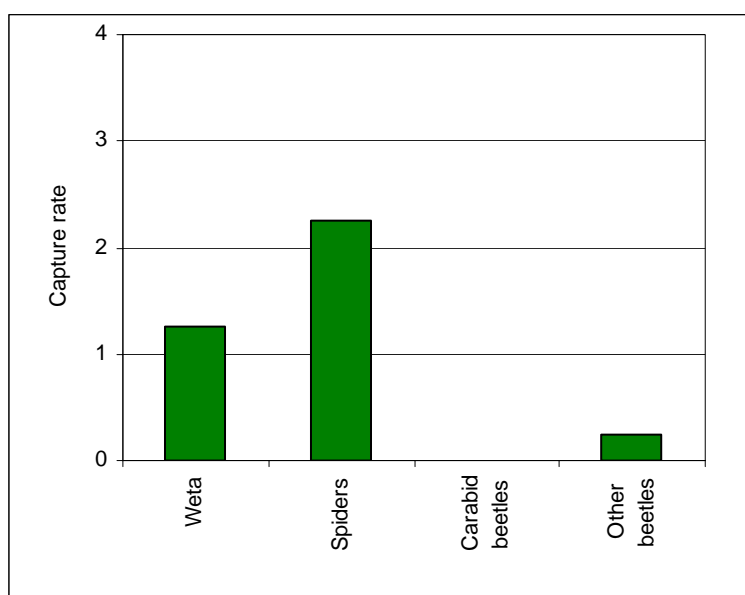
- Few species were recorded fruiting during spring 2003 or winter 2004
- Kowhai and cabbage tree are important components of the vegetation. As they are part of both the sub-canopy and canopy their fruits are accessible to birds and they are a reliable food source.

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Carmichaelia arborea</i>	NZ broom				✓		
<i>Cassinia leptophylla</i>	Tauhinu	✓	✓				
<i>Coprosma robusta</i>	Karamu	✓			✓		✓
<i>Cordyline australis</i>	Cabbage tree	✓					✓
<i>Geniostoma rupestre</i>	Hangehange						✓
<i>Kunzea ericoides</i>	Kanuka					✓	✓
<i>Leptocarpus similis</i>	Oioi	✓					
<i>Leucopogon fasciculatus</i>	Mingimingi			✓			
<i>Sophora microphylla</i>	Kowhai						✓
<i>Spinifex hirsutus</i>	Spinifex	✓					
<i>Ulex europaeus</i> *	Gorse			✓			

Note: \* = Introduced species

**Invertebrate communities:**

- Spiders and weta were the most abundant groups
- No carabid beetles were captured

**Site summary:**

Te Henga Wetland is of national and international significance due to its outstanding natural values. The significance of Te Henga Wetland as habitat for rare species has been well documented (e.g., Waitakere Ranges Protection Society 1978, Denyer *et al.* 1993). Te Henga wetland is the largest wetland in the Auckland Ecological Region. It supports a range of vegetation classes and structural types. Such diversity is also reflected by the high number of wildlife species present in the wetland.

Tui conspicuousness has increased. Surprisingly kereru have not been present during the last four years of the five minute bird counts or during the last two distance sampling surveys. This is an artefact of the timing of the bird surveys rather than kereru being absent from the site. In fact, kereru are regularly observed foraging on cabbage tree berries and kowhai leaf buds that are a dominant vegetation feature around the periphery of the wetland.

The Auckland Regional Council's Operation ForestSave has reduced possum population densities to such low levels that they were not detected during the pest monitoring. Mice were abundant at the site and may explain why carabid beetles were not detected and the other invertebrate indicator groups were not common given the quality of the leaf litter and moisture levels at the site.

The WCC has targeted the following environmental weeds in the wetland: *Nymphaea mexicana* (Mexican waterlily), *Alternanthera philoxeroides* (alligator weed), *Glyceria maxima* (reed sweetgrass) and *Salix spp.* (willow) - with wind dispersed seeds and a coloniser of open water it can drastically alter the wetland by changing habitats. The ARC has targeted *Arundo Donex* (elephant grass). This weed grows from pieces which break off in the floods, and establish further downstream. It is very vigorous and extremely hard to eradicate.

Waitakere Rivercare group is very active in restoring native vegetation along the riparian zone of the Waitakere River that flows into the Wetland and the Waitakere branch of the Royal Forest & Bird Society has undertaken substantial pest control in their Matuku Reserve which borders the northern side of the wetland. Given the high ecological value of the site's ecosystems, predator control is vital for the rare wetland bird species that are present and almost certainly would result in substantial measurable benefits for other local native fauna and flora communities.

**Note:** Monitoring of wetland bird species using a combination of call / response surveys, territory mapping and five-minute bird counts was undertaken during February - March 2006. Particular attention was paid to the following significant wetland bird species: Australasian bittern, banded rail, North Island fernbird, marsh crake, and spotless crake. The results of wetland bird monitoring have been presented to WCC in a separate report.

## 3.2 Bethells Beach

**Location:** Bethells Road, Te Henga

**Habitat:** Sand dune shrubland

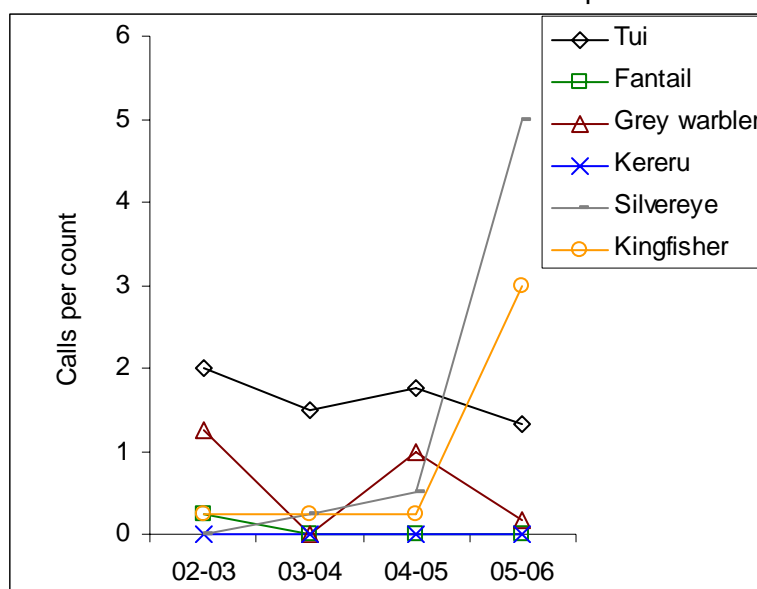
**Recent ecological management actions:** Revegetation, rabbit control

**Avifauna:**

*Five-minute bird counts:*

- Kereru not recorded
- Fantails not recorded after 02-03
- Tuis conspicuousness relatively stable
- Silvereeye and kingfisher have become more conspicuous

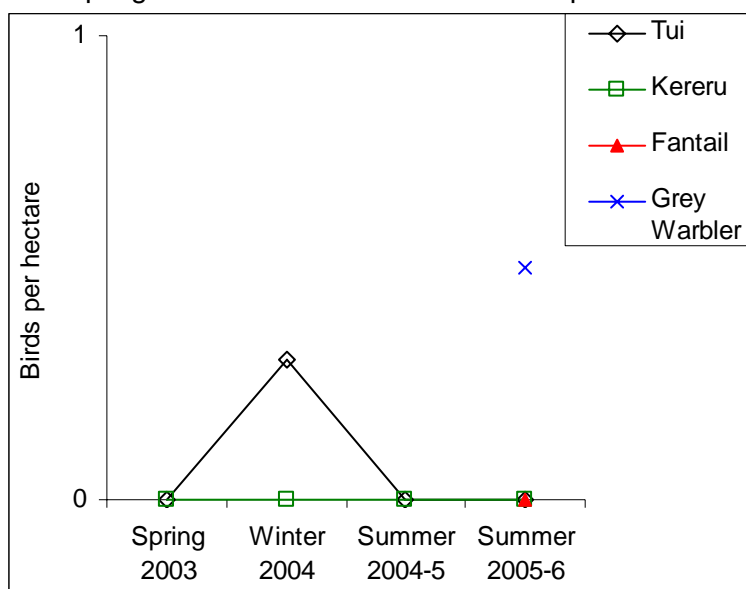
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Tui recorded during winter 2004 only
- Kereru not recorded
- Fantails were not recorded
- Grey warblers were scarce

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	1	20
Possum	0	0
Mustelid	0	0
Hedgehog	2	40

- Number of wax tags = 10

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	2	22
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 17 species was recorded across all vegetation tiers
- No canopy or subcanopy was present
- Twelve native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Ammophila arenaria</i>		3				
<i>Carex pumila</i>	3					
<i>Cassinia leptophylla</i>	3	3	4			
<i>Coprosma crassifolia</i>	2	2	3			
<i>Cordyline australis</i>		2	3			
<i>Cortaderia fulvida</i>		2	3			
<i>Cortaderia selloana</i> *		2	3			
<i>Cortaderia splendens</i>		2	3			
<i>Leptocarpus similis</i>		2				
<i>Leptospermum scoparium</i>			2			
<i>Leucopogon fasciculatus</i>	1	2	2			
<i>Lupinus arboreus</i> *	3	3	3			
<i>Melicytus ramiflorus</i>			1			
<i>Metrosideros excelsa</i>	3	3	3			
<i>Muehlenbeckia complexa</i>		3	3			
<i>Phormium tenax</i>		2	2			
<i>Spinifex sericeus</i>	2	3				

*Phenology:*

- Few species were flowering or fruiting during winter 2004
- There is good regeneration of native species

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Cassinia leptophylla</i>	Tauhinu				✓	✓	
<i>Coprosma crassifolia</i>	Thick-leaved coprosma	✓					
<i>Coprosma lucida</i>	Shining karamu		✓				
<i>Coprosma robusta</i>	Karamu	✓	✓				
<i>Cordyline australis</i>	Cabbage tree	✓					✓
<i>Geniostoma rupestre</i>	Hangehange	✓	✓				
<i>Leptospermum scoparium</i>	Manuka			✓	✓		
<i>Leucopogon fasciculatus</i>	Mingimingi	✓	✓				
<i>Melicytus ramiflorus</i>	Mahoe	✓					
<i>Metrosideros excelsa</i>	Pohutukawa					✓	✓
<i>Muehlenbeckia complexa</i>	Pohuehue			✓		✓	✓
<i>Myrsine australis</i>	Red matipo		✓				
<i>Phormium tenax</i>	Flax					✓	✓
<i>Rhopalostylis sapida</i>	Nikau	✓					
<i>Sophora microphylla</i>	Kowhai	✓	✓				

**Invertebrate communities:**

- Invertebrate monitoring was not undertaken because the method used is not appropriate for use in sand dunes

**Site summary:**

Te Henga beach is contiguous with Te Henga wetland. Tuis conspicuousness has been relatively stable while silveryeyes and kingfishers have become more conspicuous. Only mice and hedgehogs were detected during the pest monitoring. Over the last few years the Te Henga Landcare Group and the ARC has undertaken rabbit control throughout the dunes and this may have impacted the rats as well. The rabbit control has substantially improved the regeneration of vegetation communities. There has also been planting by the community and WCC (species such as pohutukawa, ngaio, flax and *Coprosma* spp. have been planted over recent years) and pampas has been targeted for control.

Note: Monitoring of shore birds at Te Henga coastline was assessed by undertaking 2-3 slow-walk transects along the foreshore during February - March 2006.. All shore birds present were identified and counted and their activity recorded (roosting, foraging, flying, etc.). The results of shore bird monitoring have been presented to WCC in a separate report.

### 3.3 Mountain Rd Esplanade

**Location:** Mountain Road, Henderson Valley

**Habitat:** Regenerating kanuka-podocarp-forest

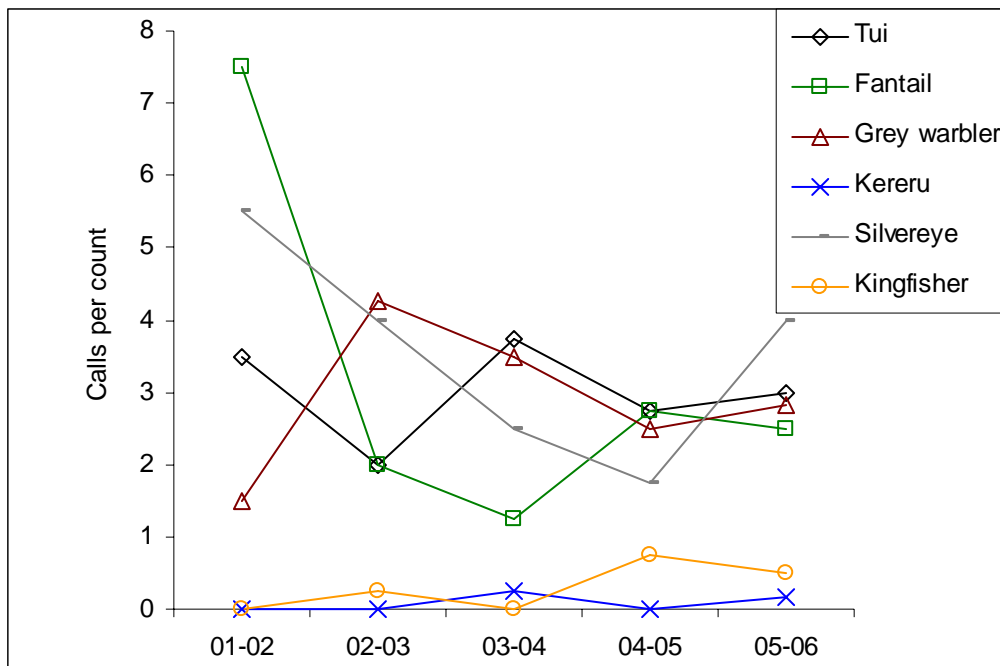
**Recent ecological management actions:** Possum control (Operation ForestSave)

**Avifauna:**

*Five-minute bird counts:*

- Grey warbler, fantail and tui conspicuousness has remained stable during the last two surveys
- Kereru recorded during 2003-4 and 2005-6
- Kingfisher conspicuousness has increased since 01-02

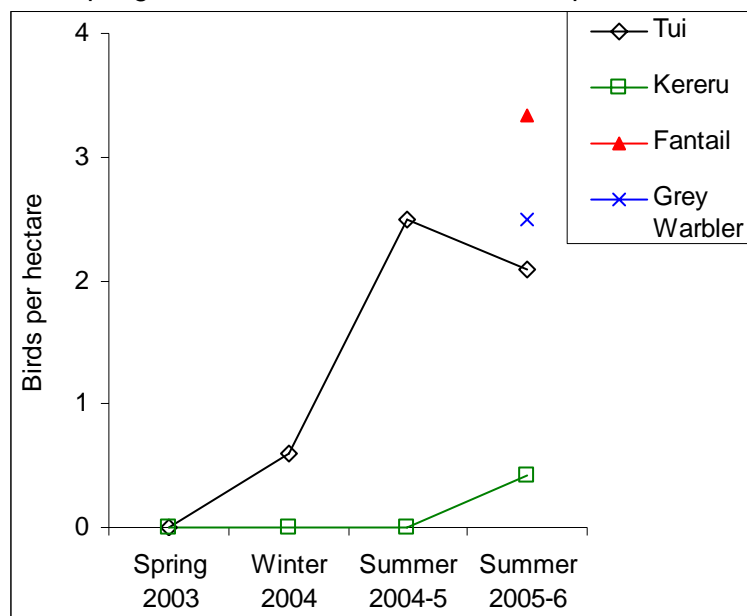
Five-minute count results for native bird indicator species 2001-2 to 2005-6



*Distance sampling:*

- Kereru were recorded in the distance sampling for the first time during 2005-2006
- Tui were not recorded in spring 2003 but were abundant during summer 2004-5 and 2005-6
- Grey warblers and fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	2	40
Possum	0	0
Mustelid	0	0
Hedgehog	5	100

- Number of wax tags = 10

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	7	70
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 26 species was recorded across all vegetation tiers
- Five native species were present in the subcanopy while kauri, kanuka and rewarewa were present in the canopy
- Twelve native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>		2			2	
<i>Brachyglottis repanda</i>			3			
<i>Carpodetus serratus</i>	3	3	3			
<i>Coprosma grandifolia</i>	2	3	3			
<i>Coprosma lucida</i>			3			
<i>Coprosma rhamnoides</i>			3			
<i>Coprosma robusta</i>			3			
<i>Cyathea medullaris</i>				3		
<i>Dacrydium cupressinum</i>			2			
<i>Dicksonia squarrosa</i>			2			
<i>Geniostoma rupestre</i>	3	3	4			
<i>Hebe stricta</i>		2	3			
<i>Hedycarya arborea</i>	3	3	3			
<i>Hoheria populnea</i>				2		
<i>Knightia excelsa</i>	2	2			2	
<i>Kunzea ericoides</i>	3	3	2	3	4	
<i>Leucopogon fasciculatus</i>	3	3	4			
<i>Melicytus ramiflorus</i>			3			
<i>Myrsine australis</i>	3	3	4			
<i>Olearia furfuracea</i>			2			
<i>Olearia rani</i>			3			
<i>Phyllocladus trichomanoides</i>	3	3	2			
<i>Pittosporum tenuifolium</i>	2	2	2			
<i>Podocarpus totara</i>		2				
<i>Prumnopitys ferruginea</i>				2		
<i>Pseudopanax arboreus</i>				2		

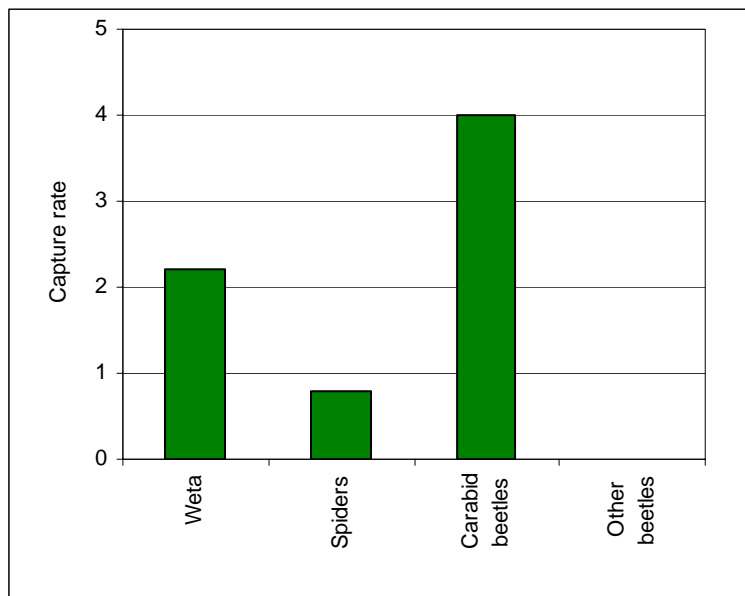
*Phenology:*

- Kanuka was the only species flowering during summer 2004-5

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma lucida</i>	Shining karamu	✓	✓		✓		
<i>Coprosma rhamnoides</i>	Twiggy coprosma	✓	✓	✓	✓		
<i>Coprosma robusta</i>	Karamu		✓				✓
<i>Coriaria arborea</i>	Tutu	✓					
<i>Geniostoma rupestre</i>	Hangehange	✓		✓			
<i>Hebe</i> sp.	Koromiko		✓				
<i>Kunzea ericoides</i>	Kanuka					✓	✓
<i>Leucopogon fasciculatus</i>	Mingimingi	✓	✓	✓			✓
<i>Myrsine australis</i>	Red matipo				✓		✓
<i>Pseudopanax arboreus</i>	Five finger	✓		✓			
<i>Ulex europaeus</i> *	Gorse			✓			

**Invertebrate communities:**

- Carabid beetles were the most abundant group
- Weta were also relatively abundant
- Spider numbers were low

**Site summary:**

All indicator bird species including kereru have been detected at Mountain Road Esplanade. This is not surprising as the site is contiguous with the Waitakere Ranges regional parkland. Indicator bird species have remained relatively stable during the last few years of monitoring. The Auckland Regional Council's Operation ForestSave has reduced possum population densities and possums were not detected during the pest monitoring. The abundance of weta and carabid beetles detected in the invertebrate samples indicates that a well developed leaf litter is present at the site. There is good natural regeneration occurring and weed infestations are limited. No additional native planting is required.

### 3.4 Douglas Scenic Reserve

**Location:** Raroa Terrace, Waitatarua

**Habitat:** Mamaku-mixed broadleaf-kauri forest

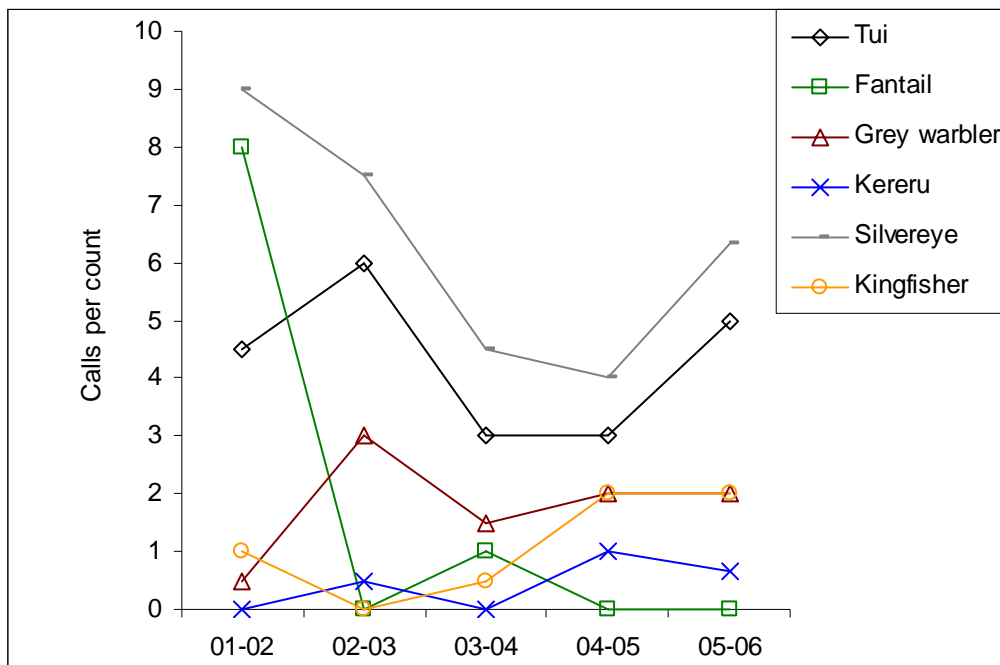
**Recent ecological management actions:** Possum control (Operation ForestSave)

**Avifauna:**

*Five-minute bird counts:*

- Fantail have decreased in conspicuousness considerably since 01-02
- Kereru have been consistently recorded during three of the five surveys
- Kingfisher and grey warbler have remained stable during the last two years

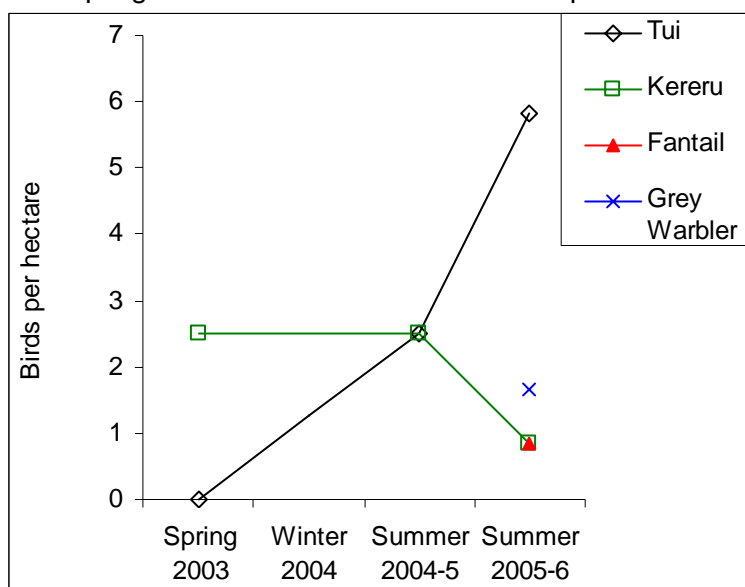
Five-minute count results for native bird indicator species 2001-2 to 2005-6



*Distance sampling:*

- Site not surveyed during winter 2004
- Kereru at same density during spring 2003 and summer 2004-5, slight drop during summer 2005-6
- Tui have increased since spring 2003
- Grey warblers and fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 4

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	3	75
Mouse	4	100
Possum	0	0
Mustelid	0	0
Hedgehog	0	0

- Number of wax tags = 7

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	1	14
Mouse	2	29
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 24 species was recorded across all vegetation tiers
- Thirteen native species were present in the subcanopy and four were present in the canopy
- *Coprosma robusta* was the only native species regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>				2		
<i>Aristotelia serrata</i>			2			
<i>Brachyglottis kirkii</i>			3			
<i>Brachyglottis repanda</i>			3	3		
<i>Carpodetus serratus</i>				2		
<i>Coprosma lucida</i>			3			
<i>Coprosma robusta</i>		2	3			
<i>Cordyline australis</i>			3	3		
<i>Cyathea medullaris</i>			2	3		
<i>Dacrycarpus dacrydioides</i>				3	3	
<i>Dicksonia squarrosa</i>			3	3		
<i>Dysoxylum spectabile</i>			2			
<i>Geniostoma rupestre</i>			3			
<i>Griselinia lucida</i>				2		
<i>Hedycarya arborea</i>			3	3		
<i>Hoheria populnea</i>			2			
<i>Knightia excelsa</i>				3	3	
<i>Kunzea ericoides</i>				3	3	
<i>Leucopogon fasciculatus</i>			3			
<i>Macropiper excelsum</i>			3			
<i>Melicytus ramiflorus</i>			4			
<i>Pseudopanax crassifolius</i>				3		
<i>Rhopalostylis sapida</i>			3			
<i>Sophora fulvida</i>			2	3	3	

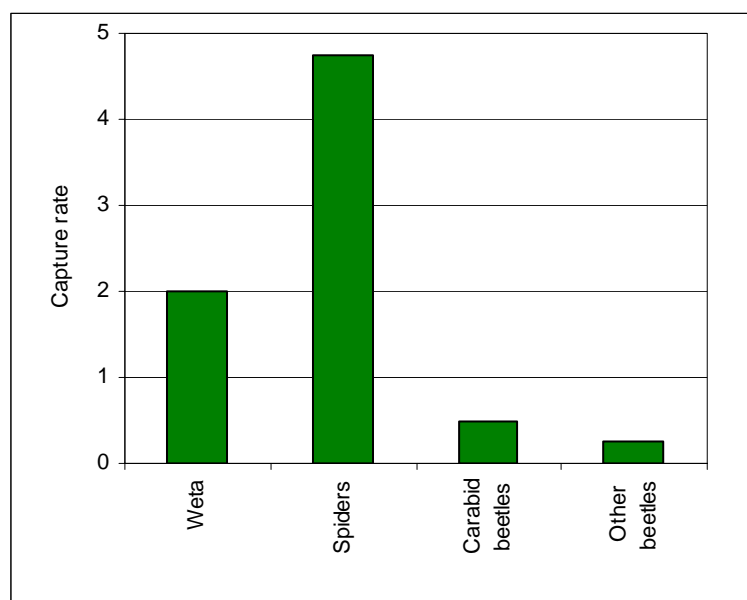
*Phenology:*

- Site not surveyed for phenology during winter 2004
- Two species were fruiting during spring 2003 and summer 2004-5: rewarewa and red matipo

Species	Common name	Spring 2003		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting
<i>Brachyglottis repanda</i>	Rangiora	✓	✓		
<i>Carpodetus serratus</i>	Putaputaweta	✓			
<i>Coprosma robusta</i>	Karamu	✓	✓		
<i>Cordyline australis</i>	Cabbage tree	✓			
<i>Geniostoma rupestre</i>	Hangehange	✓			
<i>Griselinia lucida</i>	Pukapuka	✓			
<i>Hedycarya arborea</i>	Pigeonwood	✓		✓	
<i>Knightia excelsa</i>	Rewarewa	✓			✓
<i>Leptospermum scoparium</i>	Manuka	✓			
<i>Macropiper excelsum</i>	Kawakawa	✓			
<i>Metrosideros perforata</i>	Akatea			✓	
<i>Metrosideros robusta</i>	Northern rata			✓	
<i>Myrsine australis</i>	Red matipo				✓
<i>Sophora fulvida</i>	Kowhai	✓			

**Invertebrate communities:**

- All indicator groups were present
- Spiders were the most abundant group followed by weta and carabid beetles

**Site summary:**

Douglas Scenic Reserve is surrounded by the Waitakere Ranges regional parkland and as such, vegetation diversity is high and all the indicator bird species are present. Few seedlings and saplings were noted during the rapid vegetation surveys and this is due to the dense vegetation present at the site and the low light levels on

the forest floor. Tuis can be particularly abundant at the site, taking advantage of the flowering rewarewa and kowhai. Kereru can also be at high densities at the reserve and up to five kereru have been observed feeding on a single pigeonwood tree when it has been fruiting profusely. Rats were common at Douglas Scenic Reserve.

### 3.5 Huia Reserve

**Location:** Huia Road, Huia

**Habitat:** Grassland, marine tidal flats

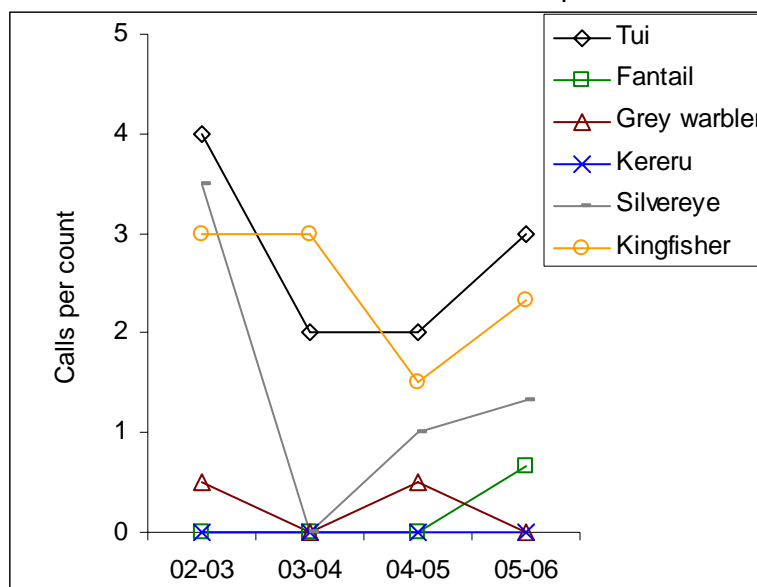
**Recent ecological management actions:** None

**Avifauna:**

*Five-minute bird counts:*

- Tui, silvereyes and kingfishers have recovered slightly since previous declines in conspicuousness
- Kereru not recorded
- Fantail recorded for the first time during 05-06

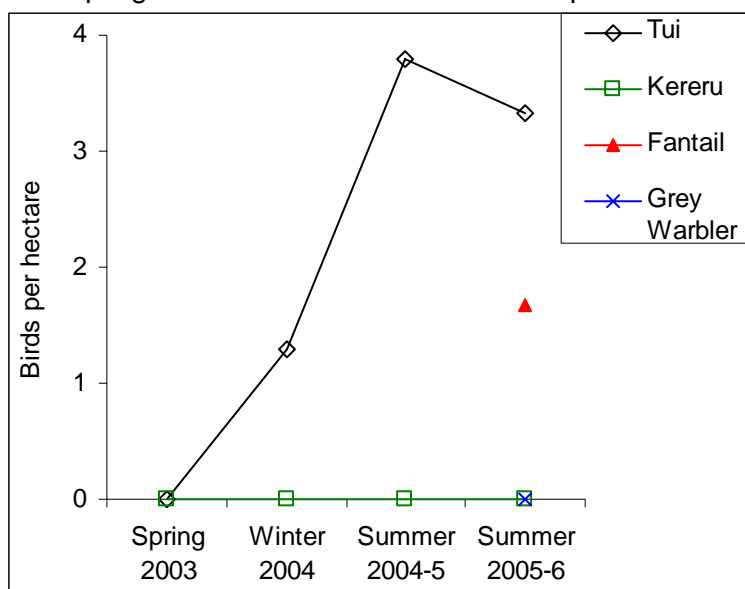
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Tui were not recorded during spring 2003 but were abundant during summer 2004-5 and 05-06
- Kereru were not recorded during any of the four rounds of surveys
- Grey warblers were not recorded during either the five-minute bird counts or the distance sampling in 2005-6
- Fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 0
- Number of wax tags = 0

**Plant communities:**

*Vegetation structure:*

- A total of five species was recorded across all vegetation tiers
- Pohutukawa was present in the canopy and subcanopy whereas *Pittosporum crassifolium* was only in the shrub and subcanopy tiers
- No native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Hebe cultivar.</i>			2			
<i>Phormium tenax</i>			3			
<i>Pittosporum crassifolium</i>			3	2		
<i>Metrosideros excelsa</i>			2	2	3	2
<i>Cupressus macrocarpa*</i>					2	2

*Phenology:*

- At least two species were flowering and two species were fruiting during each of the surveys

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Arthropodium cirratum</i>	Rengarenga				✓		
<i>Coprosma robusta</i>	Karamu	✓	✓				
<i>Hebe</i> sp.	Koromiko			✓			
<i>Macropiper excelsum</i>	Kawakawa	✓					
<i>Metrosideros excelsa</i>	Pohutukawa		✓		✓	✓	✓
<i>Muehlenbeckia complexa</i>	Pohuehue					✓	✓
<i>Phormium tenax</i>	Flax						✓
<i>Pittosporum crassifolium</i>	Karo	✓	✓	✓	✓		✓

**Invertebrate communities:**

- Invertebrate monitoring was not undertaken because the method used is not appropriate for use in open grassland used for recreational purposes

**Site summary:**

The vegetation at Huia Reserve is primarily mown grass but tuis are common due to the planted karos that provide year round food and the mature pohutukawas. Kereru are present in the vicinity of the reserve but there is no habitat suitable for them within the site.

### 3.6 Henderson Valley Scenic Reserve

**Location:** Candia Road, Henderson Valley

**Habitat:** Secondary podocarp-broadleaf forest

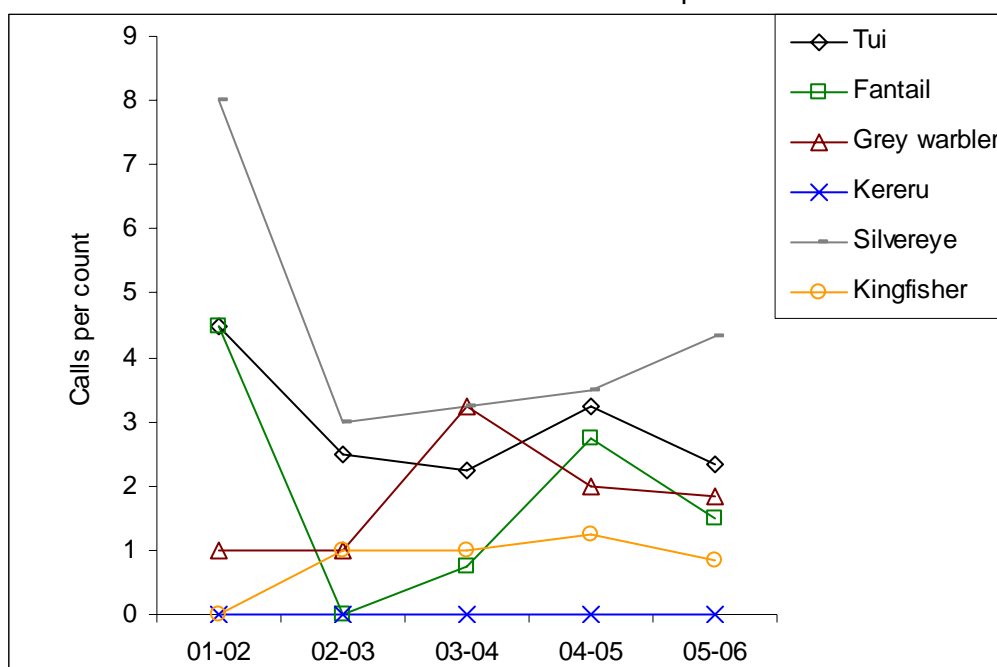
**Recent ecological management actions:** Possum control

**Avifauna:**

*Five-minute bird counts:*

- All species have remained relatively stable during the last few years of surveys
- Kereru have not been recorded

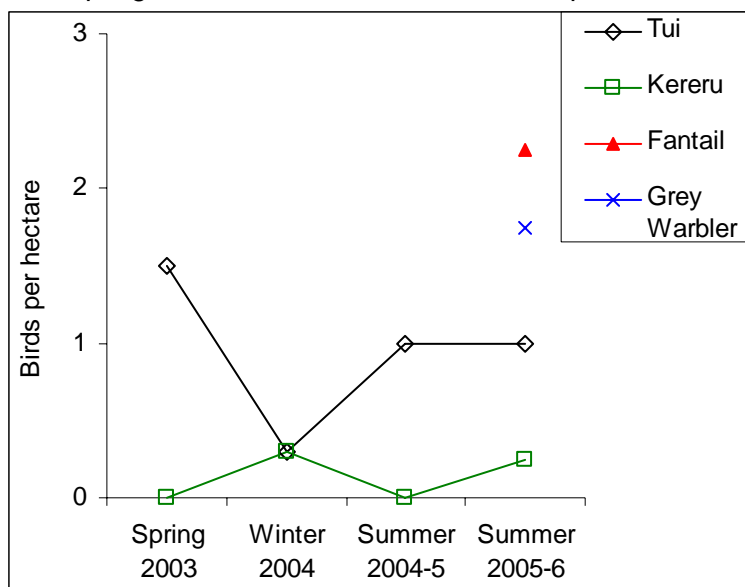
Five-minute count results for native bird indicator species 2001-2 to 2005-6



*Distance sampling:*

- Kereru were recorded during winter 2004 and summer 2005-06
- Tui abundance was lowest during winter 2004 but has been stable during the last two summers
- Grey warblers and fantails were recorded

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	2	40
Possum	2	40
Mustelid	0	0
Hedgehog	0	0

- Number of wax tags = 10

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	2	20
Mouse	1	10
Possum	1	10

**Plant communities:***Vegetation structure:*

- A total of 37 species was recorded across all vegetation tiers
- Twelve native species were present in the subcanopy and six were present in the canopy
- Thirty-four native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>		2	2	2	3	
<i>Alectryon excelsus</i>	2	1				
<i>Alseuosmia macrophylla</i>	2	2	2			
<i>Beilschmiedia tawa</i>	2					
<i>Carpodetus serratus</i>	2	2	2			
<i>Coprosma arborea</i>			1			
<i>Coprosma lucida</i>	2	2	3			
<i>Coprosma rhamnoides</i>	3	3	3			
<i>Coprosma robusta</i>	3	3	3			
<i>Corynocarpus laevigatus</i>	2	2				
<i>Dacrycarpus dacrydioides</i>	3	2	3			
<i>Dacrydium cupressinum</i>	2	2		2	3	
<i>Dicksonia squarrosa</i>		2	3	3		
<i>Geniostoma rupestre</i>	3	3	3	3		
<i>Hedycarya arborea</i>	3	4	3			
<i>Hoheria populnea</i>	2	3	1			
<i>Knightia excelsa</i>	2	2		2	2	
<i>Kunzea ericoides</i>	2	2	2	4	2	
<i>Leucopogon fasciculatus</i>	3	3	3			
<i>Melicytus macrophyllus</i>	3	2	2			
<i>Melicytus ramiflorus</i>	3	3	3	3		
<i>Myrsine salicina</i>			2			
<i>Myrsine australis</i>	3	3	3	3		
<i>Nestegis lanceolata</i>		1		1		
<i>Olearia furfuracea</i>	2	2				
<i>Olearia rani</i>			2			
<i>Phormium cookianum</i>		1				
<i>Phormium tenax</i>	1	1	2			
<i>Phyllocladus trichomanoides</i>	3	2	2	3	2	
<i>Pittosporum tenuifolium</i>	1	1	2			
<i>Podocarpus totara</i>		1	3	2		
<i>Prumnopitys ferruginea</i>		1	1			
<i>Pseudopanax arboreus</i>		2	2			
<i>Pseudopanax crassifolius</i>		2				
<i>Rhopalostylis sapida</i>	3	3	4			
<i>Sophora microphylla</i>	3	2	2	2	3	
<i>Streblus banksii</i>		2				

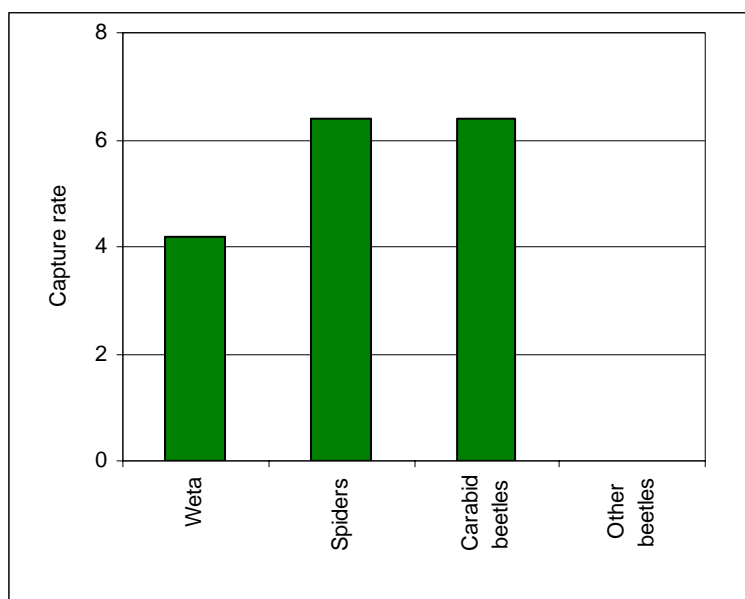
*Phenology:*

- Only mingimingi was flowering during winter 2004
- Only nikau was flowering during summer 2004-5

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Beilschmiedia tawa</i>	Tawa		✓				
<i>Coprosma rhamnoides</i>	Twiggy coprosma	✓			✓		
<i>Geniostoma rupestre</i>	Hangehange	✓	✓				✓
<i>Leucopogon fasciculatus</i>	Mingimingi	✓	✓	✓			
<i>Ligustrum sinense</i> *	Chinese privet						✓
<i>Myrsine australis</i>	Red matipo						✓
<i>Rhopalostylis sapida</i>	Nikau		✓		✓	✓	✓
<i>Ripogonum scandens</i>	Kareao				✓		
<i>Solanum mauritianum</i> *	Woolly nightshade						✓
<i>Sophora microphylla</i>	Kowhai	✓	✓		✓		

**Invertebrate communities:**

- All of the three primary indicator groups were abundant



**Site summary:**

There is very good natural regeneration occurring at Henderson Valley Scenic Reserve. Vegetation composition and structure are diverse. The mature kowhai and titoki along with the regenerating kauri, rimu and kahikatea provide good nesting, roosting and foraging habitat for native forest birds. As the podocarps continue to mature, the site will provide greater food and nesting habitat for birds. All bird species have remained relatively stable during the last few years of surveys. The greater numbers of tui recorded during spring 2003 was probably due to the abundance of kowhai flowers, a food source favoured by tui when available.

The abundance of wetas, spiders and carabid beetles in the invertebrate samples provides further evidence that the site provides high quality habitat. Rats, mice and possums are present at the site. Rodents are likely to be suppressing bird and invertebrate populations while hedgehogs and rats may be suppressing invertebrate and lizard populations. Given the high ecological value of the site's podocarp forest ecosystem, predator control would almost certainly result in substantial measurable benefits for local native fauna communities.

### 3.7 Chorley Reserve / Sunline Park

**Location:** Sunline Avenue, Massey West

**Habitat:** Mamaku-mixed broadleaf forest, intertidal mudflats / mangrove shrubland, pasture/grassland

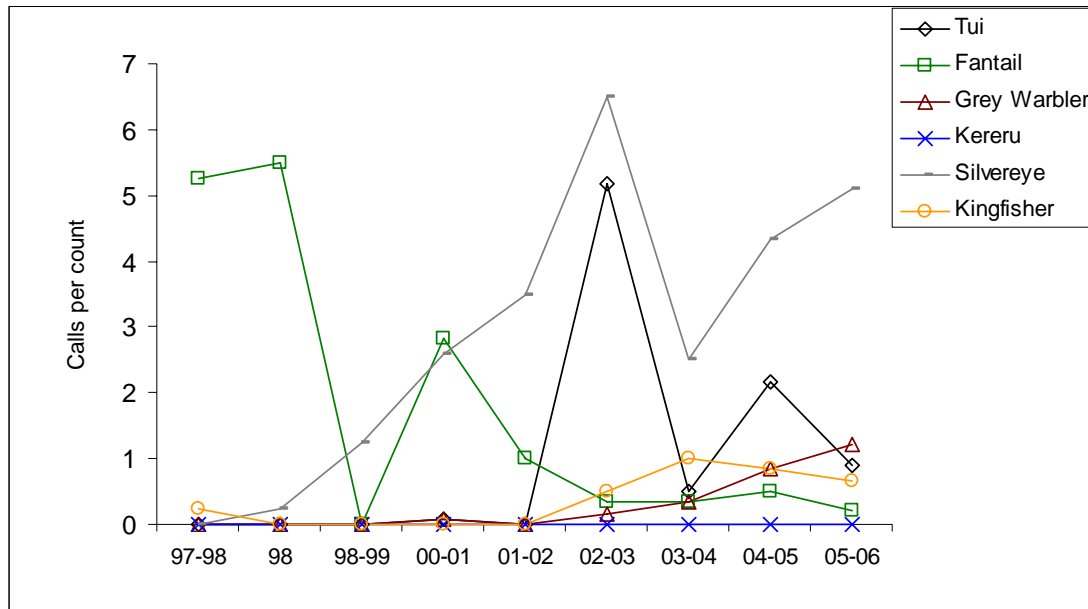
**Recent ecological management actions:** Possum control

**Avifauna:**

*Five-minute bird counts:*

- Tui, conspicuousness has tended to vary erratically from survey to survey
- Since 2001-2, the conspicuousness of grey warblers and kingfishers has increased slightly
- Fantails have remained stable since 02-03

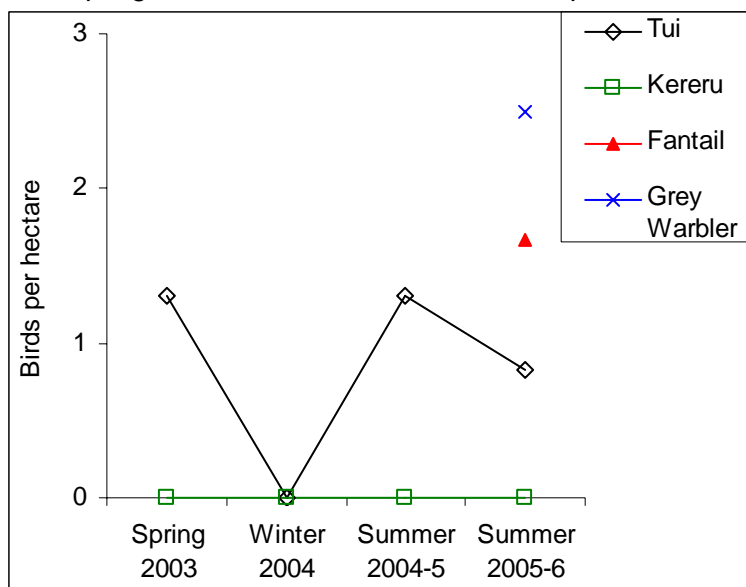
Five-minute count results for native bird indicator species 1997-8 to 2005-6



*Distance sampling:*

- Tui were present during spring 2003, summer 2004-5 and summer 2005-6 but not during winter 2004
- Kereru were not recorded during any survey
- Grey warblers and fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 4

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	1	25
Mouse	1	25
Possum	0	0
Mustelid	0	0
Hedgehog	2	50

- Number of wax tags = 6

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	1	17
Possum	2	33

**Plant communities:***Vegetation structure:*

- A total of 21 species was recorded across all vegetation tiers
- Five native species were present in the subcanopy but *Dacrydium cupressinum* was the only native species in the canopy
- Twelve native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Coprosma robusta</i>		2	3			
<i>Cordyline australis</i>	1		2	3		
<i>Corynocarpus laevigatus</i>		2				
<i>Cyathea medullaris</i>			3	4		
<i>Dacrycarpus dacrydioides</i>			2			
<i>Dacrydium cupressinum</i>					2	
<i>Geniostoma rupestre</i>		3	4			
<i>Kunzea ericoides</i>	2	2	3	3		
<i>Leptospermum scoparium</i>		2	3			
<i>Leucopogon fasciculatus</i>			2			
<i>Ligustrum sinense</i> *	3	2	2			
<i>Melicytus ramiflorus</i>	3	3	3			
<i>Myrsine australis</i>	3	3	4	3		
<i>Phormium tenax</i>			3			
<i>Pinus radiata</i> *					4	
<i>Podocarpus totara</i>		2	2			
<i>Pseudopanax arboreus</i>		3	3	2		
<i>Racosperma mearnsii</i> *				3	2	
<i>Schefflera digitata</i>	2	3	3			
<i>Sophora microphylla</i>			1			
<i>Vitex lucens</i>		3				

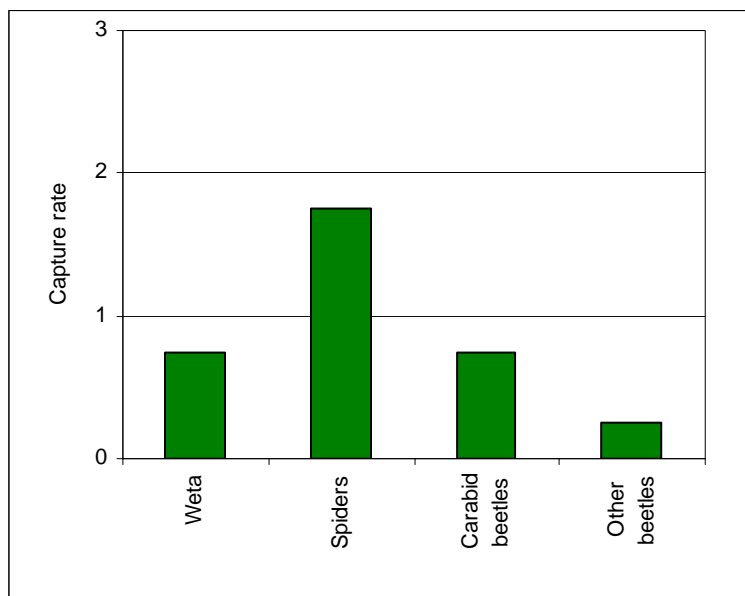
*Phenology:*

- No plants were fruiting during spring 2003, or flowering during summer 2004-5
- Only manuka was fruiting during winter 2004

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma robusta</i>	Karamu	✓					✓
<i>Cordyline australis</i>	Cabbage tree	✓					✓
<i>Geniostoma rupestre</i>	Hangehange	✓					
<i>Leptospermum scoparium</i>	Manuka	✓		✓	✓		✓
<i>Melicytus ramiflorus</i>	Mahoe	✓					✓
<i>Paraserianthes lophantha</i> *	Brush wattle			✓			✓
<i>Ulex europaeus</i> *	Gorse			✓			

**Invertebrate communities:**

- Spiders were the most abundant invertebrate group
- Weta and carabid beetles were both present

**Site summary:**

Chorley Reserve / Sunline Park is an important habitat, containing a diverse range of vegetation communities that are surrounded by dense urban housing. Given its urban context, tui can be quite conspicuous when kowhai and cabbage trees are flowering along the riparian zone. The conspicuousness of grey warblers, silvereyes and kingfishers has improved during the last few years of monitoring. All the invertebrate indicator groups are present and natural regeneration is occurring. There has been some revegetation using *Dacrycarpus dacrydioides* and *Kunzea ericoides* and the biodiversity outcomes for this site could be further enhanced through additional replanting using puriris, flax species and annual possum control.

### 3.8 Shona Esplanade

**Location:** Border Road, Henderson

**Habitat:** Mature and regenerating podocarp-hardwood forest

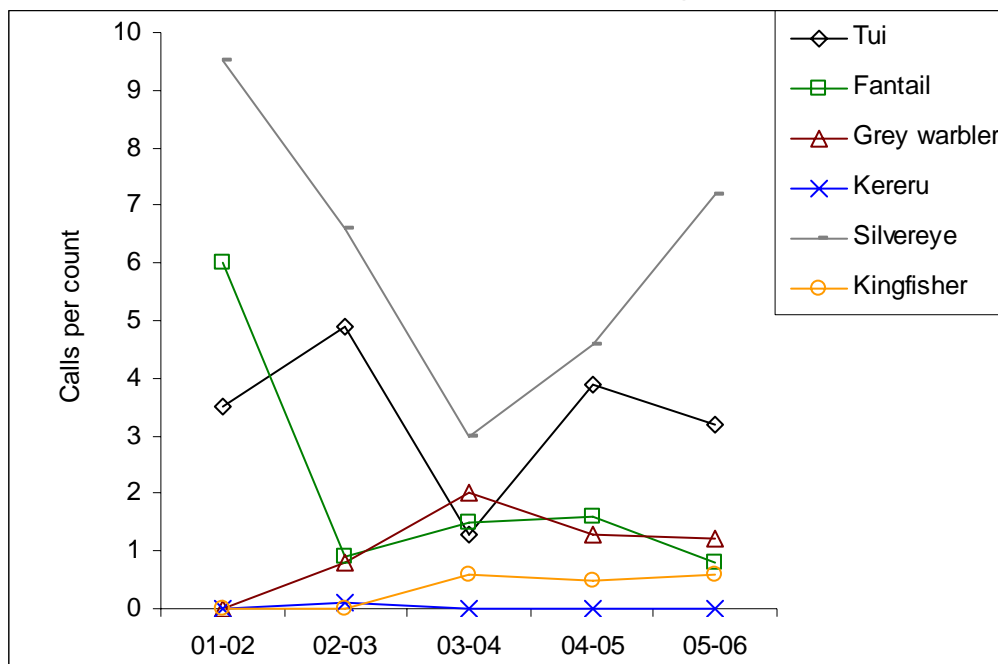
**Recent ecological management actions:** Revegetation, weed control, possum control

**Avifauna:**

*Five-minute bird counts:*

- Kereru were only recorded during 2002-3
- Despite considerable year-to-year fluctuations, the conspicuousness of fantails has declined, tui conspicuousness has remained relatively steady, and grey warblers and kingfishers have become more conspicuous since monitoring began at Shona Esplanade in 2001-2

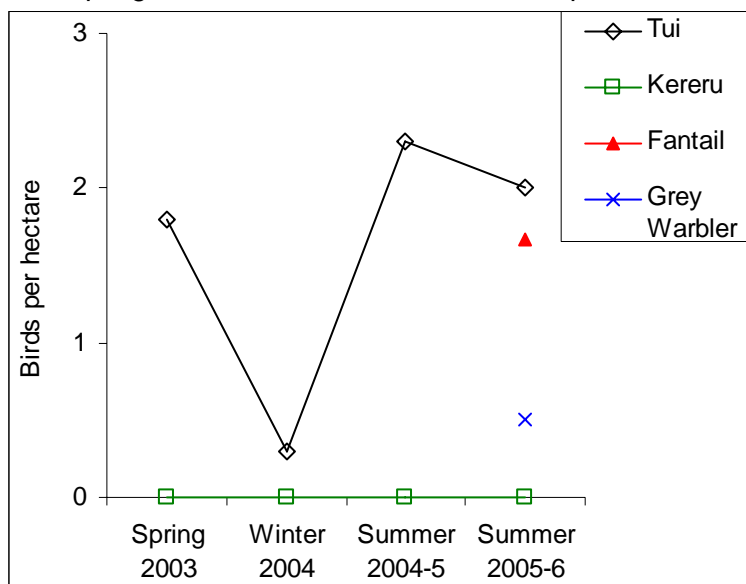
Five-minute count results for native bird indicator species 2001-2 to 2005-6



*Distance sampling:*

- Tui have been recorded during all three surveys with their greatest abundance observed during summer 2004-5 and their lowest abundance recorded during winter 2004
- Kereru were not recorded during any of the four rounds of surveys
- Grey warblers and fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	1	20
Possum	1	20
Mustelid	0	0
Hedgehog	5	100

- Number of wax tags = 7

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	4	57
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 36 species was recorded across all vegetation tiers
- Fourteen native species were present in the subcanopy and 12 were present in the canopy
- Fifteen native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>					2	
<i>Alectryon excelsus</i>	2	2	2	2	2	
<i>Beilschmiedia tawa</i>				3	2	
<i>Brachyglottis repanda</i>			2			
<i>Carpodetus serratus</i>			2			
<i>Coprosma robusta</i>	2	2	3			
<i>Cordyline australis</i>		2	3	2		
<i>Cordyline banksii</i>	1	2	2			
<i>Corynocarpus laevigatus</i>	3	2	2	3	2	
<i>Dacrycarpus dacrydioides</i>					4	
<i>Dicksonia squarrosa</i>			3	3		
<i>Dodonaea viscosa</i>			2			
<i>Geniostoma rupestre</i>	2	2	2			
<i>Hedycarya arborea</i>			3			
<i>Hoheria populnea</i>	2	2	3	2	2	
<i>Knightia excelsa</i>				2	2	
<i>Kunzea ericoides</i>			2	4	2	
<i>Leptospermum scoparium</i>	2	2	4			
<i>Ligustrum lucidum*</i>	2	2	2			
<i>Ligustrum sinense*</i>	2	2	2			
<i>Melicope ternata</i>			2			
<i>Melicytus ramiflorus</i>			4	2		
<i>Myoporum laetum</i>			2			
<i>Myrsine australis</i>	3	2	4	2		
<i>Nestegis lanceolata</i>				1	1	
<i>Nothofagus truncata</i>			2			
<i>Pittosporum crassifolium</i>	1	1	2			
<i>Pittosporum eugenioides</i>			2			
<i>Pittosporum tenuifolium</i>	2	2	3	1		
<i>Plagianthus regius</i>		2	3	1		
<i>Podocarpus totara</i>					3	
<i>Prumnopitys taxifolia</i>					2	
<i>Rhopalostylis sapida</i>		2	3			
<i>Sophora microphylla</i>	2	2	2	3	3	
<i>Streblus banksii</i>			2			
<i>Vitex lucens</i>		2	2			

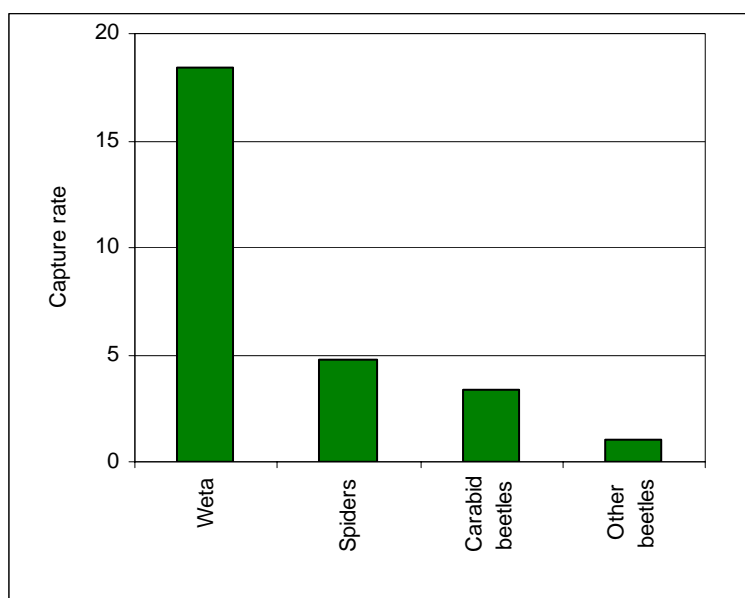
*Phenology:*

- Manuka was the only species recorded flowering during winter 2004
- At least three species were fruiting during each of the three surveys

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Agathis australis</i>	Kauri					✓	
<i>Alectryon excelsus</i>	Titoki		✓		✓		
<i>Coprosma robusta</i>	Karamu	✓	✓				✓
<i>Cordyline australis</i>	Cabbage tree						✓
<i>Corynocarpus laevigatus</i>	Karaka	✓					
<i>Dacrycarpus dacrydioides</i>	Kahikatea	✓					
<i>Hoheria populnea</i>	Lacebark		✓		✓		
<i>Kunzea ericoides</i>	Kanuka					✓	✓
<i>Leptospermum scoparium</i>	Manuka	✓	✓	✓	✓		✓
<i>Melictyus ramiflorus</i>	Mahoe	✓				✓	
<i>Nothofagus truncata</i>	Hard beech	✓				✓	
<i>Sophora microphylla</i>	Kowhai	✓	✓				

**Invertebrate communities:**

- Weta were especially abundant with capture rates over four times greater at Shona Esplanade than at any other site
- Spiders and carabid beetles were also relatively abundant



**Site summary:**

Shona Esplanade harbours one of the larger areas of mature and regenerating podocarp-hardwood forest (9.63 hectares) within urban areas of Waitakere City. The mature vegetation which includes titoki, karaka, kowhai and kahikatea are an exceptionally important component of the City’s biodiversity. All indicator bird species including kereru have been detected. While kereru were not detected during distance

sampling, and barely featured in the five-minute counts, they were observed at the site on other occasions. For example, they were observed between five-minute bird counts during summer 2003-4, and a pair of adults was observed roosting in a large kahikatea at the site during winter 2004. A small number of kereru (possibly only one or two pairs) utilise the network of reserves along the Opanuku Stream from Palomino Esplanade to Henderson Park, including Plummer Domain. The kereru utilise the large remnant podocarp trees (e.g., kahikatea and totara) as food sources and as roosting and nesting sites. Given that kereru play a vital role in the dispersal of the seeds of many native trees, areas with large podocarps should be targeted for annual predator control aimed at protecting kereru and other native fauna.

The abundance of weta and carabid beetles recorded in the invertebrate samples indicates that a well developed leaf litter is present at the site. There has been considerable weed control and revegetation at Shona Esplanade. However, possums are present. Given the high ecological value of the site's podocarp forest ecosystem, continuing to control predators would almost certainly result in substantial measurable benefits for local native fauna and flora communities.

### 3.9 Tram Valley Road

**Location:** Tram Valley Road, Swanson

**Habitat:** Secondary podocarp-broadleaf forest

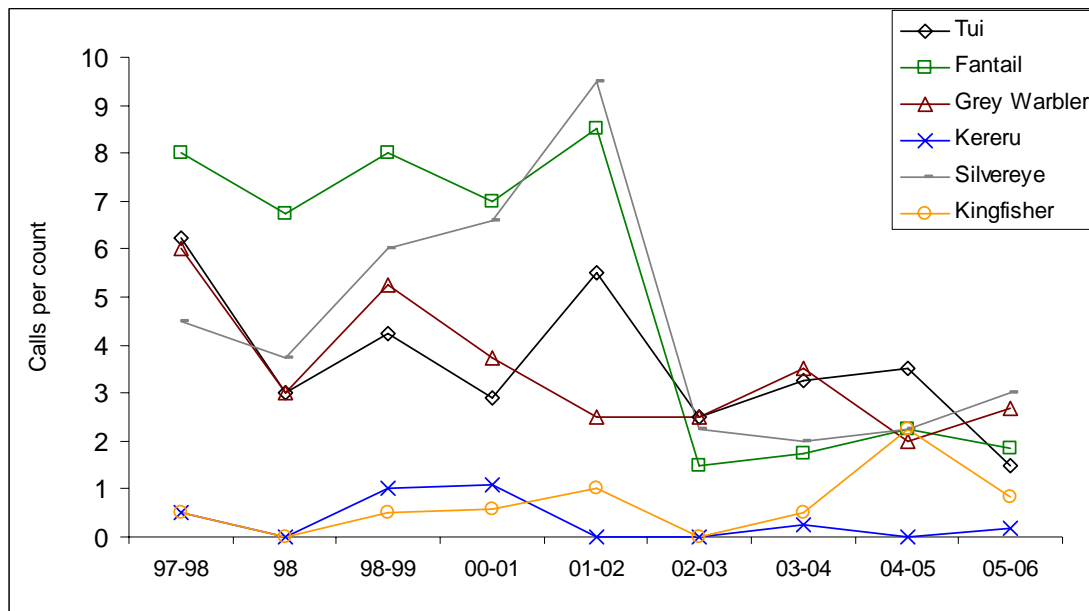
**Recent ecological management actions:** Possum control (Operation ForestSave)

**Avifauna:**

*Five-minute bird counts:*

- Dramatic declines in bird conspicuousness were recorded during 2002-3
- Since 2002-3, the conspicuousness of most species has remained steady although subtle increases were seen in fantails and grey warblers
- Kereru have been recorded sporadically in five-minute counts but only twice since 2000-1

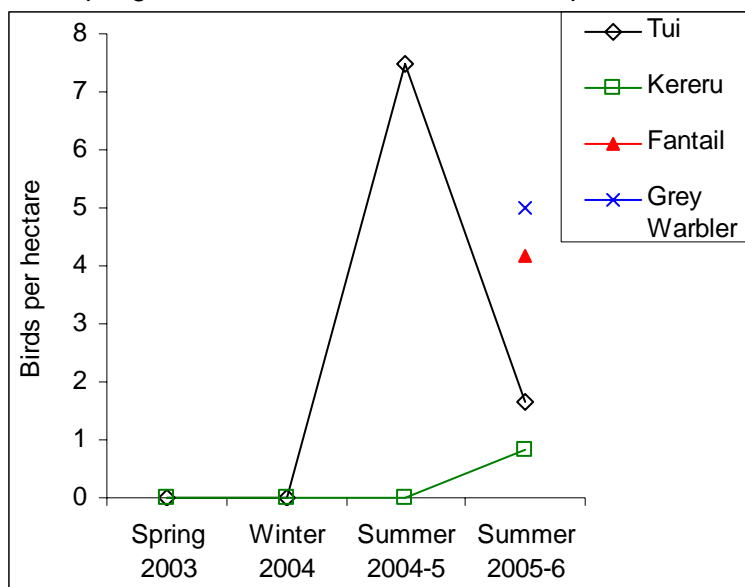
Five-minute count results for native bird indicator species 1997-8 to 2005-6



*Distance sampling:*

- Tui were recorded during summer 2004-5 at which time they were very abundant but were less conspicuous during 2005-6
- Kereru were recorded for the first time during summer 2005-06
- Grey warblers and fantails were common

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	1	20
Possum	0	0
Mustelid	0	0
Hedgehog	5	100

- Number of wax tags = 9

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	1	11
Mouse	3	33
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 20 species was recorded across all vegetation tiers
- Seven native species were present in the subcanopy, six native species were present in the canopy, and kauri was emergent over the canopy
- Twelve native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>	3				4	3
<i>Carpodetus serratus</i>	2	2	3			
<i>Coprosma areolata</i>			3			
<i>Coprosma grandifolia</i>			3			
<i>Coprosma lucida</i>			3			
<i>Coprosma robusta</i>	4	3	4			
<i>Cyathea medullaris</i>				2	2	
<i>Dacrycarpus dacrydioides</i>	3			2	2	
<i>Dacrydium cupressinum</i>				2	3	
<i>Dicksonia squarrosa</i>				3		
<i>Geniostoma rupestre</i>	4	4	4			
<i>Knightia excelsa</i>				2	3	
<i>Kunzea ericoides</i>	3	3	4	4	3	
<i>Leucopogon fasciculatus</i>	2	2				
<i>Melicytus ramiflorus</i>	3	3	4			
<i>Myrsine australis</i>	4	4	4			
<i>Olearia rani</i>	2	2				
<i>Phyllocladus trichomanoides</i>	3					
<i>Pittosporum tenuifolium</i>			2			
<i>Rhopalostylis sapida</i>	1	1	3	3		

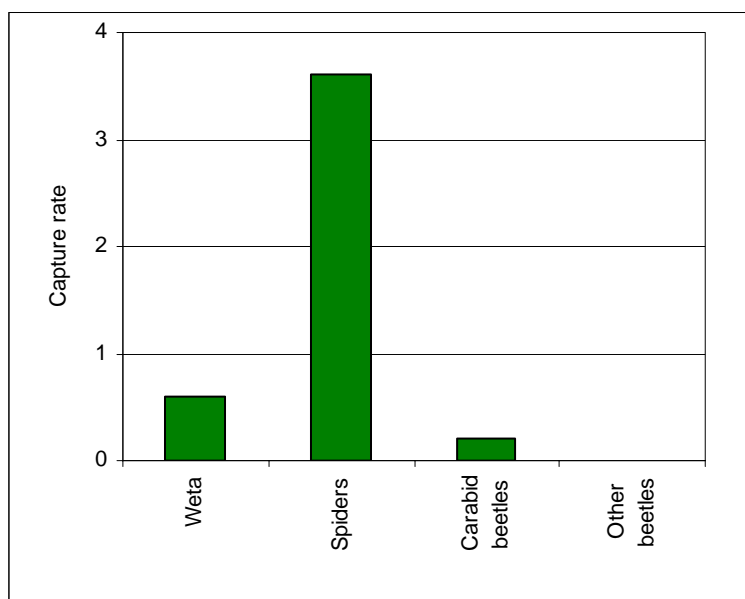
*Phenology:*

- Two species were flowering during winter 2004 and another two were flowering during summer 2004-5
- At least three species were fruiting during each survey

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma grandifolia</i>	Raurekau				✓		✓
<i>Coprosma robusta</i>	Karamu	✓	✓				✓
<i>Geniostoma rupestre</i>	Hangehange	✓	✓	✓			✓
<i>Kunzea ericoides</i>	Kanuka					✓	✓
<i>Leucopogon fasciculatus</i>	Mingimingi			✓			✓
<i>Melicytus ramiflorus</i>	Mahoe	✓				✓	
<i>Myrsine australis</i>	Red matipo				✓		✓
<i>Olearia rani</i>	Heketara	✓					
<i>Schefflera digitata</i>	Pate				✓		

**Invertebrate communities:**

- Spiders were the most abundant of the invertebrate groups
- Weta and carabid beetles were present but not common

**Site summary:**

Tram Valley Road is contiguous with a large block of the northern Waitakere Ranges forest. However, the site is dominated by young secondary podocarp-broadleaf forest and tui and kereru are often observed flying over the site rather than foraging within it. Dramatic declines in bird conspicuousness were recorded during 2002-3 but since 2002-3, the conspicuousness of most species has remained steady although subtle increases were seen in fantails and grey warblers and both bird species are common within the site. Due to the ARC's possum control through Operation ForestSave, no possums were recorded at the site. Tram Valley Road reserve is completely forested and replanting is not required.

### 3.10 Gill Esplanade

**Location:** Landing Road, Laingholm

**Habitat:** Marine tidal flats, mangrove shrubland

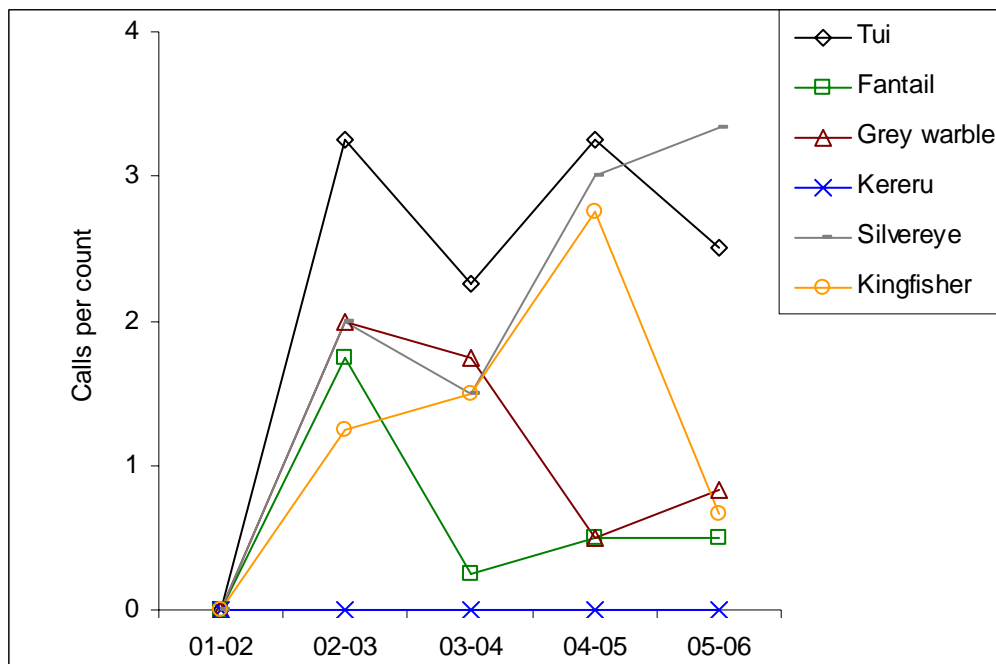
**Recent ecological management actions:** Revegetation

#### Avifauna:

##### *Five-minute bird counts:*

- Tui and kingfisher were less abundant during summer 2005-6 than they had been during the previous summer
- Grey warbler and fantail have remained stable during the past two summer surveys
- Kereru were not recorded during five-minute counts

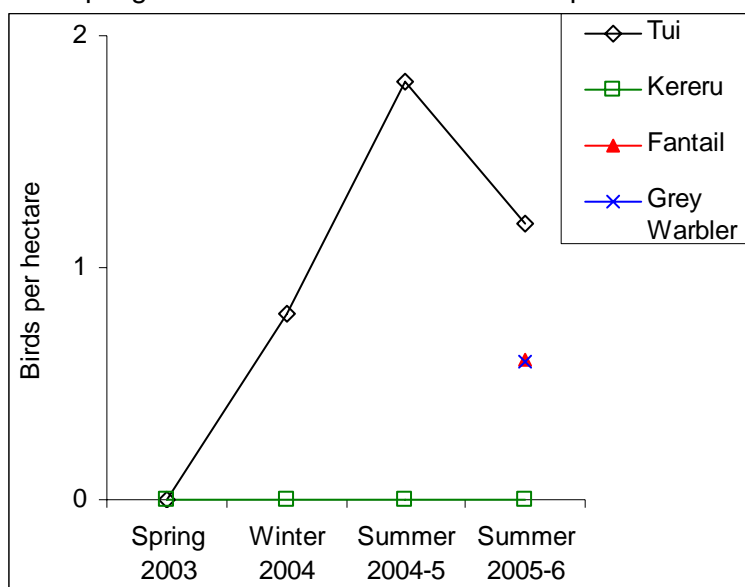
Five-minute count results for native bird indicator species 2001-2 to 2005-6



*Distance sampling:*

- Neither tui or kereru were recorded during the first distance sampling survey
- Kereru were not detected in subsequent surveys either
- Tui were most abundant during summer 2004-5
- Grey warblers and fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	2	40
Mouse	5	100
Possum	0	0
Mustelid	0	0
Hedgehog	0	0

- Number of wax tags = 5

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	4	80
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 14 species were recorded across all vegetation tiers
- No native species were present in the canopy or subcanopy tiers
- Nine native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Avicennia marina</i>	4	4	4			
<i>Coprosma robusta</i>	2	2	2			
<i>Cordyline australis</i>			2			
<i>Cyathea medullaris</i>			3			
<i>Dicksonia squarrosa</i>			2			
<i>Kunzea ericoides</i>	1	2	2			
<i>Leptocarpus similis</i>		3				
<i>Leptospermum scoparium</i>	2	2	2			
<i>Melicytus ramiflorus</i>	1	1	2			
<i>Myrsine australis</i>	2	2	2			
<i>Phormium tenax</i>	2	2	2			
<i>Plagianthus divaricatus</i>	2	2	2			
<i>Pseudopanax arboreus</i>			2			
<i>Schefflera digitata</i>			2			

*Phenology:*

- Apart from mangroves, no species were flowering or fruiting during spring 2003
- At least two species were flowering and at least two species were fruiting during the winter 2004 and summer 2004-5 surveys

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Avicennia marina</i>	Mangrove		✓				
<i>Coprosma robusta</i>	Karamu				✓		✓
<i>Dianella nigra</i>	Turutu						✓
<i>Ipomoea indica</i> *	Morning glory					✓	
<i>Kunzea ericoides</i>	Kanuka						✓
<i>Lonicera japonica</i> *	Japanese honeysuckle			✓	✓	✓	
<i>Phormium tenax</i>	Flax					✓	✓
<i>Plagianthus divaricatus</i>	Makaka						✓
<i>Ulex europaeus</i> *	Gorse			✓			

**Invertebrate communities:**

- Invertebrate monitoring was not undertaken because the method used is not appropriate for use in tidal mudflats

**Site summary:**

The habitat at Gill Esplanade consists primarily of high quality marine tidal flats and mangrove shrubland and this is why there are no native species present in the canopy or subcanopy tiers. Kereru are present in forest adjacent to Gill Esplanade

and tui are observed at the site when flax is flowering. The replanting along the riparian zone is becoming well established.

### 3.11 Swanson Scenic Reserve

**Location:** Swanson Road, Swanson

**Habitat:** Secondary kauri-kanuka forest

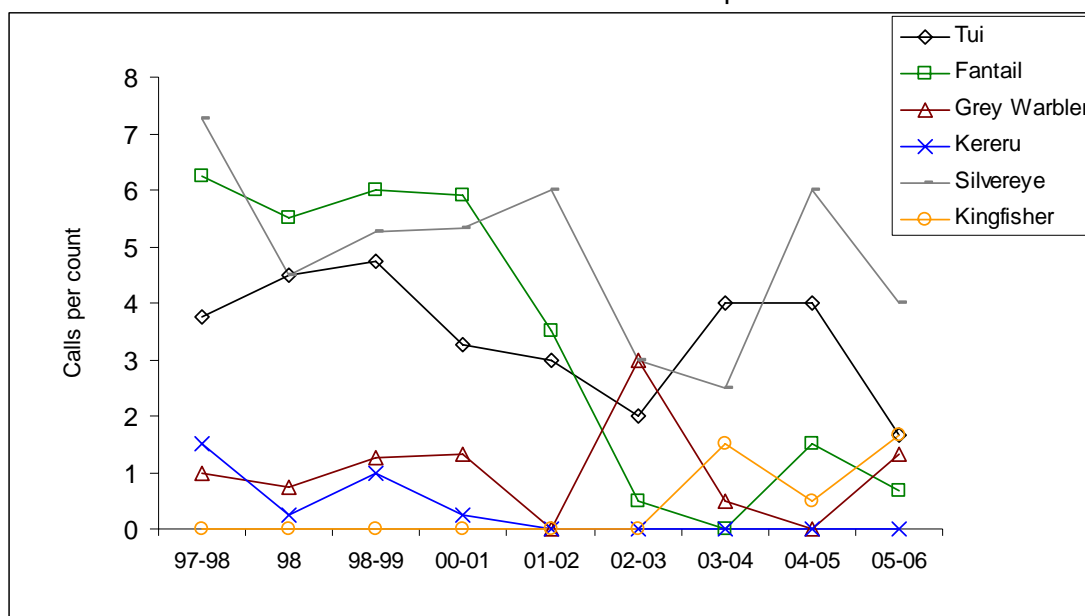
**Recent ecological management actions:** Possum control

**Avifauna:**

*Five-minute bird counts:*

- Kereru were present during every survey from 1997 to summer 2001-2 but have not been recorded since
- Kingfishers were first recorded during 2003-4 and have increased since
- Fantail conspicuousness declined dramatically from 2001-2 until 2003-4 but increased slightly in 2004-5
- The conspicuousness of tui and silvereyes varied dramatically from survey to survey but during 2004-5 counts were similar to when monitoring commenced
- During 2005-2006 tui counts were at their lowest since monitoring began

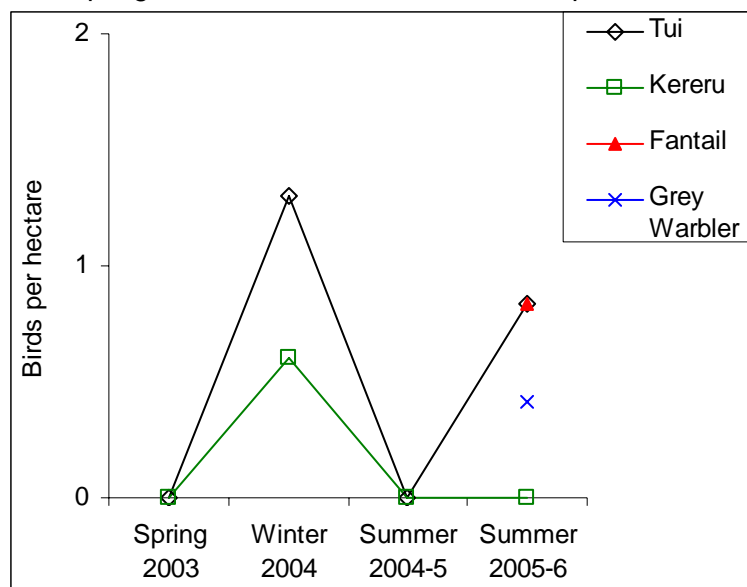
Five-minute count results for native bird indicator species 1997-8 to 2005-6



*Distance sampling:*

- Tui and kereru were recorded during winter 2004 but neither were recorded during spring 2003 or summer 2004-5
- Tui were present during summer 2005-2006
- Grey warblers and fantails were present

Distance sampling results for native bird indicator species 2003 to 2004-5



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	2	40
Mouse	4	80
Possum	1	20
Mustelid	0	0
Hedgehog	0	0

- Number of wax tags = 2

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	1	50
Mouse	1	50
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 26 species was recorded across all vegetation tiers
- Thirteen native species were present in the subcanopy, six were present in the canopy, and some rimu were emergent above the canopy
- Nine native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>				2	3	
<i>Beilschmiedia tawa</i>				2	2	
<i>Carpodetus serratus</i>			2	3		
<i>Coprosma grandifolia</i>			3			
<i>Coprosma lucida</i>			2			
<i>Coprosma rhamnoides</i>		2	3			
<i>Coprosma robusta</i>	2	2	3			
<i>Cordyline australis</i>		2	3			
<i>Cyathea medullaris</i>			3	3		
<i>Dacrycarpus dacrydioides</i>				2	3	2
<i>Dacrydium cupressinum</i>				2		
<i>Dicksonia squarrosa</i>			3	2		
<i>Geniostoma rupestre</i>	2	2	3			
<i>Hedycarya arborea</i>		3	3			
<i>Knightia excelsa</i>				3		
<i>Kunzea ericoides</i>				3	2	
<i>Leucopogon fasciculatus</i>	2	2	3			
<i>Ligustrum sinense*</i>	3	3	3			
<i>Melicytus ramiflorus</i>	2	2	3	2		
<i>Myrsine australis</i>	2	2	3	3		
<i>Pinus radiata*</i>					3	3
<i>Pittosporum tenuifolium</i>			3			
<i>Pseudopanax crassifolius</i>		2	2			
<i>Rhopalostylis sapida</i>			3	3		
<i>Sophora fulvida</i>			2	2		
<i>Vitex lucens</i>					3	

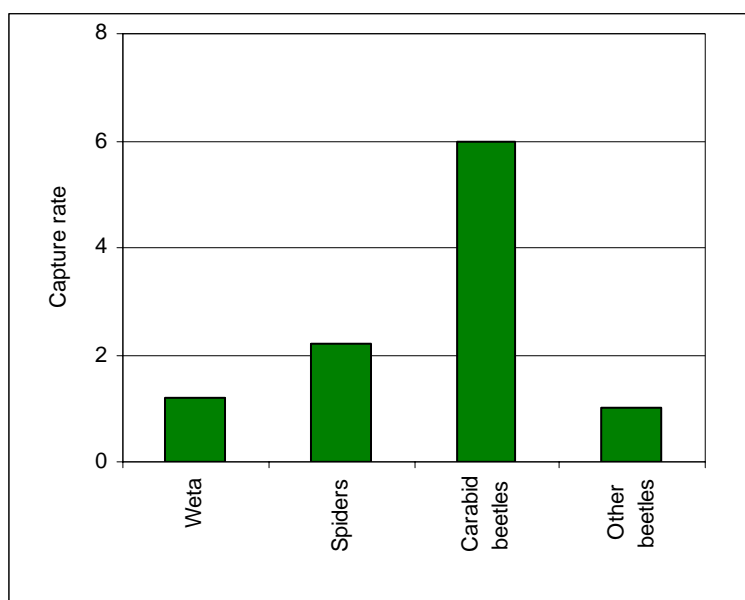
*Phenology:*

- At least two species were flowering during each survey
- At least three species were fruiting during each survey

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Carpodetus serratus</i>	Putaputaweta			✓	✓		
<i>Coprosma lucida</i>	Shining karamu	✓	✓				
<i>Coprosma rhamnoides</i>	Twiggy Coprosma	✓					
<i>Coprosma robusta</i>	Karamu	✓	✓				✓
<i>Cordyline australis</i>	Cabbage tree	✓					✓
<i>Geniostoma rupestre</i>	Hangehange			✓			✓
<i>Kunzea ericoides</i>	Kanuka					✓	
<i>Leucopogon fasciculatus</i>	Mingimingi			✓			
<i>Ligustrum sinense</i> *	Chinese privet				✓		✓
<i>Meliccytus ramiflorus</i>	Mahoe	✓				✓	
<i>Myrsine australis</i>	Red matipo				✓		✓
<i>Pittosporum tenuifolium</i>	Kohuhu	✓			✓		
<i>Sophora microphylla</i>	Kowhai	✓	✓		✓		✓
<i>Ulex europaeus</i> *	Orse			✓			

**Invertebrate communities:**

- All indicator groups were present
- Carabid beetles were abundant while spiders and weta were common



**Site summary:**

Swanson Scenic Reserve is comprised of a riparian strip along the southern bank of Swanson Stream. The site's vegetation is dominated by tall kanuka, naturally regenerating young native forest, scattered exotic trees (pines and macrocarpas) and approximately 50% of the site is mown recreational reserve. All of the indicator native

bird species except for kereru are present at Swanson Scenic Reserve. Kereru were recorded during every survey from 1997 to summer 2001-2 but have not been noted since. While the vegetation of the sampling site alone does not constitute ideal habitat for kereru, the site is contiguous with larger areas of native forest on private and council land on the northern side of the stream. The collective area of native forest in the vicinity of the sampling site is sufficient to support kereru and other native fauna.

Despite the presence of *Tradescantia* and *Ligustrum sinense* over some of the site, there is a good functioning leaf litter cover and as such, all invertebrate indicator groups were present with carabid beetles abundant. Rats mice and possums are all present at the site and ecological improvements at the site would be enhanced if they were effectively controlled during the bird breeding season.

### 3.12 Lowtherhurst Reserve

**Location:** Lowtherhurst Road, Massey East

**Habitat:** Secondary kanuka-broadleaf forest

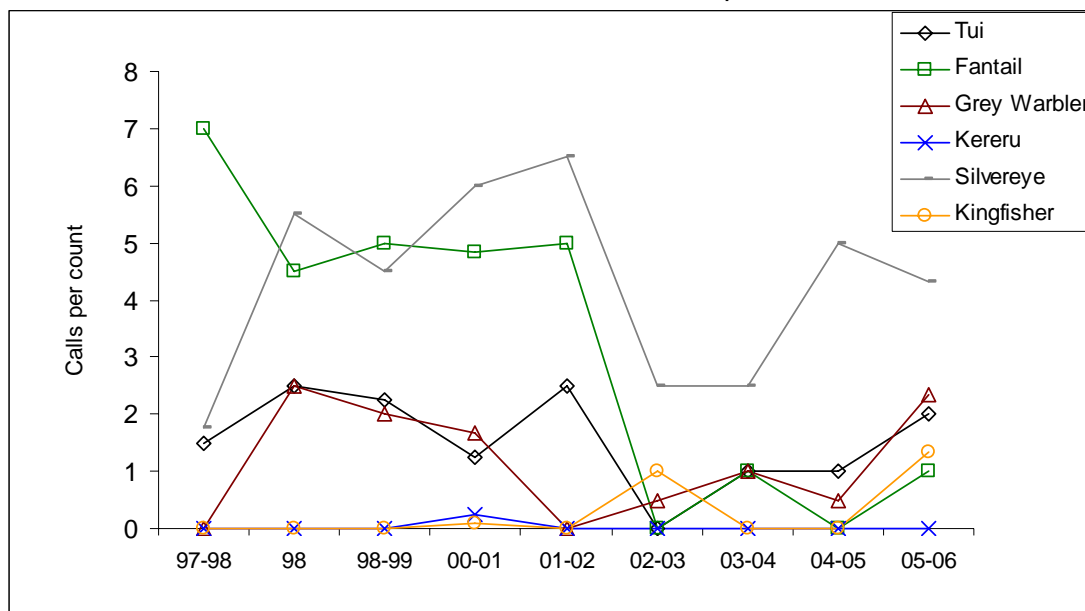
**Recent ecological management actions:** None

**Avifauna:**

*Five-minute bird counts:*

- Fantail conspicuousness has declined dramatically since monitoring commenced
- Kereru were only recorded during summer 2000-1
- During the 2004-5 survey, all native bird species other than silvereyes were relatively inconspicuous but silvereyes have recovered slightly during 2005-06

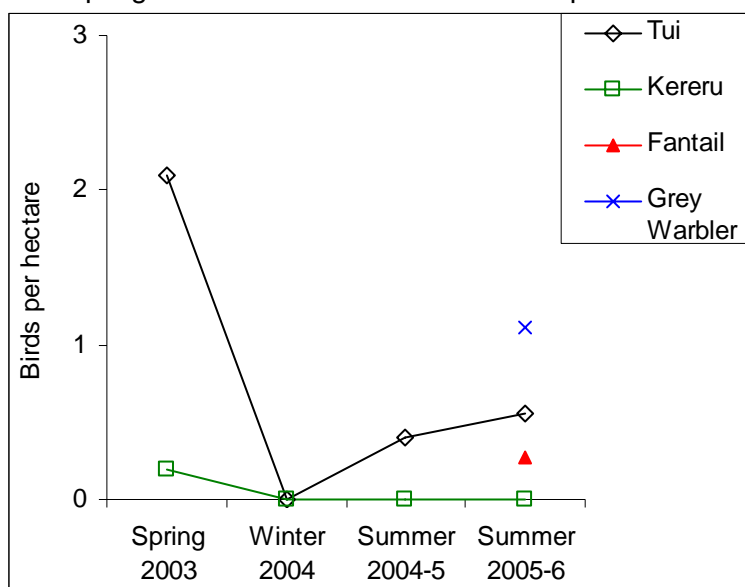
Five-minute count results for native bird indicator species 1997-8 to 2005-6



*Distance sampling:*

- Kereru were recorded during spring 2003 but have not been recorded since
- Tui were abundant during the spring 2003 survey but were not recorded during winter 2004 survey but their abundance has been recovering since
- Fantails were present, although scarce
- Grey warblers were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	4	80
Mouse	2	40
Possum	0	0
Mustelid	0	0
Hedgehog	1	20

- Number of wax tags = 4

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	2	50
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 25 species was recorded across all vegetation tiers
- Six native species were present in the subcanopy and seven were present in the canopy
- Eight native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>					3	
<i>Alectryon excelsus</i>				2		
<i>Avicennia marina</i>			4			
<i>Beilschmiedia tawa</i>					3	
<i>Coprosma areolata</i>			3			
<i>Coprosma robusta</i>	3	3				
<i>Cordyline australis</i>				3		
<i>Coriaria arborea</i>			2			
<i>Corynocarpus laevigatus</i>					3	
<i>Cyathea medullaris</i>				3		
<i>Dacrycarpus dacrydioides</i>						
<i>Dysoxylum spectabile</i>				2		
<i>Geniostoma rupestre</i>			4			
<i>Hedycarya arborea</i>	2	2				
<i>Knightia excelsa</i>		2			3	
<i>Kunzea ericoides</i>	3			3	3	
<i>Leucopogon fasciculatus</i>	2		3			
<i>Macropiper excelsum</i>			3			
<i>Melicytus ramiflorus</i>			4			
<i>Metrosideros perforata</i>			2			
<i>Myrsine australis</i>	3		4			
<i>Nestegis lanceolata</i>	1				1	
<i>Pittosporum tenuifolium</i>		2	2			
<i>Sophora microphylla</i>					3	
<i>Weinmannia silvicola</i>			1	2		

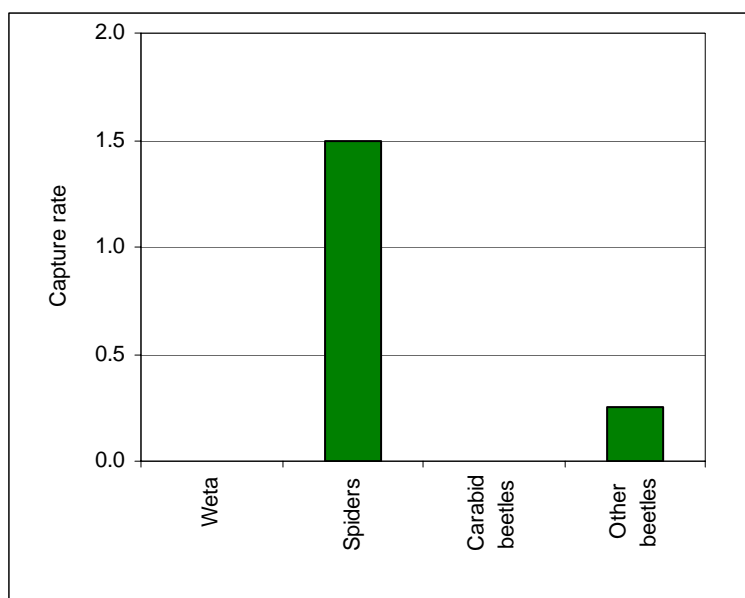
*Phenology:*

- At least four species were recorded flowering or fruiting except during winter 2004 when only red matipo was fruiting, and during summer 2004-5 when Japanese honeysuckle was the only species flowering

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma robusta</i>	Karamu	✓	✓				✓
<i>Coriaria arborea</i>	Tutu			✓			
<i>Geniostoma rupestre</i>	Hangehange	✓					✓
<i>Hedycarya arborea</i>	Pigeonwood		✓				
<i>Knightia excelsa</i>	Rewarewa		✓				
<i>Kunzea ericoides</i>	Kanuka			✓			
<i>Leucopogon fasciculatus</i>	Mingimingi	✓	✓	✓			✓
<i>Lonicera japonica*</i>	Japanese honeysuckle					✓	
<i>Metrosideros perforata</i>	Akatea			✓			
<i>Myrsine australis</i>	Red matipo				✓		✓
<i>Pittosporum tenuifolium</i>	Kohuhu	✓	✓				
<i>Sophora microphylla</i>	Kowhai	✓					
<i>Weinmannia silvicola</i>	Towai		✓				

**Invertebrate communities:**

- Weta and carabid beetles were not recorded
- Spiders were present



**Site summary:**

Lowtherhurst Reserve contains a significant remnant of regenerating kauri- kanuka- broadleaf forest. The mature kowhai, towai, tawa and karaka provide a vital resource for native birds. Given the quality of the vegetation at the site, it could be anticipated that native birds would be more conspicuous and that all the invertebrate indicator

groups would be common. Unfortunately this is not the case. Furthermore, fantail conspicuousness has declined dramatically since monitoring commenced. Eighty percent of tracking tunnels contained rat tracks and rodents are likely to be suppressing populations of birds, invertebrates and lizards. The abundance of native birds susceptible to predation by rats (e.g., fantail and grey warbler) would almost certainly increase if a rodent control programme was initiated at the site.

### 3.13 Warner Park

**Location:** Laingholm Drive, Laingholm

**Habitat:** Regenerating coastal forest, marine tidal flats

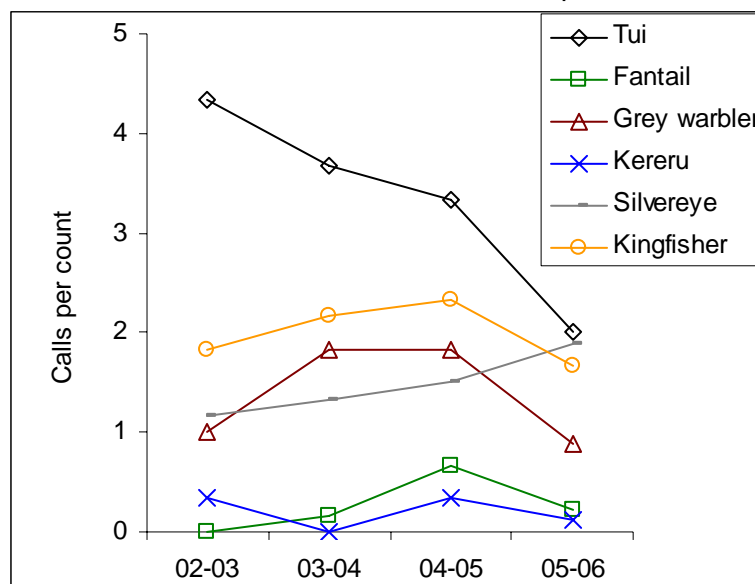
**Recent ecological management actions:** Possum control

#### Avifauna:

*Five-minute bird counts:*

- Tui conspicuousness has declined over the three years of monitoring but they are still the most conspicuous native bird species
- Kereru were recorded during 2002-3, 2004-5 and 2005-06
- The conspicuousness of all native bird species except silvereyes was reduced compared to 04-05

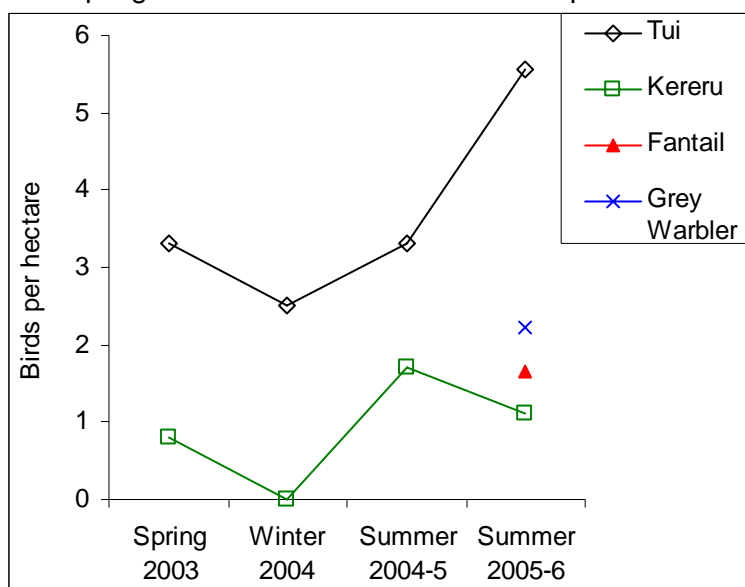
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Tui were abundant during all four distance sampling surveys
- Kereru were present during the spring 2003 and summer 2005-6 survey but were more abundant during the 2004-5 survey
- Kereru were not recorded during the winter 2004 survey
- Grey warblers and fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	3	60
Mouse	2	40
Possum	0	0
Mustelid	0	0
Hedgehog	4	80

- Number of wax tags = 9

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	4	44
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 30 species was recorded across all vegetation tiers
- Seventeen native species were present in the subcanopy and 13 were present in the canopy
- Nineteen native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>				2	4	
<i>Alseuosmia macrophylla</i>			2			
<i>Beilschmiedia tawa</i>	2	2	2	2	2	
<i>Brachyglottis repanda</i>	2	3	3			
<i>Coprosma arborea</i>		1	2	2		
<i>Coprosma areolata</i>		2	2			
<i>Coprosma rhamnoides</i>		2	3			
<i>Coprosma robusta</i>	4	3	4	4		
<i>Coprosma spathulata</i>		2	2			
<i>Corynocarpus laevigatus</i>		2	3	3	3	
<i>Cyathea medullaris</i>			2			
<i>Dacrycarpus dacrydioides</i>				2	4	
<i>Dacrydium cupressinum</i>				2	2	
<i>Dicksonia squarrosa</i>			3			
<i>Dysoxylum spectabile</i>		2	3	4	3	
<i>Geniostoma rupestre</i>	3	4	4			
<i>Hedycarya arborea</i>	2	2	2	2		
<i>Hoheria populnea</i>		2	2			
<i>Knightia excelsa</i>				3	3	
<i>Kunzea ericoides</i>	3	3	3	3	4	
<i>Leucopogon fasciculatus</i>	3	3	3	2		
<i>Macropiper excelsum</i>	3	3	3			
<i>Melicytus ramiflorus</i>			3			
<i>Metrosideros excelsa</i>					3	
<i>Myrsine australis</i>	3	3	4	4		
<i>Olearia furfuracea</i>			2			
<i>Podocarpus totara</i>	2	2		1	2	
<i>Rhopalostylis sapida</i>		3	4	3	2	
<i>Sophora chathamica</i>	3	4	2	3	3	
<i>Vitex lucens</i>				3	3	

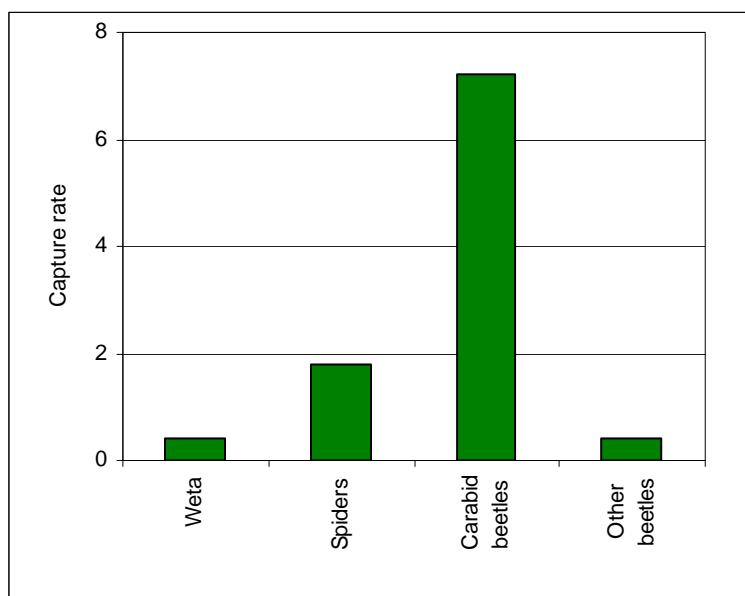
*Phenology:*

- No flowering of any species was observed during summer 2004-5
- Two or more species were fruiting during each of the three surveys

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Brachyglottis repanda</i>	Rangiora		✓				
<i>Coprosma rhamnoides</i>	Twiggy Coprosma		✓		✓		
<i>Coprosma robusta</i>	Karamu			✓			✓
<i>Coprosma spathulata</i>				✓			
<i>Corynocarpus laevigatus</i>	Karaka	✓					✓
<i>Dysoxylum spectabile</i>	Kohekohe			✓			✓
<i>Geniostoma rupestre</i>	Hangehange	✓					✓
<i>Hedycarya arborea</i>	Pigeonwood		✓				
<i>Knightia excelsa</i>	Rewarewa	✓					
<i>Leucopogon fasciculatus</i>	Mingimingi	✓	✓				
<i>Myrsine australis</i>	Red matipo				✓		✓
<i>Olearia furfuracea</i>	Akepiro		✓				
<i>Rhopalostylis sapida</i>	Nikau		✓				
<i>Sophora chathamica</i>	Kowhai	✓	✓				
<i>Vitex lucens</i>	Puriri	✓		✓			✓

**Invertebrate communities:**

- Carabid beetles were the most abundant indicator group followed by spiders
- Weta were present but scarce as were non-carabid beetles



**Site summary:**

Warner Park contains coastal regenerating forest with a diverse range of native flora and fauna. The site's shape, vegetation characteristics, rural location and close proximity to the Waitakere Ranges mean that the negative ecological pressures occurring at many of the other monitoring sites are much lower at Warner Park. The native bird indicator monitoring has confirmed the expected ecological qualities with most species more stable than at other monitoring sites. Kereru have been recorded during three of the four years of monitoring. Distance sampling has shown that tui population density has increased despite a decline in tui conspicuousness apparent in the five-minute bird count data.

Warner Park is entirely covered in secondary growth coastal forest with all vegetation tiers present. There is a high level of native plant diversity in all tiers. As a result, there is good availability of habitat and food sources for native birds and other fauna. The adjoining tidal flats are a valuable feeding ground for indigenous coastal birds such as oystercatchers and pied stilts. The presence of all four terrestrial invertebrate indicator groups further demonstrates the site's significant ecological qualities and functioning ecological processes.

Rodents and hedgehogs are abundant at Warner Park. Given the ecological importance of the site, a predator control programme is required. Possum control alone will protect the vegetation and reduce predation by some degree. However, effectively protecting Warner Park's unique ecological values will also require an ongoing rodent control programme.

### 3.14 Catherine Esplanade

**Location:** Vitasovich Avenue, Henderson

**Habitat:** Exotic-regenerating native mix

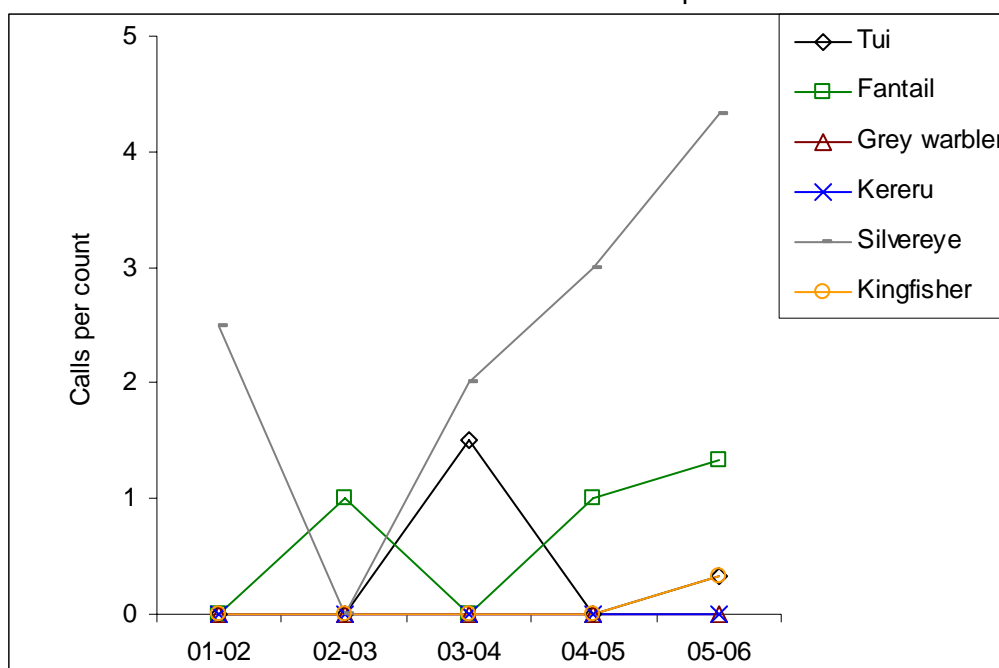
**Recent ecological management actions:** Revegetation, extensive weed clearance

#### Avifauna:

*Five-minute bird counts:*

- Kereru and grey warblers were not recorded during any survey
- Tui were only recorded during 2003-4
- Silvereye and fantail conspicuousness has increased
- Kingfishers were recorded for the first time during summer 2005-06

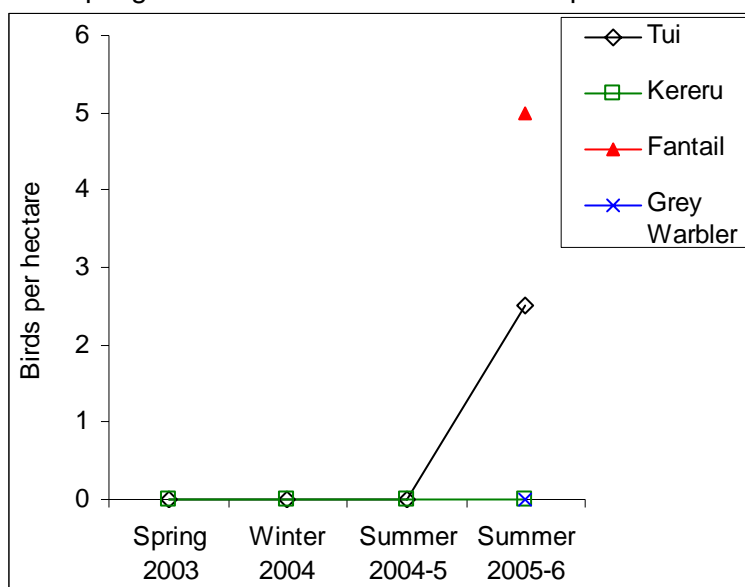
Five-minute count results for native bird indicator species 2001-2 to 2005-6



*Distance sampling:*

- No kereru were recorded during any of the four distance sampling surveys
- Tui were recorded for the first time during summer 2005-06
- Grey warblers were not recorded during either the five-minute bird counts or the distance sampling in 2005-6
- Fantails were common

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	0	0
Possum	0	0
Mustelid	0	0
Hedgehog	5	100

- Number of wax tags = 9

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	4	44
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 20 species was recorded across all vegetation tiers
- Twelve native species were present in the subcanopy and four were present in the canopy
- Two native species were regenerating: *Coprosma robusta* and *Leptospermum scoparium*

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Alectryon excelsus</i>				2		
<i>Coprosma lucida</i>			2			
<i>Coprosma rhamnoides</i>						
<i>Coprosma robusta</i>		2	3	2		
<i>Coprosma spathulata</i>			2			
<i>Cordyline australis</i>			3	3		
<i>Dacrycarpus dacrydioides</i>			2	2		
<i>Dicksonia squarrosa</i>				2	2	
<i>Kunzea ericoides</i>			2	3	3	
<i>Leptospermum scoparium</i>	2	3	3	2		
<i>Ligustrum lucidum*</i>			2			
<i>Melicytus macrophyllus</i>				3		
<i>Melicytus ramiflorus</i>			3	3		
<i>Metrosideros excelsa</i>				3	2	
<i>Phormium tenax</i>				3		
<i>Pittosporum tenuifolium</i>			2			
<i>Plagianthus regius</i>			2			
<i>Podocarpus totara</i>			3			
<i>Pseudopanax crassifolius</i>						
<i>Sophora microphylla</i>				2	2	

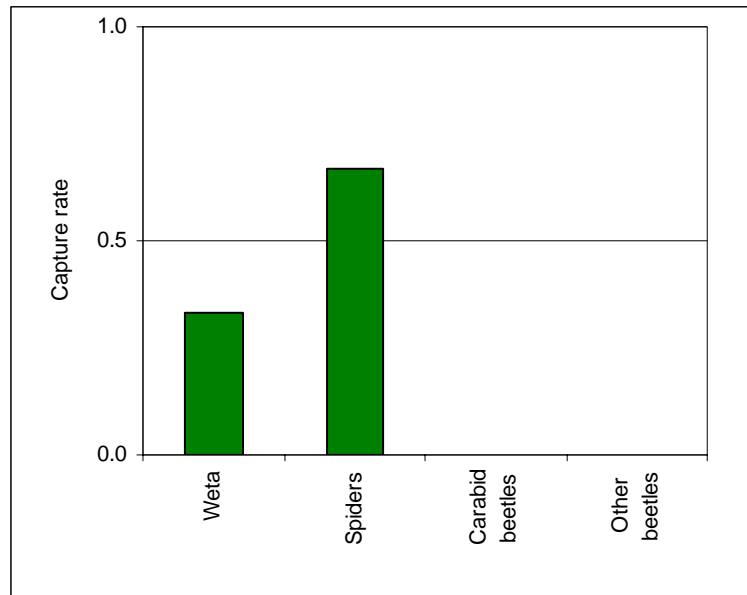
*Phenology:*

- At least two species were recorded flowering during each survey
- Three species were recorded fruiting during each survey

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Acacia mearnsii*</i>	Black wattle			✓			
<i>Coprosma lucida</i>	Shining karamu	✓					
<i>Coprosma robusta</i>	Karamu	✓	✓		✓		✓
<i>Ipomoea indica*</i>	Morning glory					✓	
<i>Kunzea ericoides</i>	Kanuka					✓	✓
<i>Leptospermum scoparium</i>	Manuka	✓	✓	✓	✓		
<i>Ligustrum lucidum*</i>	Tree privet						✓
<i>Ligustrum sinense*</i>	Chinese privet				✓		
<i>Paraserianthes lophantha*</i>	Brush wattle			✓			
<i>Phormium tenax</i>	Flax		✓				
<i>Sophora microphylla</i>	Kowhai	✓					

**Invertebrate communities:**

- Spiders and weta were present however both groups were rare
- No beetles were captured

**Site summary:**

The well-established revegetation plantings provide good nesting habitat for native forest birds such as fantails, silvereyes and grey warblers as well as the wide range of introduced birds present. The kowhai trees attract tui to the site while they are flowering however tui are unlikely to roost or nest at the site due to the intensive level of industrial development in the surrounding area.

The presence of weta in the invertebrate samples reflects the well developed leaf litter present beneath the tall kanuka along parts of the site. The presence of several vegetation tiers in the kanuka dominated areas, including a dense shrub tier, also contributes to the ongoing presence of a thick, moist leaf litter favoured by indigenous terrestrial macroinvertebrates such as weta.

Rats are almost certainly present at Catherine Esplanade. However, the low tracking rates may be partly due to the extensive weed control program that has recently removed much of the vegetation cover in the lower tiers across parts of the site. Also, the 100% hedgehog tracking rate indicates that hedgehogs may have consumed the bait in the tunnels before rats accessed the tunnels. Removal of the bait renders the tracking tunnels unattractive to rodents.

### 3.15 Waikumete Cemetery

**Location:** Waitakere View Road, Glen Eden

**Habitat:** Exotic-regenerating kanuka mix

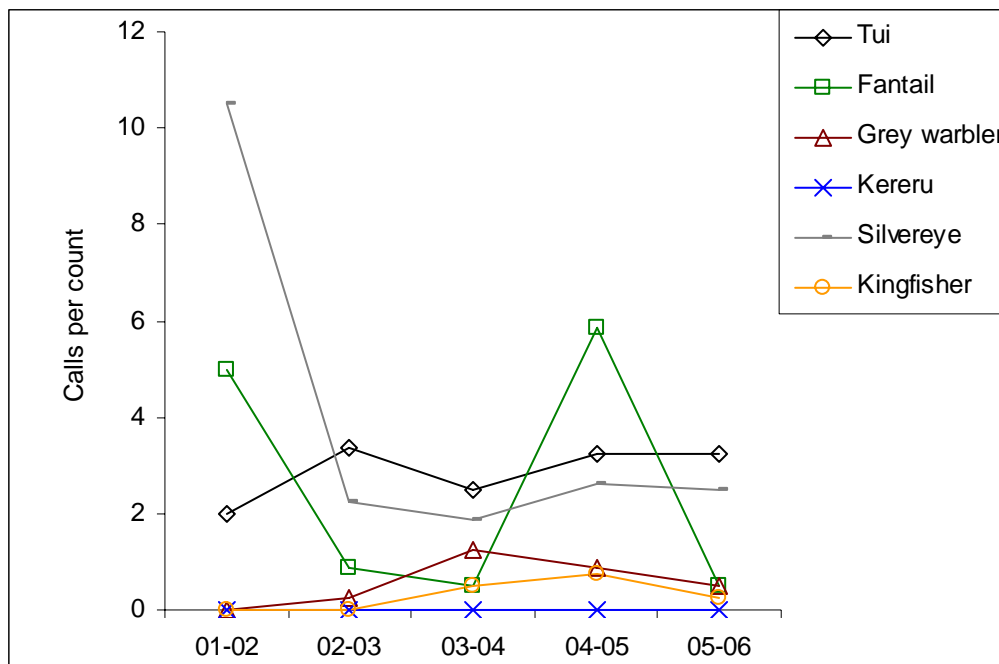
**Recent ecological management actions:** weed control, revegetation

#### Avifauna:

##### *Five-minute bird counts:*

- Tui conspicuousness has remained relatively steady with a slight increase over levels recorded when monitoring commenced
- Kereru have not been recorded
- Grey warblers and kingfishers conspicuousness has increased slightly but they remain relatively inconspicuous

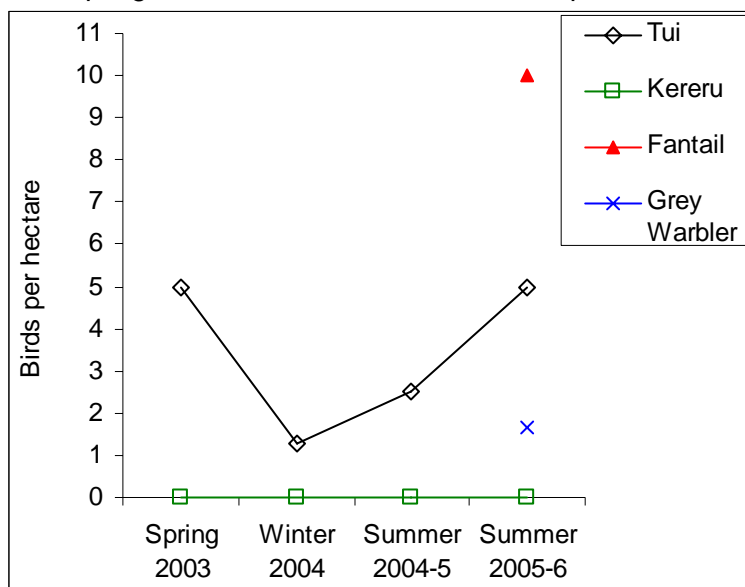
Five-minute count results for native bird indicator species 2001-2 to 2005-6



*Distance sampling:*

- Kereru were not detected during any of the four surveys
- Tui were very abundant during the spring 2003 and during summer 2005-6 surveys
- Fantails were abundant
- Grey warblers were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	1	20
Possum	2	40
Mustelid	0	0
Hedgehog	4	80

- Number of wax tags = 10

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	5	50
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 24 species was recorded across all vegetation tiers
- Thirteen native species were present in the subcanopy and seven were present in the canopy
- Six native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Acmena smithii</i> *	3	3	3	3	3	
<i>Agathis australis</i>					2	
<i>Alectryon excelsus</i>				2		
<i>Coprosma robusta</i>	3	3	3	2		
<i>Coprosma spathulata</i>						
<i>Cordyline australis</i>			3	3	3	
<i>Cyathea medullaris</i>			2	2		
<i>Dacrycarpus dacrydioides</i>				2	3	
<i>Dacrydium cupressinum</i>				2	3	
<i>Dicksonia squarrosa</i>			3			
<i>Elaeocarpus dentatus</i>			2			
<i>Eucalyptus regnans</i> *	2	2	2	2	3	
<i>Geniostoma rupestre</i>	3	3	3			
<i>Knightia excelsa</i>				3	3	
<i>Kunzea ericoides</i>	3	3	3	3	3	
<i>Leucopogon fasciculatus</i>		2	3			
<i>Metrosideros excelsa</i>			2	2		
<i>Myrsine australis</i>	3	3	3	2		
<i>Olearia furfuracea</i>			1			
<i>Phyllocladus trichomanoides</i>			2	2		
<i>Pinus radiata</i> *	2	2	2	2	2	
<i>Pittosporum eugenioides</i>			2			
<i>Podocarpus totara</i>	2	3	2	2	2	
<i>Vitex lucens</i>				2		

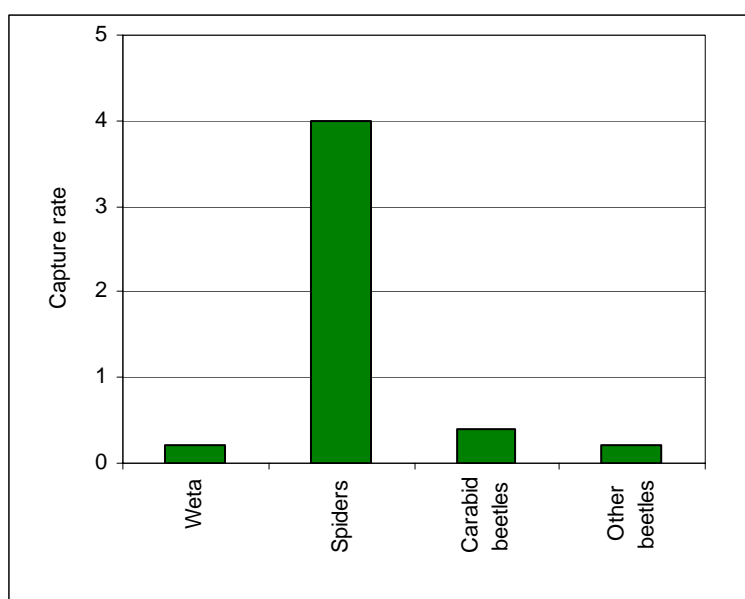
*Phenology:*

- No fruiting was observed during winter 2004 and only one species (puriri) was observed fruiting during spring 2003
- Only one species was recorded flowering during the winter 2004 survey (gorse) and another single species (kanuka) was flowering during summer 2004-5

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma robusta</i>	Karamu	✓					✓
<i>Cordyline australis</i>	Cabbage tree						✓
<i>Geniostoma rupestre</i>	Hangehange	✓					✓
<i>Kunzea ericoides</i>	Kanuka					✓	✓
<i>Leptospermum scoparium</i>	Manuka						✓
<i>Leucopogon fasciculatus</i>	Mingimingi	✓					
<i>Phormium tenax</i>	Flax						✓
<i>Ulex europaeus</i> *	Gorse			✓			
<i>Vitex lucens</i>	Puriri	✓	✓				

**Invertebrate communities:**

- All indicator groups were present but apart from spiders, all were scarce

**Site summary:**

Waikumete Cemetery encompasses an area of 108 hectares and a diverse range of habitats is present at the site. The mix of forest, shrubland, tall individual trees (native and exotic) and open grassland is particularly favourable for a wide range of native and introduced bird species and other wildlife.

Kereru were not detected during any of the bird surveys but all the other native bird indicator species were present, including a good abundance of tui and fantails. The bird monitoring data indicates that native bird populations at Waikumete Cemetery are relatively stable.

Hedgehogs, possums and mice are present at the site and there are reports of rats nesting in the heads of phoenix palms. Given the site's large area and diverse range of habitats, mustelids are also likely to be present. While the native bird populations appear stable, a well-planned predator control programme would result in significant ecological benefits for native birds and other fauna within the cemetery.

All four invertebrate indicator groups were present indicating that a good quality leaf litter is present in the sampling area. However, only spiders were abundant. The diverse invertebrate fauna further supports the conclusion that the site is of considerable value as a functioning ecosystem that would benefit from a predator control programme.

### 3.16 Oratia Esplanade

**Location:** Newham Road, McLaren Park

**Habitat:** Mixed bamboo-willow, regenerating native riparian shrubland

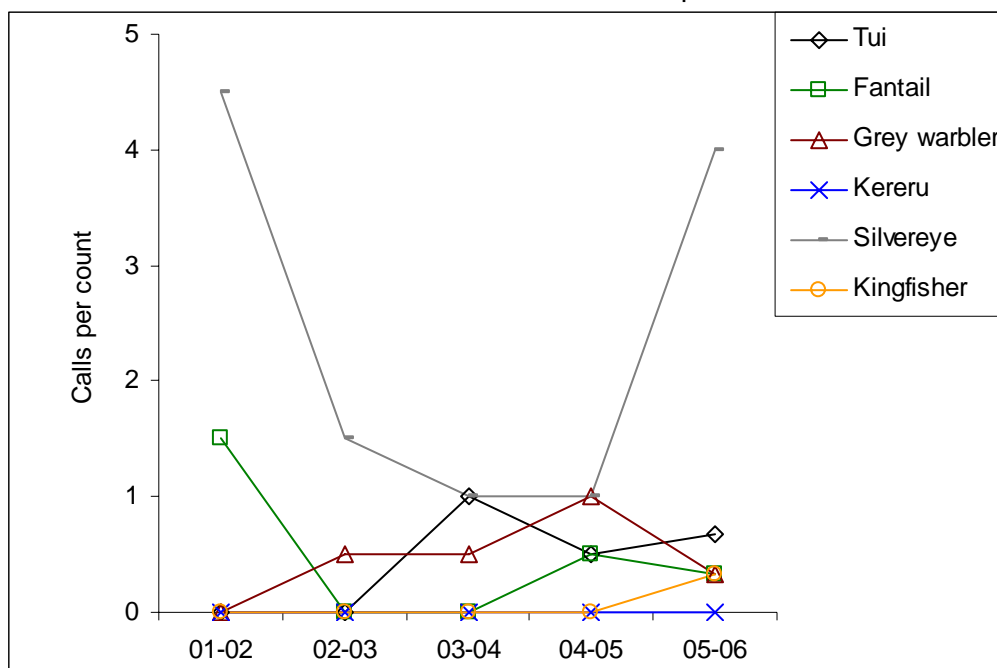
**Recent ecological management actions:** Revegetation, weed control

**Avifauna:**

*Five-minute bird counts:*

- Kereru were not recorded
- Silvereeye, grey warbler and kingfisher conspicuousness has increased
- Tui were recorded for the first time during the 2003-4 survey but they were less conspicuous during the 2004-5 and 2005-6 survey

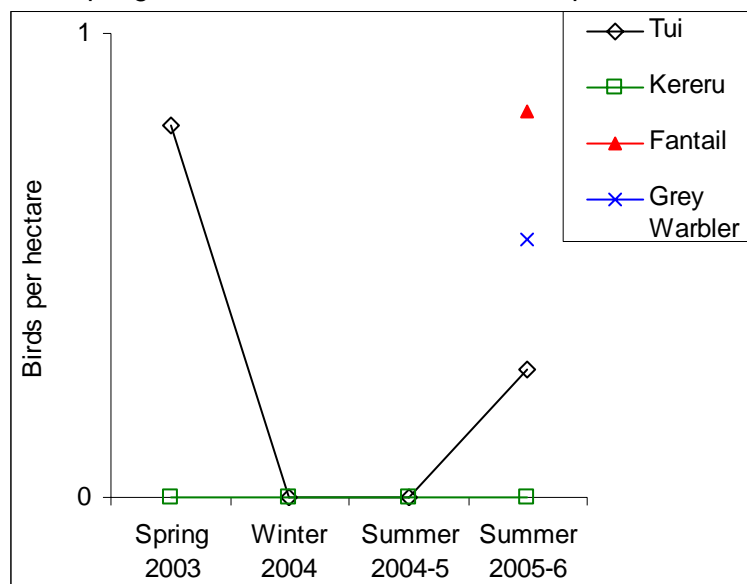
Five-minute count results for native bird indicator species 2001-2 to 2005-6



*Distance sampling:*

- Tui were recorded during the spring 2003 survey but not during winter 2004 or summer 2004-5. Tui were present during summer 2005-6 but their abundance was low
- Kereru were not recorded
- Grey warblers and fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	4	80
Mouse	3	60
Possum	1	20
Mustelid	0	0
Hedgehog	5	100

- Number of wax tags = 10

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	2	20
Mouse	3	30
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 12 species was recorded across all vegetation tiers
- Two native species were present in the subcanopy and three
- No native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>			2			
<i>Cordyline australis</i>			2	2		
<i>Dacrycarpus dacrydioides</i>			2		2	
<i>Dicksonia squarrosa</i>			3	3		
<i>Hedychium gardnerianum</i> *	2					
<i>Kunzea ericoides</i>					3	
<i>Ligustrum lucidum</i> *	2	2	3	2		
<i>Ligustrum sinense</i> *	2	2	3			
<i>Pinus radiata</i> *					1	
<i>Salix fragilis</i> *					2	
<i>Sophora microphylla</i>					2	
<i>Tradescantia fluminensis</i> *	3					

*Phenology:*

- No species were recorded flowering during the winter 2004 survey
- Only one species was recorded fruiting during spring 2003 (kowhai) and summer 2004-5 (Chinese privet)

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Cordyline australis</i>	Cabbage tree	✓				✓	
<i>Ipomoea indica</i> *	Morning glory					✓	
<i>Ligustrum lucidum</i> *	Tree privet				✓	✓	
<i>Ligustrum sinense</i> *	Chinese privet				✓		✓
<i>Sophora microphylla</i>	Kowhai	✓	✓		✓		

**Invertebrate communities:**

- All invertebrate traps were lost to vandalism or another disturbance that precluded obtaining data

**Site summary:**

Oratia Esplanade is largely ecologically degraded and is dominated by weeds and other exotic plant species. There are a few mature kowhai and small-medium kahikatea at the northern end of the site and this native vegetation remnant is the focus of most native bird activity at the site. Silvereyes and several common introduced bird species are abundant in the areas of dense bamboo and privet and the adjoining open grassland.

The abundance of predators at the site is suppressing native fauna communities and this will continue until predator control measures are implemented. Weed control and revegetation are also required to improve the ecology of the site. However, as exotic

plant species provide food for native birds at the site, ecological restoration activities should be planned to ensure a continuous supply of food and nest sites for birds.

### 3.17 Brigham Creek Recreational Reserve

**Location:** Dale Road, Whenuapai

**Habitat:** Marine tidal flats, mangrove shrubland, scattered exotic trees

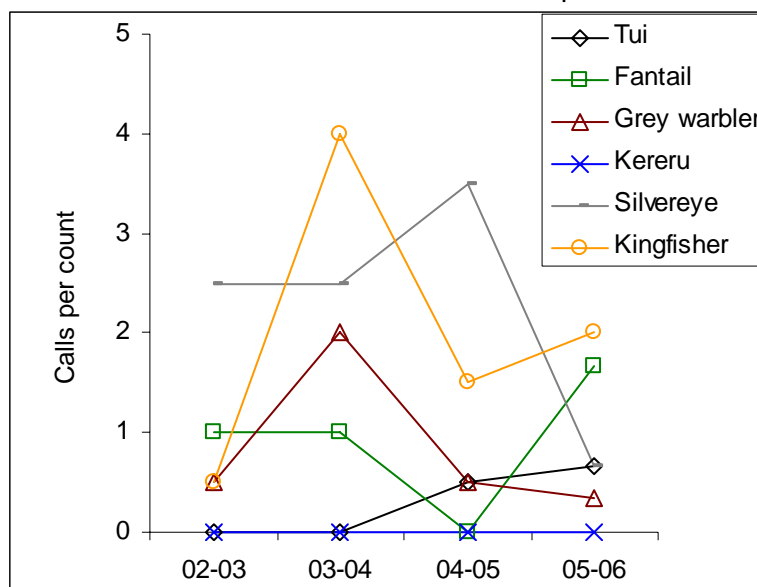
**Recent ecological management actions:** None

#### Avifauna:

##### *Five-minute bird counts:*

- There was a spike in kingfisher and grey warbler conspicuousness during 2003-4
- Tui have increased slightly since 03-04
- Kereru have not been recorded at all
- Fantails were not detected during 2004-5 but have recovered since

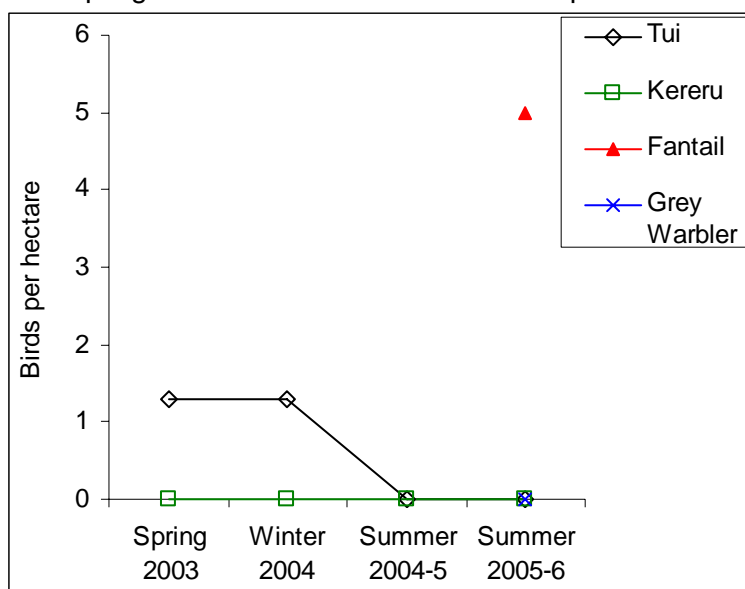
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Kereru were not recorded
- Tui were present at low densities during spring 2003 and winter 2004 but were not recorded during the summer 2004-5 or summer 2005-6 surveys
- Fantails were common
- Grey warblers were recorded during the five minute bird counts but were undetected during the 2005-6 distance sampling survey

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	4	80
Mouse	3	60
Possum	1	20
Mustelid	0	0
Hedgehog	1	20

- Number of wax tags = 9

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	5	56
Mouse	4	44
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 10 species was recorded across all vegetation tiers
- No native species were present in the subcanopy or canopy
- No native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Avicennia marina</i>	3	3	4			
<i>Coprosma robusta</i>			3			
<i>Eucalyptus globulus</i> *		2			3	
<i>Ipomoea indica</i> *			3			
<i>Ligustrum sinense</i> *	3	3	3			
<i>Melicytus ramiflorus</i>			2			
<i>Paraserianthes lophantha</i> *	3	3	3	2		
<i>Pinus radiata</i> *			2	2	3	
<i>Pteridium esculentum</i>			3			
<i>Solanum mauritianum</i> *			2			

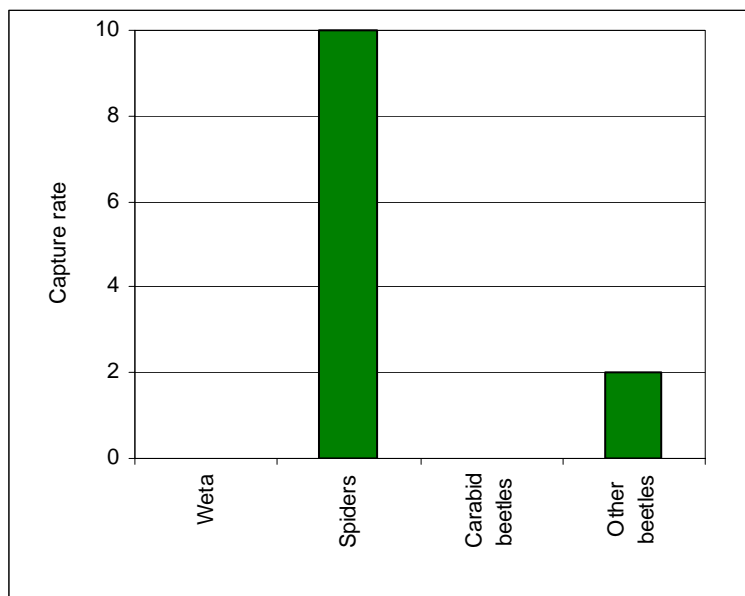
*Phenology:*

- Most of the reproductive plant species were weeds
- At least one species was recorded flowering and at least one species was recorded fruiting during each survey

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma robusta</i>	Karamu	✓	✓	✓			
<i>Geniostoma rupestre</i>	Hangehange	✓		✓			✓
<i>Lonicera japonica</i> *	Japanese honeysuckle					✓	
<i>Paraserianthes lophantha</i> *	Brush wattle			✓	✓		
<i>Ulex europaeus</i> *	Gorse			✓			

**Invertebrate communities:**

- Weta and carabid beetles were not recorded although other beetles were present
- Spiders were abundant

**Site summary:**

All native bird indicator species other than kereru have been recorded at Brigham Creek Road Recreational Reserve. In particular, kingfishers and fantails are abundant. The ecological value of the site is enhanced considerably by the adjacent tidal mudflats and the birds that forage there at low tide.

Rodents, possums and hedgehogs are all present and it is highly likely that these pests are suppressing native fauna communities.

The terrestrial vegetation of the site is dominated by weeds and other exotic species whereas mangroves are common along the edge of the tidal flats. The vegetation lacks a multi-tiered structure and there is little leaf litter for terrestrial invertebrates hence the absence of weta and carabid beetles.

### 3.18 Kellys Bridge Esplanade

**Location:** West Coast Road, Oratia

**Habitat:** Regenerating kanuka-kauri forest

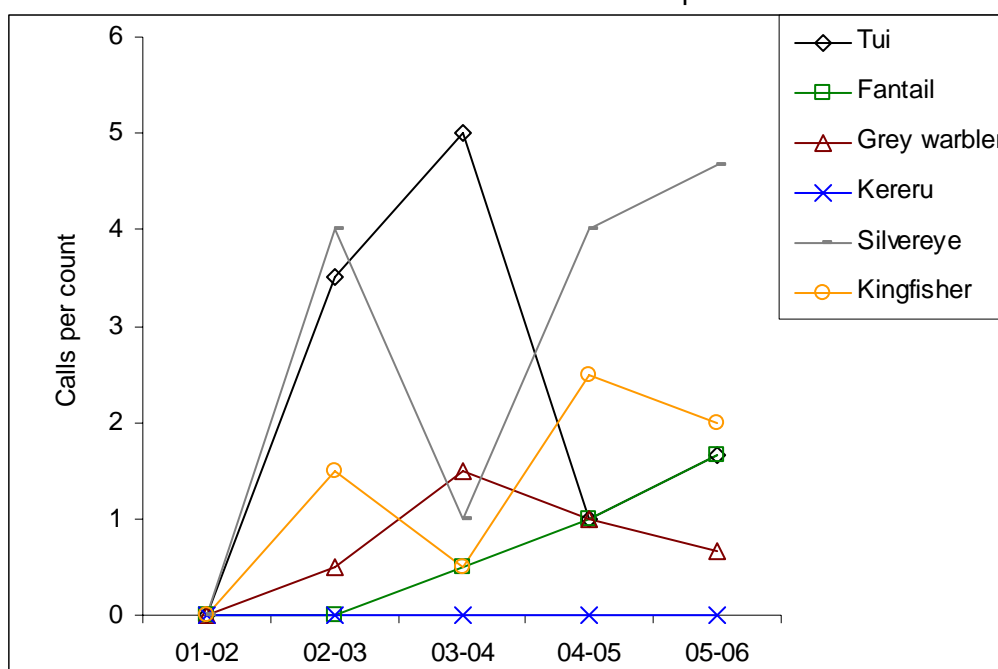
**Recent ecological management actions:** None

**Avifauna:**

*Five-minute bird counts:*

- None of the native bird indicator species were recorded when monitoring commenced at Kellys Bridge
- Apart from kereru, which has not been recorded, native bird conspicuousness has increased dramatically.
- Fantails were not recorded until 2003-4 and while they were more conspicuous again during the 2004-5 surveys, they are relatively scarce
- Tui and silvereye conspicuousness varied considerably since they were first recorded during 2002-3

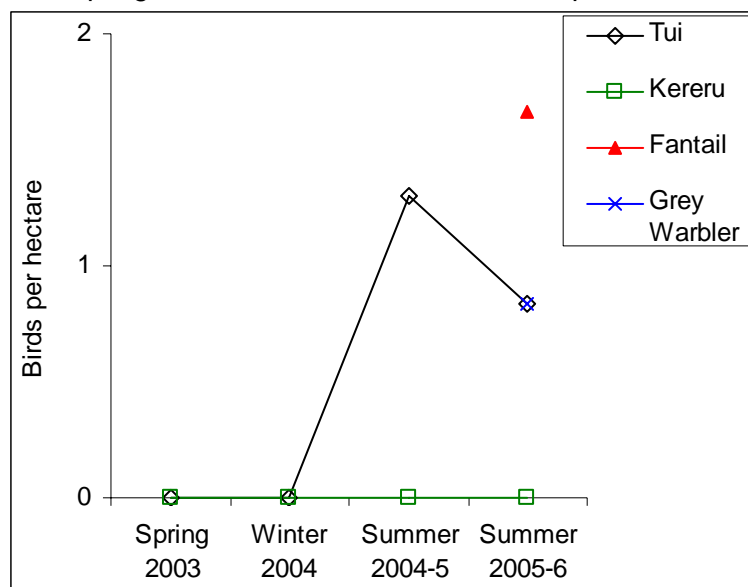
Five-minute count results for native bird indicator species 2001-2 to 2005-6



*Distance sampling:*

- Kereru were not recorded
- Tui were only recorded during the two most recent surveys, but they were at relatively low density
- Fantails and grey warblers were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 3

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	1	33
Possum	0	0
Mustelid	0	0
Hedgehog	3	100

- Number of wax tags = 5

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	3	60
Mouse	2	40
Possum	0	0

**Plant communities:****Vegetation structure:**

- A total of 24 species was recorded across all vegetation tiers
- Five native species were present in the subcanopy and two (kauri and kanuka) were present in the canopy
- Eight native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Acmena smithii</i> *	3	3		1		
<i>Agathis australis</i>			2		3	
<i>Coprosma rhamnoides</i>			2			
<i>Coprosma robusta</i>	3	3	3			
<i>Cordyline banksii</i>			2			
<i>Crocsmia x crocosmiiflora</i> *		3				
<i>Cyathea medullaris</i>			1			
<i>Dacrycarpus dacrydioides</i>	2	2				
<i>Dicksonia squarrosa</i>			3	2		
<i>Freycinetia baueriana</i>			2			
<i>Geniostoma rupestre</i>	3	3	3			
<i>Griselinia lucida</i>			1			
<i>Hedycarya arborea</i>		1	2			
<i>Hoheria populnea</i>		2	2	2		
<i>Kunzea ericoides</i>				2	3	
<i>Melicytus ramiflorus</i>	2	2	3			
<i>Metrosideros excelsa</i>				1		
<i>Myrsine australis</i>	3	3	3	3		
<i>Paraserianthes lophantha</i> *						
<i>Phormium tenax</i>			2			
<i>Phyllocladus trichomanoides</i>	1					
<i>Phyllostachys aurea</i> *			3			
<i>Pittosporum tenuifolium</i>						
<i>Tradescantia fluminensis</i> *		3				

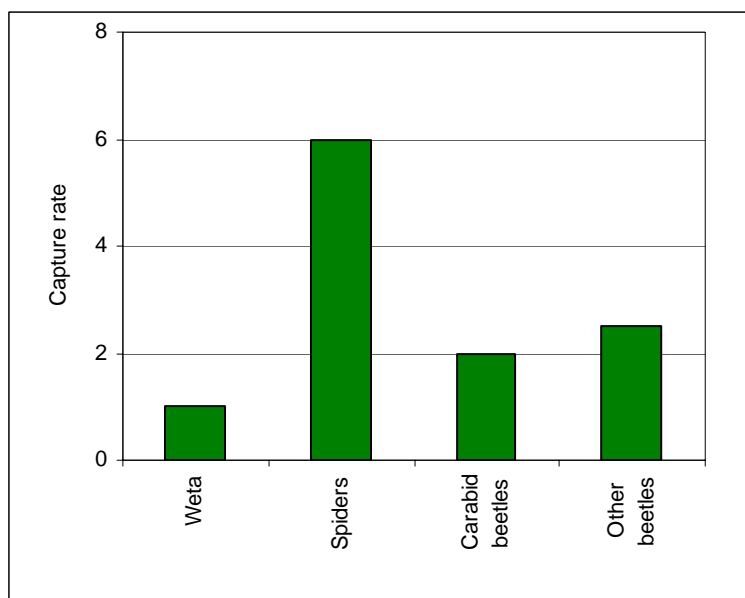
**Phenology:**

- No plant species were fruiting during spring 2003 nor were any recorded flowering during summer 2004-5
- Karamu was the only species observed fruiting during winter 2004

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma lucida</i>	Shining karamu	✓					
<i>Coprosma robusta</i>	Karamu	✓			✓		
<i>Cordyline australis</i>	Cabbage tree						✓
<i>Geniostoma rupestre</i>	Hangehange	✓		✓			✓
<i>Myrsine australis</i>	Red matipo						✓
<i>Paraserianthes lophantha</i> *	Brush wattle			✓			
<i>Pittosporum tenuifolium</i>	Kohuhu						✓

**Invertebrate communities:**

- Spiders were the most abundant indicator group followed by non-carabid beetles
- Carabid beetles were moderately abundant while weta were the least abundant group

**Site summary:**

Kellys Bridge Esplanade is a small reserve within a matrix of rural land that is lightly-wooded with many open areas. The site is within 100 metres of kanuka forest contiguous with the extensive native forest of the Waitakere Ranges. Despite some weed infestations, the native vegetation of the site is relatively diverse and the multi-tiered structure provides good nesting and foraging habitat for a range of native and introduced bird species.

Since bird monitoring commenced at the site in 2001-2, there has been an overall trend of increases in the native bird indicator species. The peaks in tui and silvereye abundance observed in some years masks a general upward trend for those species too. A likely reason for the increases is that the ecological benefits of the Auckland Regional Council's possum control programme have also benefited the native bird communities of Kellys Bridge and the surrounding area. This conclusion is supported by the relatively low tracking rates of predators at the site.

The abundance of the terrestrial invertebrate indicator groups at the site confirm that despite its small size, Kellys Bridge Esplanade contains an ecologically functional remnant able to support a wide variety of birds and terrestrial invertebrates.

### 3.19 Rahui Kahika Reserve

**Location:** Pendlebury Street, Green Bay

**Habitat:** Secondary kauri-kanuka forest, podocarp-broadleaf forest, secondary puriri-composite forest

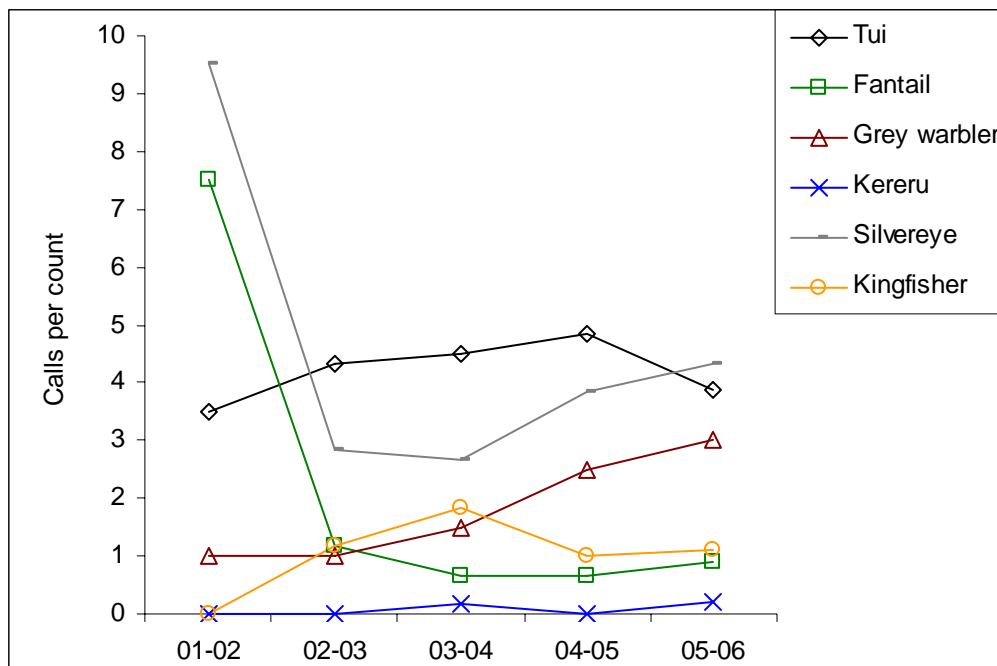
**Recent ecological management actions:** Possum control, weed control

**Avifauna:**

*Five-minute bird counts:*

- Kereru were recorded during the 2003-4 survey and during summer 2005-6
- Fantail and silvereye conspicuousness decreased dramatically from 2001-2 to 2002-3 but has since levelled off
- Tui and grey warbler conspicuousness has increased slowly but steadily

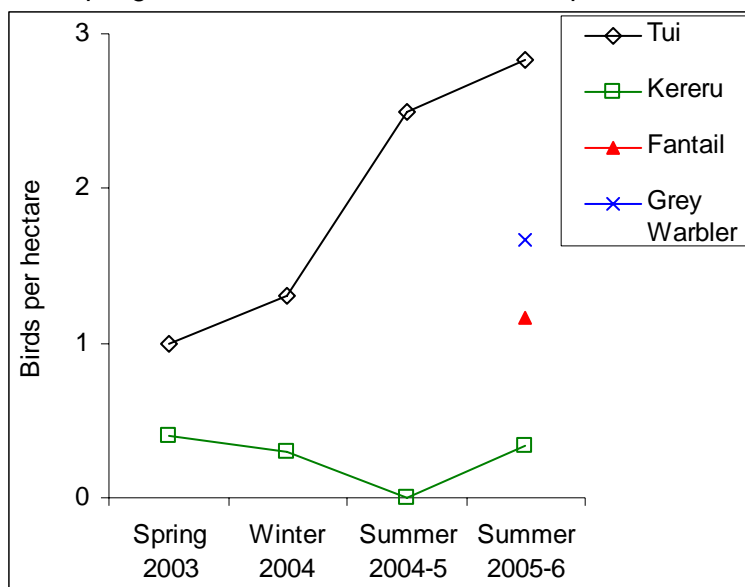
Five-minute count results for native bird indicator species 2001-2 to 2005-6



*Distance sampling:*

- Tui have increased considerably and were most abundant during summer 2005-6 and least abundant during spring 2003
- Kereru were recorded during three of the four surveys
- Grey warblers and fantails were detected

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	2	40
Possum	0	0
Mustelid	0	0
Hedgehog	2	40

- Number of wax tags = 10

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	6	60
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 41 species was recorded across all vegetation tiers
- Eighteen native species were present in the subcanopy and five were present in the canopy
- Twenty-five native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>	2				3	
<i>Alseuosmia macrophylla</i>	2	2	3			
<i>Carpodetus serratus</i>	3	2	3	2		
<i>Coprosma arborea</i>			2			
<i>Coprosma grandifolia</i>	3	3	3			
<i>Coprosma lucida</i>	3	3	4			
<i>Coprosma rhamnoides</i>			2			
<i>Coprosma robusta</i>	4	4	4			
<i>Coprosma spathulata</i>	3	3	2			
<i>Cordyline australis</i>			3	3		
<i>Corynocarpus laevigatus</i>			2	3		
<i>Cyathea medullaris</i>			2	3		
<i>Dacrycarpus dacrydioides</i>	2	3	3		3	
<i>Dacrydium cupressinum</i>	1				3	
<i>Dicksonia squarrosa</i>			3	3		
<i>Dysoxylum spectabile</i>		1	2	2		
<i>Freycinetia baueriana</i>			3			
<i>Fuchsia excorticata</i>				1		
<i>Geniostoma rupestre</i>	4	4	4			
<i>Hedycarya arborea</i>	2	2	4	3		
<i>Knightia excelsa</i>	2			3	2	
<i>Kunzea ericoides</i>	4	3	2	4	4	
<i>Leucopogon fasciculatus</i>			4			
<i>Melicytus ramiflorus</i>	4	4	4	3		
<i>Myrsine australis</i>	4	4	5	3		
<i>Myrsine salicina</i>				1		
<i>Nestegis lanceolata</i>	1	1				
<i>Olearia furfuracea</i>			2			
<i>Olearia rani</i>			2			
<i>Phyllocladus trichomanoides</i>	1					
<i>Pinus radiata</i> *						3
<i>Pittosporum eugenioides</i>		1		3		
<i>Pittosporum tenuifolium</i>	2		2			
<i>Pomaderris kumeraho</i>			3			
<i>Pseudopanax arboreus</i>			3	3		
<i>Pseudopanax crassifolius</i>	2	2		2		
<i>Rhopalostylis sapida</i>	2	2	3	3		
<i>Ripogonum scandens</i>	2		2			
<i>Schefflera digitata</i>		2	2			
<i>Sophora fulvida</i>	2	3	2	3	2	
<i>Vitex lucens</i>					1	

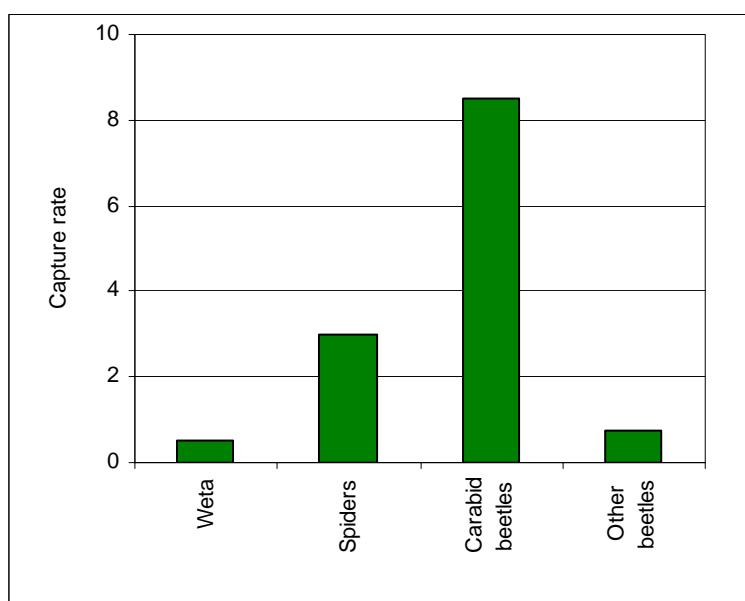
*Phenology:*

- Apart from summer 2004-5 when only puriri and akatea were flowering, a wide range of plants were flowering or fruiting during each of the surveys

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Alseuosmia macrophylla</i>	Toropapa	✓		✓			
<i>Coprosma grandifolia</i>	Raurekau				✓		✓
<i>Coprosma robusta</i>	Karamu	✓		✓			
<i>Cordyline australis</i>	Cabbage tree						✓
<i>Fuchsia excorticata</i>	kotukutuku	✓	✓				
<i>Geniostoma rupestre</i>	Hangehange	✓					✓
<i>Hedycarya arborea</i>	Pigeonwood		✓				✓
<i>Leucopogon fasciculatus</i>	Mingimingi	✓	✓	✓			
<i>Macropiper excelsum</i>	Kawakawa	✓					
<i>Melicytus ramiflorus</i>	Mahoe	✓					
<i>Metrosideros perforata</i>	Akatea					✓	
<i>Myrsine australis</i>	Red matipo				✓		
<i>Pittosporum eugenioides</i>	Tarata	✓	✓		✓		
<i>Pittosporum tenuifolium</i>	Kohuhu	✓					
<i>Pomaderris kumeraho</i>	Kumerahou	✓	✓	✓			
<i>Rhopalostylis sapida</i>	Nikau		✓				✓
<i>Sophora chathamica</i>	Kowhai	✓			✓		
<i>Vitex lucens</i>	Puriri	✓	✓	✓		✓	✓

**Invertebrate communities:**

- Carabid beetles were very abundant and spiders were moderately abundant
- Weta and non-carabid beetles were present but relatively scarce



**Site summary:**

Rahui Kahika Reserve is a 12 hectare native forest remnant that includes a variety of habitats including mature kauri-podocarp forest, a small wetland, dry kanuka forest, and open grassland. Apart from the very high abundance of silvereyes and fantails recorded in the first year of bird monitoring, the bird monitoring data indicates that the site's native bird populations are relatively stable with no obvious declines or increases. The continued presence of kereru at the site demonstrates that the site is of high ecological value.

Mice and hedgehogs were the only species recorded using tracking tunnels and wax tags. The possum population at Rahui Kahika Reserve has been controlled to a low density by WCC contractors. There are numerous weed species present within the reserve. However, the site's diverse vegetation communities - especially the presence of mature native forest with a multi-tiered structure - provide native fauna with year-round food sources and high quality roosting / nesting habitat.

The results of terrestrial invertebrate monitoring at Rahui Kahika Reserve show that the ecological value of the reserve is not limited to native birds and trees. A diverse terrestrial invertebrate fauna indicates that a healthy layer of leaf litter is present at the site. Processes such as water and nutrient cycling function much better at sites with biologically active leaf litter such as that found at Rahui Kahika Reserve.

### 3.20 Moire Park

**Location:** Granville Drive, Massey East

**Habitat:** Regenerating kanuka forest Marine tidal flats, mangrove shrubland, Grassland-exotic mix

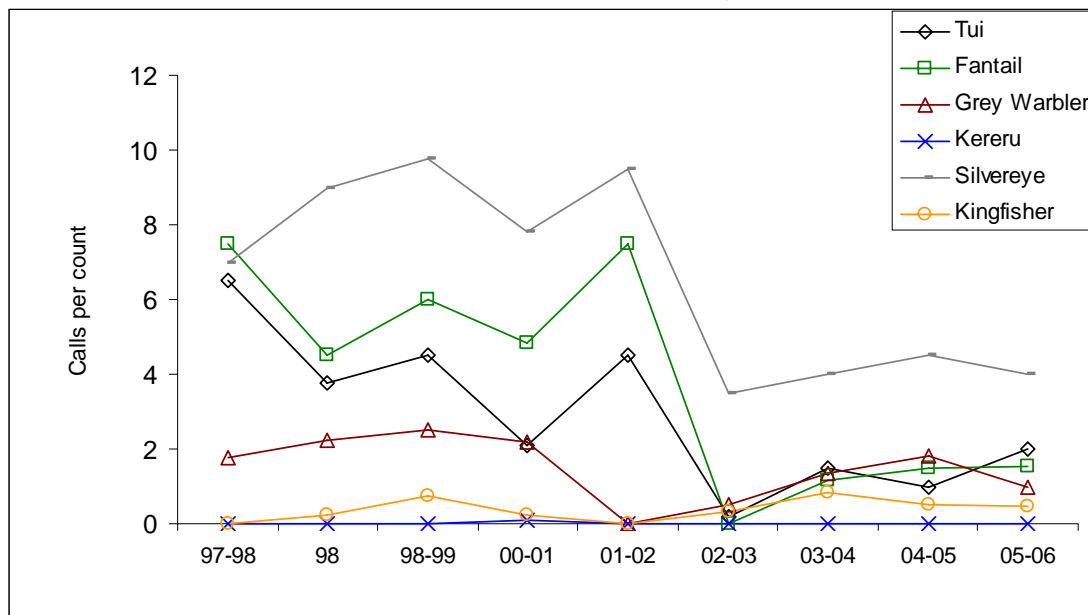
**Recent ecological management actions:** Possum control

**Avifauna:**

*Five-minute bird counts:*

- Kereru were not detected since 2000-1 when a single individual was observed during a count
- The conspicuousness of all indicator species, other than grey warblers and kingfishers, declined dramatically during 2002-3 but recovered slightly during the three surveys undertaken since then

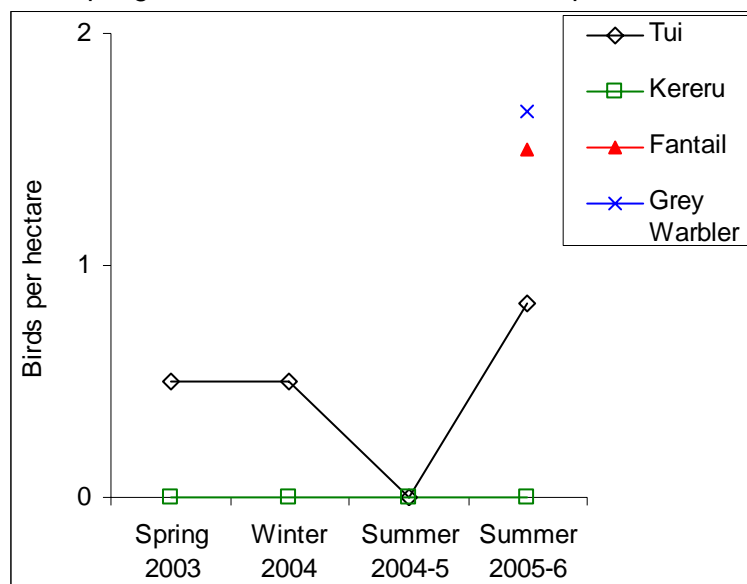
Five-minute count results for native bird indicator species 1997-8 to 2005-6



*Distance sampling:*

- Tui were present at low density during spring 2003, winter 2004 and summer 2005-6 but were not detected during summer 2004-5
- Kereru were not recorded
- Grey warblers and fantails were detected

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	0	0
Possum	1	20
Mustelid	0	0
Hedgehog	1	20

- Number of wax tags = 9

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	2	22
Mouse	2	22
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 25 species was recorded across all vegetation tiers
- Seven native species were present in the subcanopy and none were present in the canopy
- Eleven native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>			2			
<i>Carpodetus serratus</i>			2			
<i>Coprosma grandifolia</i>		3	3			
<i>Coprosma lucida</i>		2	3	1		
<i>Coprosma rhamnoides</i>		2	3			
<i>Coprosma robusta</i>	3	3	3	2		
<i>Cordyline australis</i>			3			
<i>Corynocarpus laevigatus</i>			1			
<i>Cyathea medullaris</i>			2	3		
<i>Dacrycarpus dacrydioides</i>			2			
<i>Dacrydium cupressinum</i>			1			
<i>Dicksonia squarrosa</i>			3	2		
<i>Geniostoma rupestre</i>	3	4	4			
<i>Hedycarya arborea</i>		2	3			
<i>Kunzea ericoides</i>			3	4		
<i>Leptospermum scoparium</i>	2	3	3			
<i>Leucopogon fasciculatus</i>		2	3			
<i>Melicytus ramiflorus</i>	3	3	4	3		
<i>Metrosideros excelsa</i>			1			
<i>Myrsine australis</i>	3	3	4	3		
<i>Paraserianthes lophantha</i> *				3	3	
<i>Pinus radiata</i> *				3	4	
<i>Podocarpus totara</i>			2			
<i>Racosperma mearnsii</i> *				3	3	
<i>Vitex lucens</i>	1	1	1			

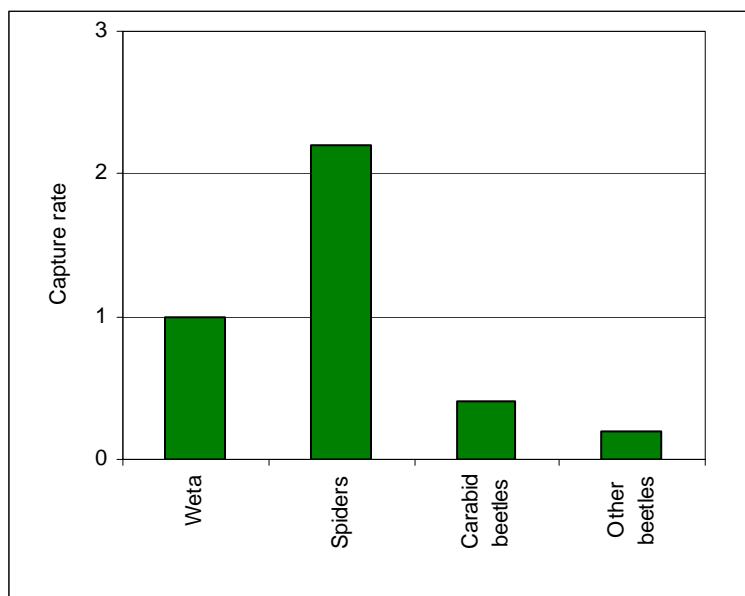
*Phenology:*

- Only kanuka was flowering during summer 2004-5
- At least three species were recorded fruiting during each survey

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Acacia longifolia</i> *	Sydney golden wattle			✓			
<i>Coprosma robusta</i>	Karamu	✓	✓		✓		✓
<i>Geniostoma rupestre</i>	Hangehange	✓					✓
<i>Knightia excelsa</i>	Rewarewa	✓					
<i>Kunzea ericoides</i>	Kanuka					✓	
<i>Leptospermum scoparium</i>	Manuka			✓	✓		✓
<i>Leucopogon fasciculatus</i>	Mingimingi			✓			✓
<i>Myrsine australis</i>	Red matipo				✓		
<i>Olearia solandri</i>	Coastal tree daisy			✓			
<i>Pomaderris kumeraho</i>	Kumerahou	✓	✓	✓			
<i>Pseudopanax arboreus</i>	Five finger		✓				✓
<i>Ulex europaeus</i> *	Gorse			✓			

**Invertebrate communities:**

- All indicator groups were present
- Spiders were the most abundant indicator group followed by weta and carabid beetles

**Site summary:**

Moire Park is a 20 hectare reserve encompassing sports fields and clubrooms, car parks, open grassland, exotic trees, native forest, shrubland and riparian vegetation. Moire Park's bird communities have been monitored annually since 1998. Since Envirologic took over the bird monitoring in 2002, the trends in native bird indicator species have tended towards slight increases (e.g., tui and grey warbler) or are relatively stable (e.g., kingfisher and silvereye). Kereru were recorded during the summer of 2000-1 but have not been recorded since.

The cause of the dramatic decline in the conspicuousness of tui, fantail and silvereye detected in 2002-3 is unclear. It is unlikely to be solely a result of observer bias because a similar decline was recorded in grey warblers the year before Envirologic took over the monitoring. Therefore the fluctuations should be considered to reflect actual population changes resulting from unknown cause(s).

Moire Park's native vegetation is diverse but the highest tiers in the bush areas are dominated by exotics such as wattles and radiata pine. Structurally, the tall exotics provide high nesting and roosting sites similar to mature native trees such as kauri and kahikatea. However, they do not provide the food resources (berries) that native podocarps provide for birds. In the long term, the podocarps currently present in the shrub tier will grow to become a significant food resource in the forest.

Rodents, possums and hedgehogs were recorded at Moire Park but not at high abundances. The indigenous flora and fauna at the site would benefit from a predator control programme. The complete range of terrestrial invertebrate indicator groups was recorded at the site. This supports the conclusion that overall, the site is in good ecological health.

### 3.21 Takaranga Reserve

**Location:** Staley Road, Parau

**Habitat:** Dry kanuka forest, coastal broadleaf-podocarp-kauri forest, marine tidal flats, mangrove shrubland

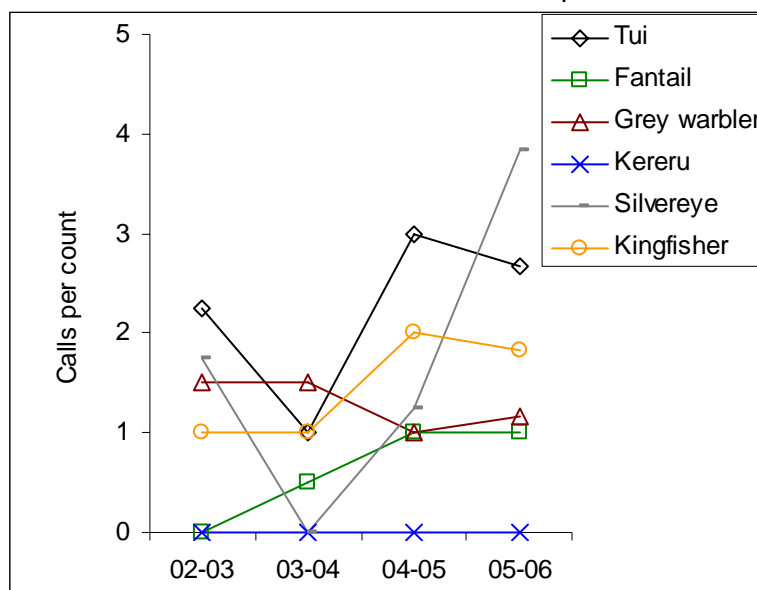
**Recent ecological management actions:** None

**Avifauna:**

*Five-minute bird counts:*

- Since monitoring commenced, the conspicuousness of tui, fantails, and kingfishers has increased slightly
- Kereru were not detected
- Grey warbler conspicuousness has remained relatively stable whereas silvereye conspicuousness has varied considerably with none recorded during 2003-4

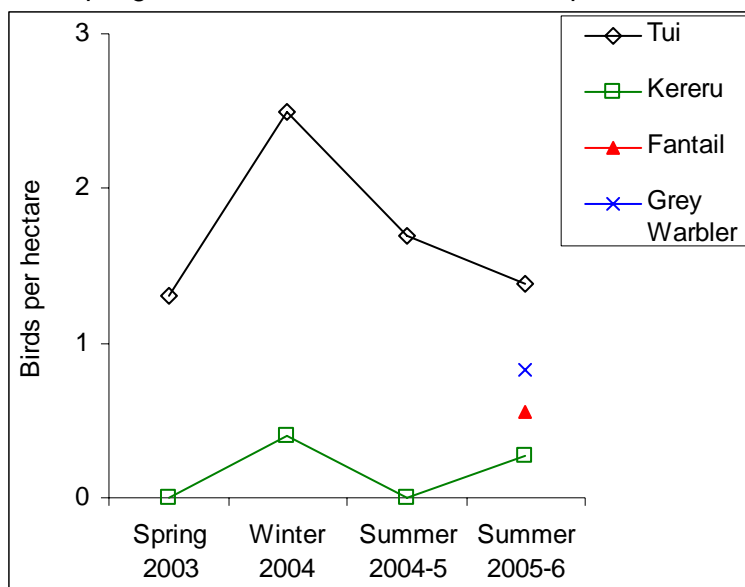
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Tui abundance was greatest during winter 2004 and lowest during spring 2003
- Kereru were detected during winter 2004 and summer 2005-6
- Grey warblers and fantails were detected

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 4

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	1	25
Possum	0	0
Mustelid	0	0
Hedgehog	4	100

- Number of wax tags = 10

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	3	30
Mouse	5	50
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 17 species was recorded across all vegetation tiers
- Seven native species were present in the subcanopy, two were present in the canopy, and kauri, kahikatea and rimu were emergent above the canopy
- Six native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>						2
<i>Brachyglottis repanda</i>					1	
<i>Coprosma areolata</i>				2		
<i>Coprosma rhamnoides</i>		2	2			
<i>Coprosma robusta</i>		3				
<i>Dacrycarpus dacrydioides</i>						3
<i>Dacrydium cupressinum</i>						2
<i>Dicksonia squarrosa</i>				3		
<i>Gahnia</i> sp.			2			
<i>Geniostoma rupestre</i>		4	4			
<i>Kunzea ericoides</i>					5	
<i>Macropiper excelsum</i>				3		
<i>Melicytus ramiflorus</i>		4	4	4		
<i>Myrsine australis</i>		2	4	4		
<i>Rhopalostylis sapida</i>			3	3		
<i>Sophora chathamica</i>				2		
<i>Vitex lucens</i>						2

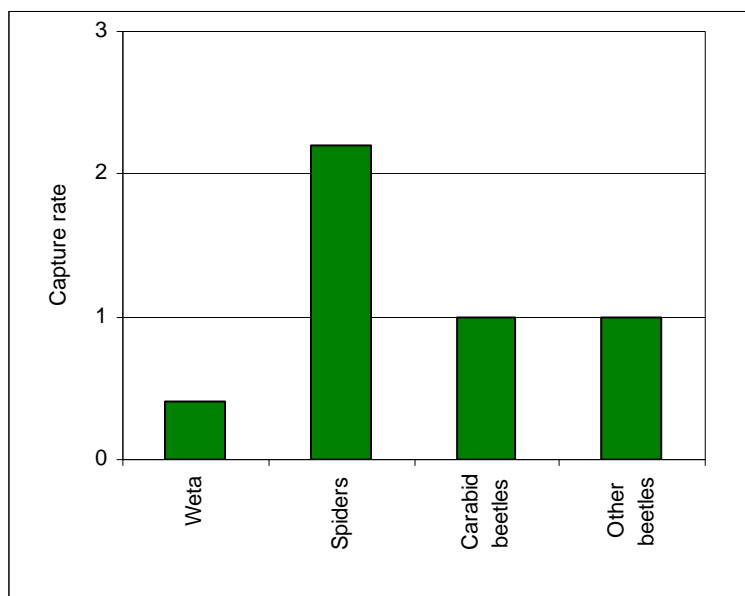
*Phenology:*

- At least three species were recorded flowering during each survey
- At least five species were recorded fruiting during each survey

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Brachyglottis repanda</i>	Rangiora	✓					
<i>Coprosma areolata</i>	Thin-leaved coprosma	✓					
<i>Coprosma rhamnoides</i>	Twiggy Coprosma	✓	✓				
<i>Coprosma robusta</i>	Karamu	✓			✓		✓
<i>Gahnia</i> sp.	Cutty grass				✓		
<i>Geniostoma rupestre</i>	Hangehange	✓					✓
<i>Kunzea ericoides</i>	Kanuka					✓	✓
<i>Leptospermum scoparium</i>	Manuka		✓				
<i>Lycium ferocissimum</i> *	Boxthorn						✓
<i>Macropiper excelsum</i>	Kawakawa	✓	✓	✓	✓		
<i>Melicytus ramiflorus</i>	Mahoe					✓	
<i>Metrosideros excelsa</i>	Pohutukawa	✓					✓
<i>Myrsine australis</i>	Red matipo		✓	✓	✓		✓
<i>Sophora chathamica</i>	Kowhai	✓			✓		
<i>Ulex europaeus</i> *	Gorse			✓			
<i>Vitex lucens</i>	Puriri	✓	✓	✓	✓	✓	✓

**Invertebrate communities:**

- All indicator groups were present
- Spiders were the most abundant indicator group
- Weta were the least abundant of the indicator groups

**Site summary:**

The Takaranga Reserve monitoring site includes the Armour Bay Reserve with its regenerating coastal native forest remnant. Collectively, the area includes native forest at varying stages of regeneration, a shelly beach, tidal mudflats, mangrove forest, and open grassland / recreational areas. This combination of habitats provides an excellent environment for native birds and other fauna.

The native vegetation has good species diversity and the more mature forest areas are characterised by a multi-tiered structure. Consequently, the site provides good bird nesting habitat. Vegetation and phenology monitoring also confirms that the site's native vegetation provides year-round food sources for native birds.

Avifauna monitoring revealed that the conspicuousness of most indicator species has increased since monitoring began in summer 2002-3. Kereru were not detected during the five-minute counts but were detected by distance sampling during two of the four surveys. Grey warbler conspicuousness has remained relatively stable from survey to survey.

Terrestrial invertebrate monitoring showed that beneath the site's forests, invertebrate groups typical of healthy leaf litter are present. Therefore, important ecological processes such as water filtration and nutrient cycling are occurring unimpeded across much of the site. A significant ecological feature of Takaranga Reserve is that the native forest grows right to the high water mark along much of the site's coastline. These factors are particularly important given that the site's surface- and ground-water flows directly into the Manukau Harbour.

### 3.22 Harbourview Park

**Location:** Te Atatu Road, Te Atatu Peninsula

**Habitat:** Saltmarsh, freshwater wetland, shrubland, grassland, marine tidal flats

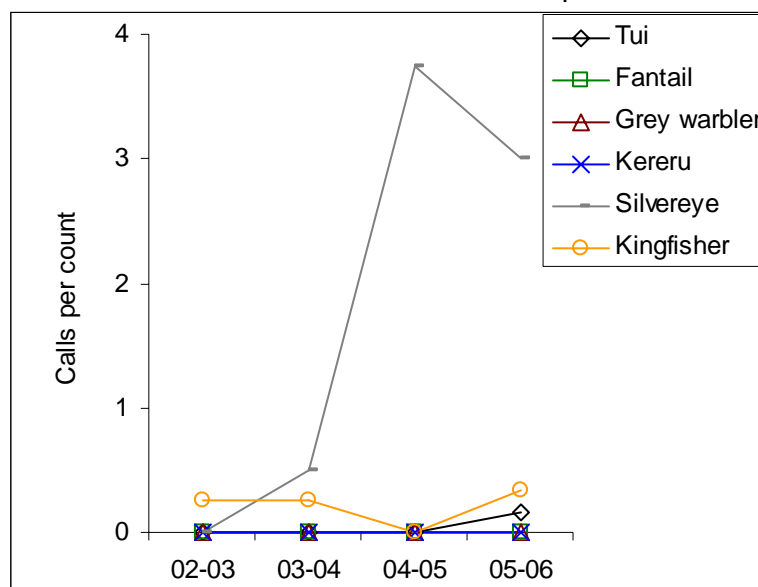
**Recent ecological management actions:** Weed control, revegetation

#### Avifauna:

*Five-minute bird counts:*

- Tui were detected for the first time during summer 2005-6
- Grey warbler, kereru and fantail were not detected during summer 2005-6
- Silvereyes continue to be the most conspicuousness indicator species

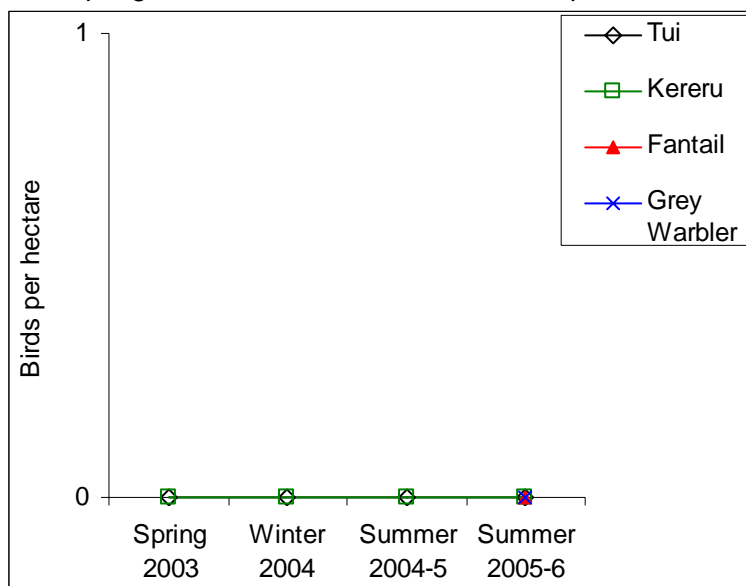
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- No tui, grey warbler, fantail or kereru were detected during the distance sampling surveys

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	1	20
Mouse	1	20
Possum	0	0
Mustelid	0	0
Hedgehog	4	80

- Number of wax tags = 10

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	2	20
Mouse	6	60
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 14 species was recorded across all vegetation tiers
- Kanuka was present in the subcanopy but no canopy was present
- Five native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Coprosma arborea</i>			1			
<i>Coprosma repens</i>		2				
<i>Coprosma robusta</i>			2			
<i>Cordyline australis</i>			3			
<i>Cortaderia fulvida</i>			2			
<i>Kunzea ericoides</i>				2		
<i>Leptospermum scoparium</i>			4			
<i>Metrosideros excelsa</i>			2			
<i>Olearia solandri</i>		2				
<i>Phormium tenax</i>			2			
<i>Pittosporum tenuifolium</i>		2				
<i>Plagianthus divaricatus</i>		2	2			
<i>Podocarpus totara</i>		1				
<i>Sophora fulvida</i>			2			

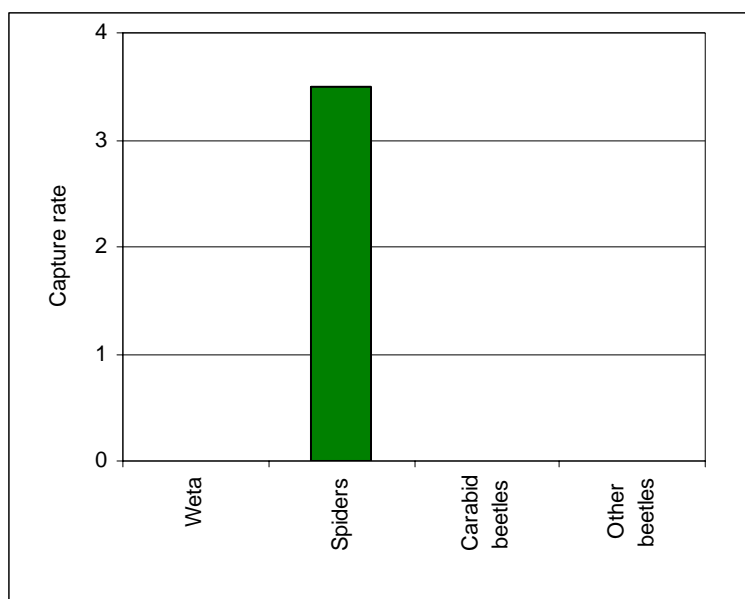
*Phenology:*

- Only flax was flowering during summer 2004-5
- At least two species were recorded fruiting during each survey

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma grandifolia</i>	Raurekau			✓	✓		
<i>Coprosma robusta</i>	Karamu	✓	✓	✓			✓
<i>Cordyline australis</i>	Cabbage tree						✓
<i>Leptospermum scoparium</i>	Manuka	✓	✓	✓	✓		✓
<i>Paraserianthes lophantha</i> *	Brush wattle			✓			✓
<i>Phormium tenax</i>	Flax					✓	✓
<i>Plagianthus divaricatus</i>	Makaka	✓					
<i>Sophora microphylla</i>	Kowhai	✓					
<i>Ulex europaeus</i> *	Gorse			✓			

**Invertebrate communities:**

- Spiders were the only indicator group recorded

**Site summary:**

The most significant ecological features of Harbourview Park are the saltmarsh and freshwater wetlands and the tidal mudflats. The shorebird and wetland bird populations are monitored under a separate project using targeted methods appropriate for those species and habitats. Therefore, the focus of this programme were the regenerating and revegetated shrublands.

Only three of the six native bird indicator species were detected at Harbourview Park. Of those three species, tui were only detected during the 2005-6 surveys. Silvereyes and kingfishers were the other species present. Silvereyes are ubiquitous across Waitakere City's parks network and kingfishers would be expected to occur at a wetland site such as Harbourview. The rodents and hedgehogs recorded by the tracking tunnels and wax tags pose a serious threat to the shorebirds and wetland birds inhabiting Harbourview Park. A predator control programme is recommended.

The vegetation composition, structure and phenology were typical of shrubland in the early stages of restoration / regeneration. The native plant species utilised in revegetation at the site are already beginning to provide a source of fruit and nectar for iconic native birds such as tui. Any tui present on the Te Atatu Peninsula probably roost and nest in suburban gardens or the pohutukawa forest remnants in other coastal reserves. However, as the Harbourview shrublands develop into forest, species such as tui, fantails and grey warblers will probably colonise them.

The terrestrial invertebrate monitoring data indicate that a healthy leaf litter is yet to accumulate beneath Harbourview Park's shrublands. As with the native forest birds, the more sensitive terrestrial macroinvertebrate species are likely to colonise the site as the shrubland progresses along the successional pathway and a healthy leaf litter develops.

### 3.23 Karekare Beach

**Location:** Watchmans and Lone Kauri Roads, Karekare

**Habitat:** Puriri composite forest, pohutukawa forest

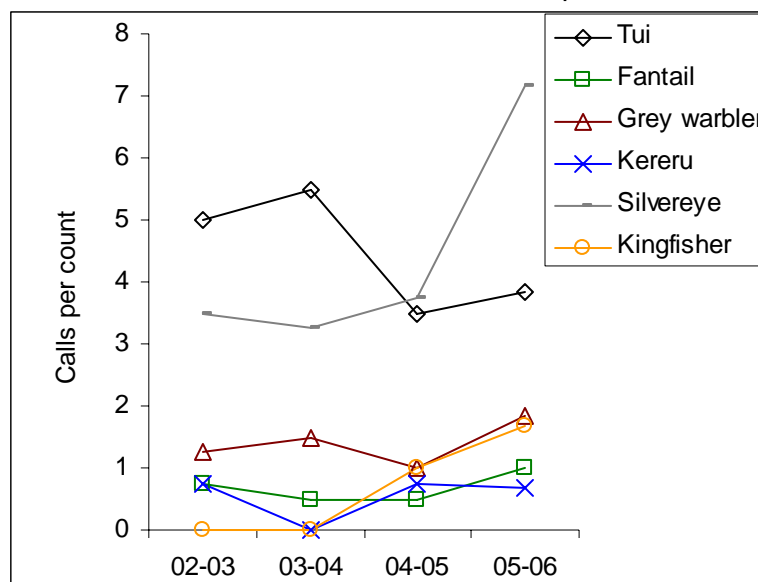
**Recent ecological management actions:** Weed control, revegetation, possum control

#### Avifauna:

*Five-minute bird counts:*

- Kereru were detected during 2002-3, 2004-5 and 2005-6 but not during 2003-4
- Kingfishers, fantails, grey warblers and kereru have increased since 03-04
- Tui conspicuousness decreased slightly during 2004-5

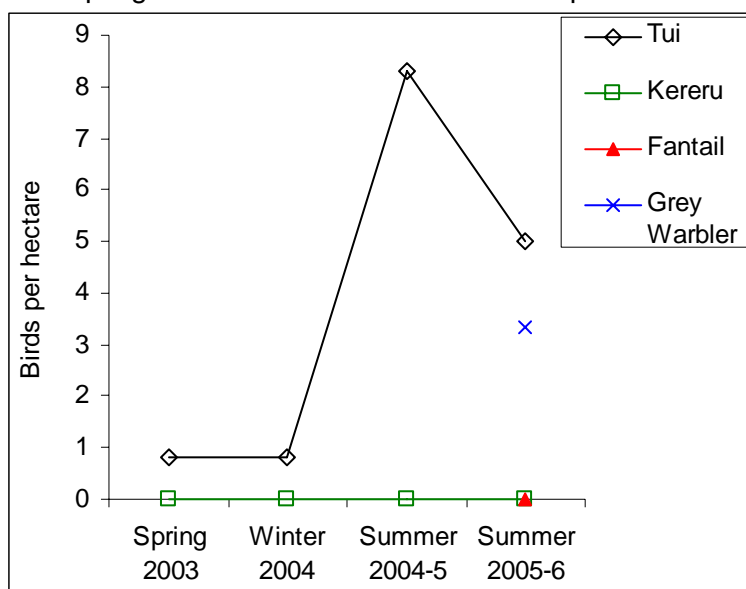
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Tui were very abundant during summer 2004-5 and summer 2005-6 but while present during the other surveys, they were scarce
- Kereru were not detected
- Fantails were present during the five-minute bird counts but were not detected during the distance sampling
- Grey warblers were common

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	5	100
Mouse	1	20
Possum	0	0
Mustelid	0	0
Hedgehog	0	0

- Number of wax tags = 9

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	6	67
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 10 species was recorded across all vegetation tiers
- Two native species were present in the subcanopy (cabbage tree and kanuka), and pohutukawa was the only species present in the canopy
- Seven native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Coprosma macrocarpa</i>	2	2	2			
<i>Coprosma repens</i>	2	2	3			
<i>Cordyline australis</i>			3	3		
<i>Corynocarpus laevigatus</i>		3	3	3		
<i>Cyathea medullaris</i>			2			
<i>Macropiper excelsum</i>	3	3	4			
<i>Melicytus ramiflorus</i>		2	3			
<i>Metrosideros excelsa</i>	1	1	1		4	
<i>Phormium tenax</i>			3			
<i>Pittosporum crassifolium</i>		2	2			

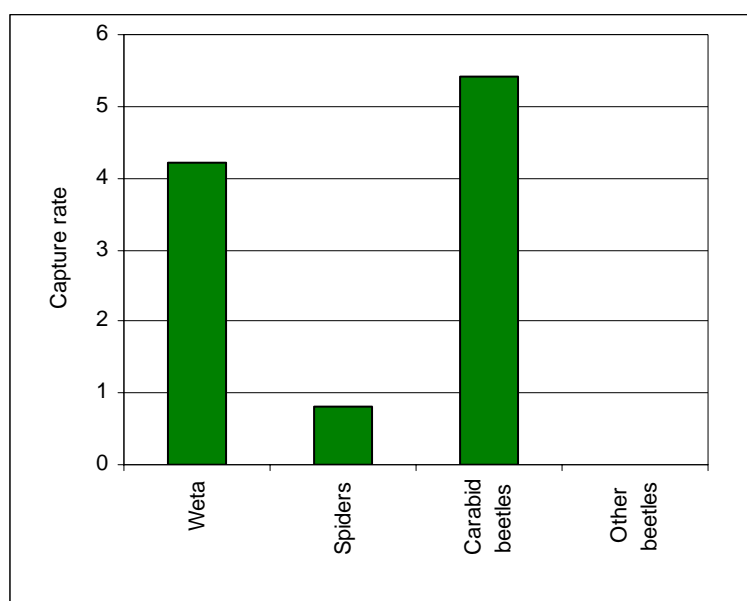
*Phenology:*

- At least two species were recorded flowering during each survey and at least two species were recorded fruiting during each survey

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Brachyglottis repanda</i>	Rangiora	✓	✓				
<i>Coprosma repens</i>	Taupata	✓					
<i>Coprosma robusta</i>	Karamu	✓	✓				
<i>Cordyline australis</i>	Cabbage tree						✓
<i>Corynocarpus laevigatus</i>	Karaka	✓					✓
<i>Entelea arborescens</i>	Whau	✓	✓				
<i>Freycinetia banksii</i>	Kiekie	✓					
<i>Geniostoma rupestre</i>	Hangehange	✓					
<i>Hebe</i> sp.	Koromiko	✓					
<i>Macropiper excelsum</i>	Kawakawa	✓	✓	✓	✓		✓
<i>Melicytus ramiflorus</i>	Mahoe	✓				✓	
<i>Metrosideros excelsa</i>	Pohutukawa					✓	✓
<i>Phormium tenax</i>	Flax					✓	
<i>Rhopalostylis sapida</i>	Nikau	✓					
<i>Vitex lucens</i>	Puriri	✓		✓	✓	✓	✓

**Invertebrate communities:**

- Weta and carabid beetles were very abundant
- Spiders were present but relatively scarce

**Site summary:**

Contiguous with the Waitakere Ranges' native forest, the Karekare Beach monitoring sites provide excellent habitat for native fauna. All native bird indicator species were detected during all surveys except for kingfishers during 2002-3 and 2003-4, and kereru during 2003-4. Tui abundance was particularly high during the summer of 2004-5 and this was probably because the counts were conducted during the peak flowering of pohutukawa and flax. The overall trend for the indicator species was relatively stable. The only obvious exception to this was silvereye which increased in conspicuousness in the 2005-6 survey.

The mature puriri forest provides a source of fruits and nectar for birds throughout much of the year while flax and pohutukawa provide nectar at the start and peak of the breeding season for native birds. As is typical of intact coastal native forest along Auckland's west coast, the monitoring sites' canopies are dominated by pohutukawa whereas the lower tiers are occupied by a diverse range of coastal and forest shrub species. This vegetation structure provides good nesting and foraging habitat for a wide variety of forest and coastal bird species.

Possums were not detected during the pest surveys but this is not surprising given that the area has been targeted for possum control by the Auckland Regional Council and a local community group for several years. However, rodents are present and rats appear to be particularly abundant. A rodent control operation would benefit native flora and fauna but would require a coordinated effort from WCC, ARC and the local community to be effective.

A healthy leaf litter is present beneath the forested parts of the sampling sites. Weta and carabid beetles were abundant in the invertebrate samples. Many of the carabid beetles in the samples were large (>20 mm total length) and probably suppress smaller invertebrates. This may explain the lack of other beetles in the samples.

### 3.24 Claude Abel Reserve

**Location:** Garden Road, Piha

**Habitat:** Wetland, pohutukawa forest

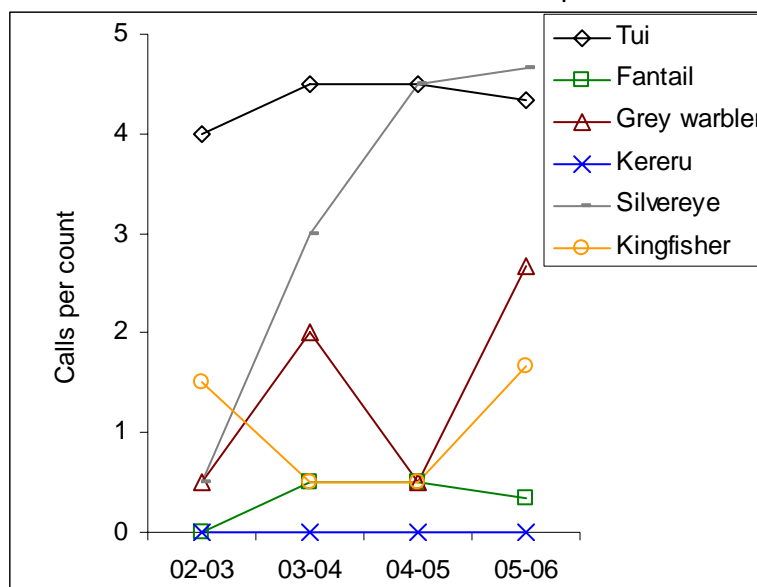
**Recent ecological management actions:** Weed control

#### Avifauna:

*Five-minute bird counts:*

- Tui abundance has remained consistently high
- Kereru were not detected
- Silvereye, kingfisher and grey warbler conspicuousness has increased while fantail conspicuousness has remained relatively steady

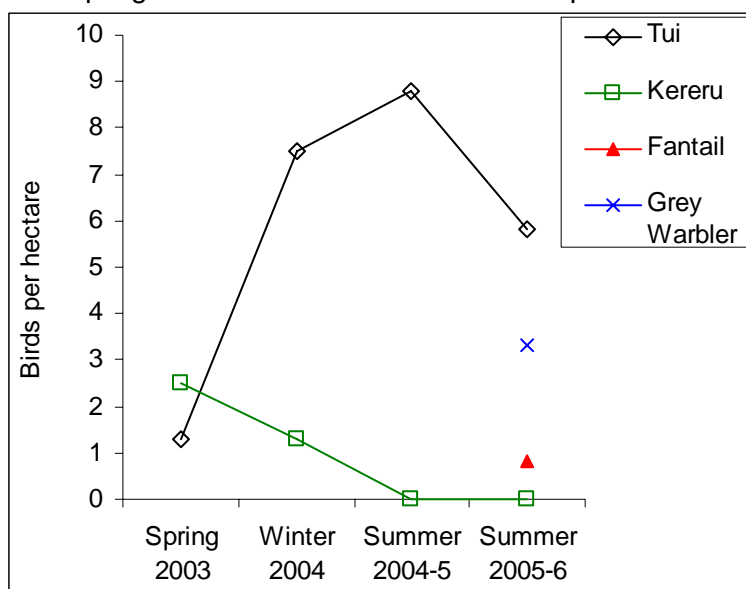
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Tui were present during spring 2003 but were much more abundant during the two subsequent surveys
- Kereru were most abundant during spring 2003 but were not recorded during summer 2004-5 or summer 2005-6
- Grey warblers were common
- Fantails were detected

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	3	60
Mouse	2	40
Possum	0	0
Mustelid	0	0
Hedgehog	5	100

- Number of wax tags = 9

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	0	0
Mouse	5	56
Possum	1	11

**Plant communities:***Vegetation structure:*

- A total of 15 species was recorded across all vegetation tiers
- Ten native species were present in the subcanopy and six were present in the canopy
- Nine native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Coprosma arborea</i>	3	3	3			
<i>Coprosma robusta</i>	3	3	3			
<i>Cordyline australis</i>			2	3	3	
<i>Corynocarpus laevigatus</i>	2	2	2	2		
<i>Kunzea ericoides</i>			2	3	4	
<i>Macropiper excelsum</i>	3	4	4	2		
<i>Melicytus ramiflorus</i>	3	3	3	2		
<i>Metrosideros excelsa</i>				2	4	
<i>Phormium tenax</i>			3			
<i>Pittosporum crassifolium</i>		2	2	2		
<i>Podocarpus totara</i>			2			
<i>Pseudopanax lessonii</i>	2	2	2			
<i>Rhopalostylis sapida</i>	3	3	3	3	2	
<i>Sophora fulvida</i>	3	3	3	3	3	
<i>Vitex lucens</i>				2	3	

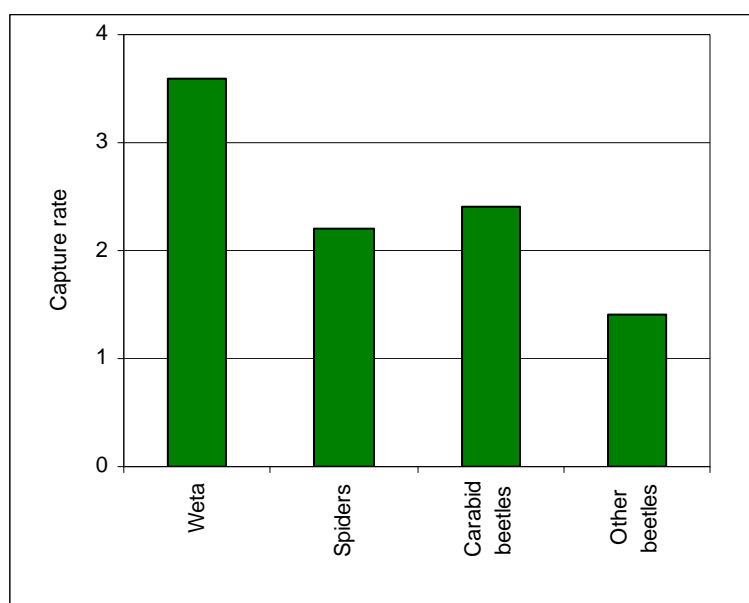
*Phenology:*

- Few species were observed flowering during winter 2004 or summer 2004-5
- Only two species were observed fruiting during winter 2004

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma macrocarpa</i>	Coastal karamu		✓				✓
<i>Cordyline australis</i>	Cabbage tree	✓	✓				✓
<i>Corynocarpus laevigatus</i>	Karaka	✓					✓
<i>Macropiper excelsum</i>	Kawakawa	✓	✓				✓
<i>Melicytus ramiflorus</i>	Mahoe	✓					
<i>Metrosideros excelsa</i>	Pohutukawa					✓	✓
<i>Phormium tenax</i>	Flax					✓	✓
<i>Pittosporum crassifolium</i>	Karo		✓				
<i>Rhopalostylis sapida</i>	Nikau	✓	✓		✓		
<i>Sophora fulvida</i>	Kowhai	✓					✓
<i>Vitex lucens</i>	Puriri	✓	✓	✓	✓	✓	✓

**Invertebrate communities:**

- All indicator groups were relatively abundant
- Weta and carabid beetles were the most abundant groups

**Site summary:**

Claude Abel Reserve is contiguous with the Waitakere Ranges' native forest and provides excellent habitat for native fauna. All native bird indicator species except kereru were detected during five-minute counts. Distance sampling revealed that kereru were in fact present during spring 2003 and winter 2004 however they have not been detected since. Tui, kingfishers and fantail counts have remained relatively stable with tui being very conspicuous during all years. Silvereve and grey warbler conspicuousness has increased since monitoring began.

The mature pohutukawa forest provides excellent habitat for native forest birds. The pond / wetland area supports native species such as kingfishers, shags and pukekos along with introduced mallard ducks. The diverse subcanopy and shrub tiers provide fruit and nectar for birds and a multi-tiered structure conducive to nesting by native birds.

Rats, mice, hedgehogs and possums were detected during the pest surveys. The resident native birds would benefit from a predator control programme however rapid reinvasion is likely unless control is also implemented on the adjoining private land and regional parkland.

All invertebrate indicator species were present in the invertebrate samples. This shows that a healthy leaf litter is present beneath the forested parts of the sampling site. The presence of a biologically active leaf litter indicates that important processes such as water filtration and nutrient cycling are occurring.

### 3.25 Karaka Park / Green Bay Beach

**Location:** Harrybrook and Portage Roads, Green Bay

**Habitat:** Original pohutukawa coastal forest, marine tidal flats

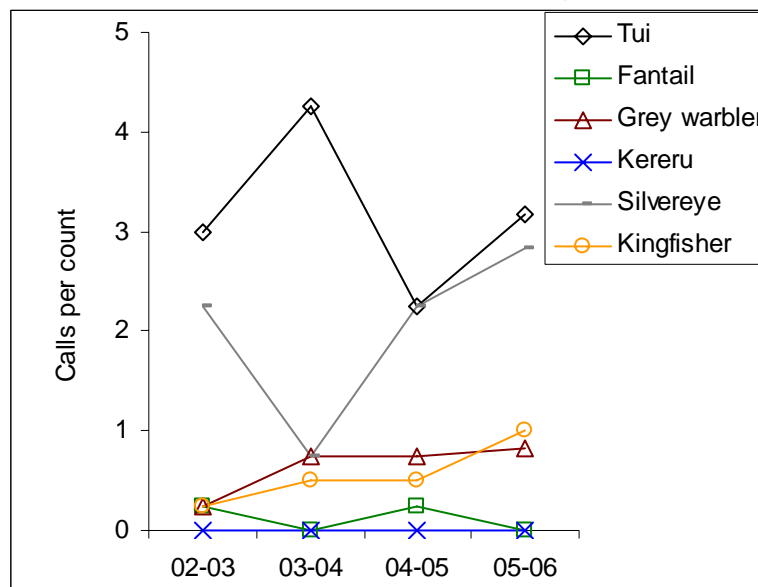
**Recent ecological management actions:** Weed control

#### Avifauna:

*Five-minute bird counts:*

- Kereru were not detected during counts
- Apart from fantails which were not detected during 2003-4 or 2005-6, the conspicuousness of native birds has remained relatively stable

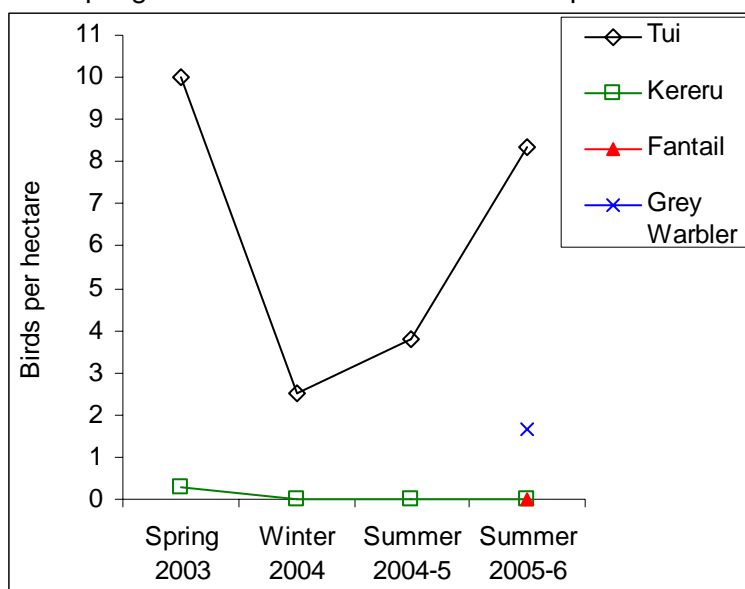
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Tui were very abundant during spring 2003 and summer 2005-6 and were also relatively abundant during the other surveys
- Kereru were only recorded during spring 2003
- Grey warblers were present
- Fantails were not recorded during either distance sampling or 5-minute bird counts during the 2005-6 survey

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 4

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	3	75
Possum	0	0
Mustelid	0	0
Hedgehog	0	0

- Number of wax tags = 8

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	1	13
Mouse	4	50
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 28 species was recorded across all vegetation tiers
- Sixteen native species were present in the subcanopy and four were present in the canopy
- Fourteen native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Alectryon excelsus</i>				2		
<i>Brachyglottis repanda</i>		2	3	3		
<i>Coprosma macrocarpa</i>			3			
<i>Coprosma rhamnoides</i>		2	2			
<i>Coprosma robusta</i>	2	2	4			
<i>Cordyline australis</i>			2	3		
<i>Corynocarpus laevigatus</i>		2	2			
<i>Dacrycarpus dacrydioides</i>		2				
<i>Dicksonia squarrosa</i>			3	2		
<i>Dysoxylum spectabile</i>		2	3	3		
<i>Geniostoma rupestre</i>	3	3	5			
<i>Hoheria populnea</i>	3	3	3	2		
<i>Knightia excelsa</i>					3	
<i>Leucopogon fasciculatus</i>	1	2	3	2		
<i>Macropiper excelsum</i>	3	3	3			
<i>Meliclytus ramiflorus</i>	3	3	4	3		
<i>Metrosideros excelsa</i>					3	
<i>Myrsine australis</i>	3	3	4	4		
<i>Nestegis lanceolata</i>				2		
<i>Olearia furfuracea</i>				2		
<i>Pinus radiata</i>					2	2
<i>Pittosporum crassifolium</i>			3	3		
<i>Pittosporum eugenioides</i>			2			
<i>Pseudopanax arboreus</i>			2	3		
<i>Pseudopanax lessonii</i>			3	2		
<i>Rhopalostylis sapida</i>	2	2	3	3		
<i>Sophora chathamica</i>	2	2	2	2	3	
<i>Vitex lucens</i>					3	

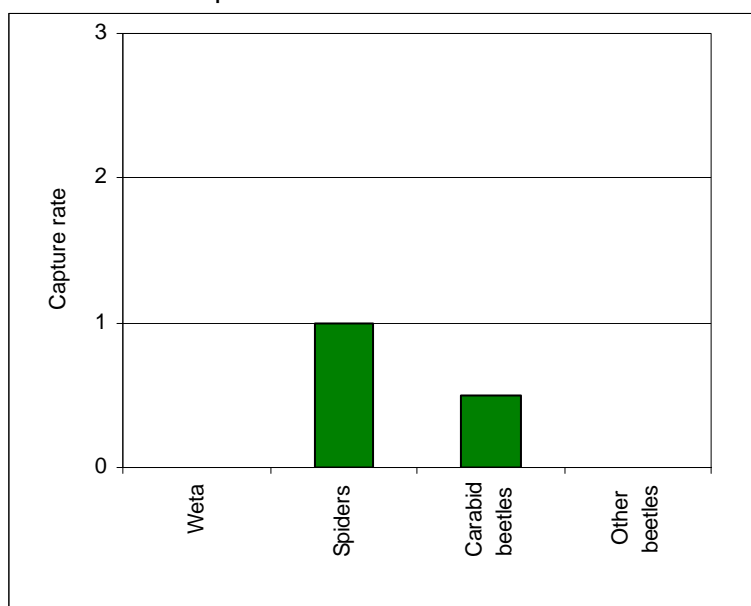
*Phenology:*

- A wide range of species was observed flowering or fruiting during the surveys

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma macrocarpa</i>	Coastal karamu		✓				
<i>Coprosma robusta</i>	Karamu	✓	✓			✓	
<i>Cordyline australis</i>	Cabbage tree	✓					
<i>Dracophyllum latifolium</i>	Neinei						✓
<i>Elaeagnus x reflexa</i>	Elaeagnus				✓		
<i>Gahnia</i> sp.	Cutty grass			✓	✓		
<i>Geniostoma rupestre</i>	Hangehange	✓		✓			✓
<i>Hedycarya arborea</i>	Pigeonwood		✓				
<i>Hoheria populnea</i>	Lacebark		✓				
<i>Knightia excelsa</i>	Rewarewa	✓					
<i>Leptospermum scoparium</i>	Manuka		✓				✓
<i>Leucopogon fasciculatus</i>	Mingimingi	✓	✓				
<i>Macropiper excelsum</i>	Kawakawa	✓		✓	✓		
<i>Melicytus ramiflorus</i>	Mahoe	✓				✓	
<i>Metrosideros excelsa</i>	Pohutukawa		✓			✓	✓
<i>Myrsine australis</i>	Red matipo		✓		✓		✓
<i>Olearia furfuracea</i>	Akepiro	✓					
<i>Pittosporum crassifolium</i>	Karo	✓		✓			
<i>Pseudopanax arboreus</i>	Five finger		✓				
<i>Pseudopanax lessonii</i>	Houpara		✓		✓	✓	✓
<i>Ripogonum scandens</i>	Kareao				✓		
<i>Sophora chathamica</i>	Kowhai	✓	✓		✓		✓
<i>Vitex lucens</i>	Puriri	✓	✓	✓	✓	✓	✓

**Invertebrate communities:**

- Spiders were the most abundant of the indicator groups but even they were scarce
- Carabid beetles were present in low numbers but weta were not detected



**Site summary:**

The Karaka Park / Green Bay Beach monitoring site includes part of a pohutukawa-dominated coastal native forest remnant that extends along the northern foreshore of the Manukau Harbour. The site also includes native forest at varying stages of regeneration, a shelly beach, tidal mudflats, and open grassland / recreational areas.

The native vegetation has good species diversity and the more mature forest areas are characterised by a multi-tiered structure. Consequently, the site provides good bird nesting habitat. Vegetation and phenology monitoring also confirms that the site's native vegetation provides year-round food sources for native birds.

Kereru were detected during distance sampling conducted in spring 2003 but have not been observed since. Tui conspicuousness and population density has fluctuated considerably since monitoring commenced but remains similar to levels recorded during baseline surveys. The conspicuousness of the other indicator species has remained relatively steady from survey to survey.

Terrestrial invertebrate monitoring revealed the presence of only two of the four indicator groups. The relatively depauperate invertebrate fauna in the samples may be a result of surface water run-off from the residential area immediately above the reserve. During periods of heavy or persistent rain, much of the leaf litter is washed further down the coastal slopes. Ecological processes such as water filtration and nutrient cycling may be affected, especially along the higher parts of the reserve adjacent to residential dwellings. A significant feature of the Karaka Park / Green Bay Beach monitoring site is that the native forest grows right to the high water mark along much of the site's coastline. These factors are particularly important given that the site's surface- and ground-water flows directly into the Manukau Harbour.

### 3.26 Kay Road Balefill

**Location:** Kay Road, Swanson

**Habitat:** Secondary kauri-tanekaha-rimu forest, regenerating kauri-kanuka forest, planted manuka scrubland

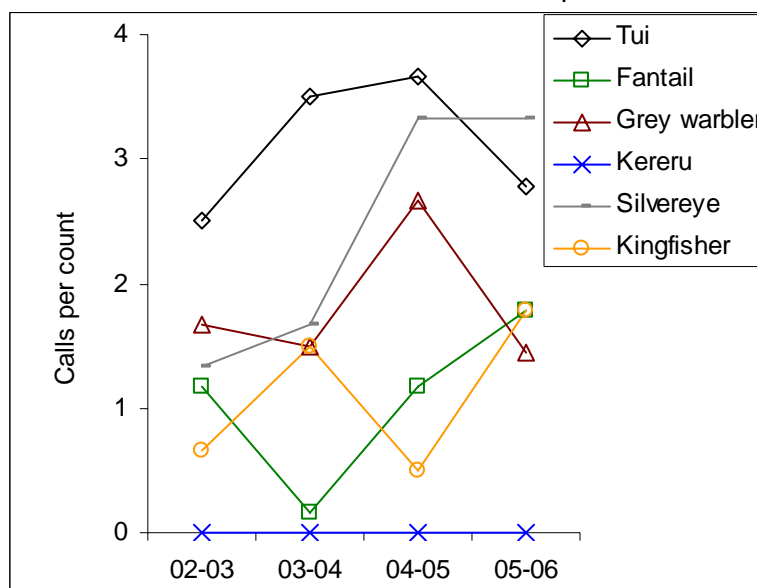
**Recent ecological management actions:** Weed control, rodent control, revegetation, possum control

#### Avifauna:

*Five-minute bird counts:*

- Kereru were not recorded
- Silvereeye, fantail and kingfisher conspicuousness has increased
- The conspicuousness of grey warblers and tuis decreased slightly during summer 2005-6 compared to the previous years conspicuousness

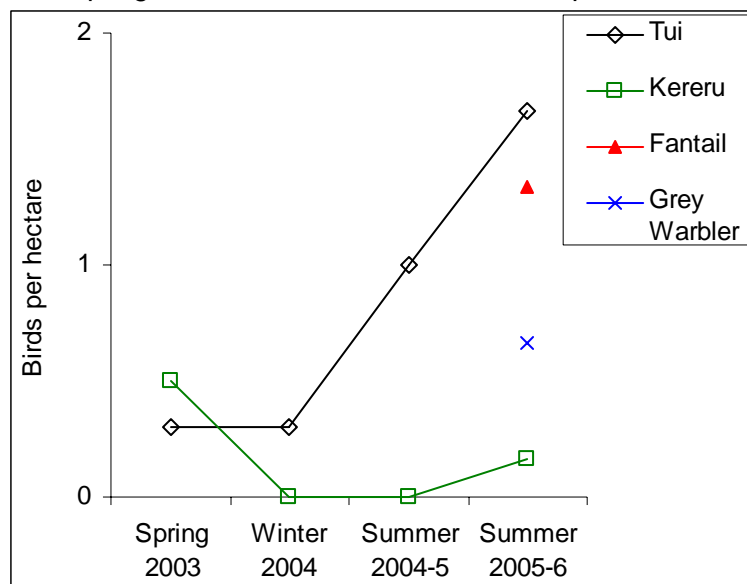
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Tui have consistently increased since spring 2003
- Kereru were only recorded during spring 2003
- Grey warblers and fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	5	100
Mouse	0	0
Possum	1	20
Mustelid	0	0
Hedgehog	0	0

- Number of wax tags = 9

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	5	56
Mouse	2	22
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 12 species was recorded across all vegetation tiers
- Four native species were present in the subcanopy and three were present in the canopy (kauri, kahikatea and rewarewa)
- Six native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Agathis australis</i>		2			4	
<i>Corynocarpus laevigatus</i>		2	2			
<i>Dacrycarpus dacrydioides</i>					3	
<i>Knightia excelsa</i>				3	3	
<i>Leptospermum scoparium</i>	4	4	5	2		
<i>Phyllocladus trichomanoides</i>	3	3	3	3		
<i>Pinus radiata</i> *	2	2	2	2	3	
<i>Pittosporum crassifolium</i>			2			
<i>Pittosporum eugenioides</i>			3			
<i>Podocarpus totara</i>		1				
<i>Rhopalostylis sapida</i>			3	3		
<i>Sophora fulvida</i>			1			

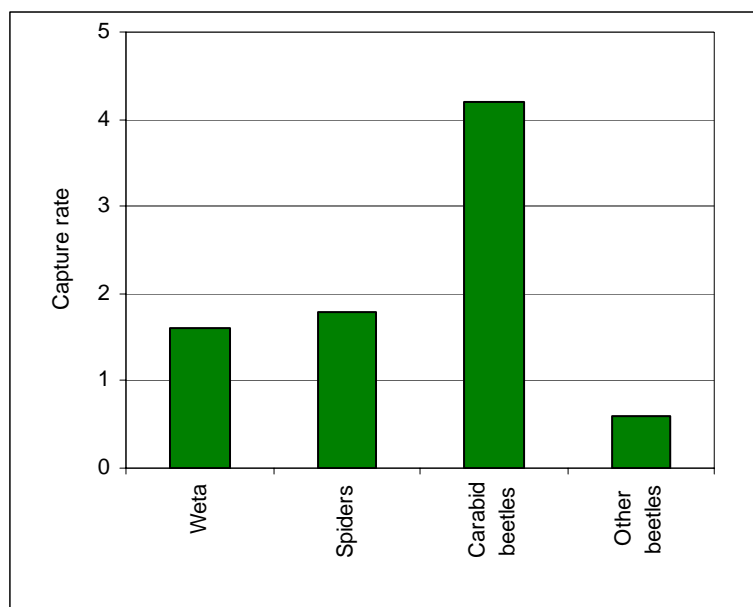
*Phenology:*

- Only kanuka was observed flowering during summer 2004-5
- At least two species were observed fruiting during each survey

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma robusta</i>	Karamu						✓
<i>Corynocarpus laevigatus</i>	Karaka	✓					
<i>Geniostoma rupestre</i>	Hangehange	✓		✓			
<i>Hebe</i> sp.	Koromiko						✓
<i>Kunzea ericoides</i>	Kanuka					✓	
<i>Leptospermum scoparium</i>	Manuka	✓	✓	✓	✓		✓
<i>Phormium cookianum</i>	Mountain flax	✓	✓				
<i>Pittosporum crassifolium</i>	Karo	✓					
<i>Pittosporum eugenioides</i>	Tarata	✓					
<i>Pittosporum tenuifolium</i>	Kohuhu	✓			✓		✓
<i>Pomaderris kumeraho</i>	Kumerahou	✓		✓			
<i>Sophora microphylla</i>	Kowhai	✓	✓				
<i>Toronia toru</i>	Toru	✓					
<i>Ulex europaeus</i> *	Gorse	✓		✓			

**Invertebrate communities:**

- All indicator groups were present
- Carabid beetles were the most abundant indicator group whereas other beetles were relatively scarce
- Spiders and weta were moderately abundant

**Site summary:**

The Kay Road Balefill site is 33 hectares in area with approximately 19 hectares of regenerating native forest surrounding the 14 hectare area formerly used for refuse bale disposal and associated activities. An extensive site rehabilitation programme has been implemented. In addition to pollution prevention measures, the programme also includes extensive revegetation. Several pest control projects have also been undertaken at the site - including predator trapping.

Kereru were not detected during any of the 5-minute counts but distance sampling revealed their presence during two of the four surveys - including the most recent one. The other native bird indicator species have fluctuated considerably in conspicuousness over the four years of monitoring. However, most were more conspicuous during the most recent surveys than they were when monitoring commenced during 2002-3.

Kay Road Balefill's native vegetation is diverse and includes canopy species such as kauri, tanekaha and kahikatea. Many pine trees are present with some larger specimens in the canopy. The combination of regenerating forest native forest, tall exotic trees, revegetated shrubland, and open areas provides good habitat for a wide range of native and introduced birds. The diverse vegetation provides ample food and nesting habitat resources.

Rodents and possums are present at Kay Road Balefill with rats being abundant. The indigenous flora and fauna at the site would benefit from regular (e.g., annual) pest / predator control programme. The complete range of terrestrial invertebrate indicator groups was recorded in the leaf litter. This supports the conclusion that overall, much the site is in good ecological health.

### 3.27 Hobsonville Esplanade

**Location:** Hudson Bay Road, Hobsonville

**Habitat:** Regenerating kanuka forest, intertidal mudflats, mangrove shrubland, pasture

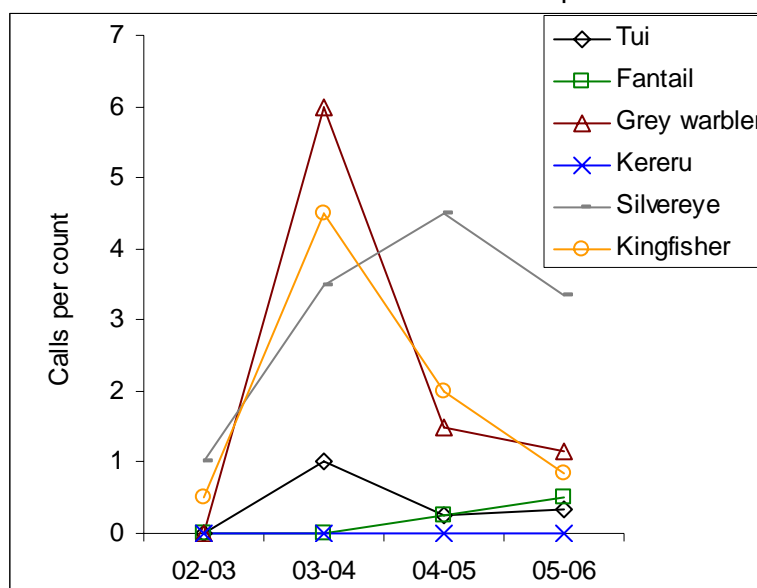
**Recent ecological management actions:** None

#### Avifauna:

*Five-minute bird counts:*

- Grey warbler, kingfisher and tui conspicuousness all spiked during 2003-4, decreasing since then
- Kereru were not detected
- Fantails have increased since 03-04
- Silvereyes were the most conspicuous indicator bird species

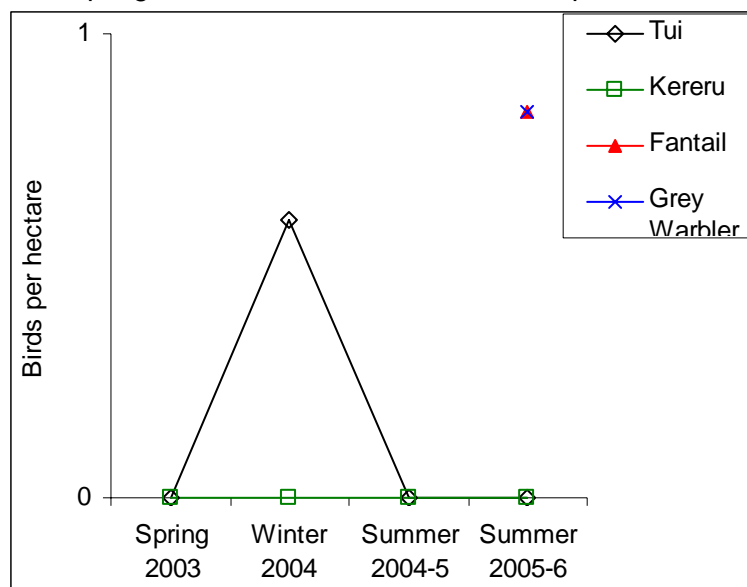
Five-minute count results for native bird indicator species 2002-3 to 2005-6



*Distance sampling:*

- Kereru were not observed during any survey
- Tui were only detected during winter 2004 however they were of low abundance even when present
- Grey warblers and fantails were present

Distance sampling results for native bird indicator species 2003 to 2005-6



**Pest communities:**

- Number of tracking tunnels = 5

Species	No. of tracking tunnels with tracks	% of tracking tunnels with tracks
Rat	0	0
Mouse	0	0
Possum	3	60
Mustelid	0	0
Hedgehog	0	0

- Number of wax tags = 10

Species	No. of wax tags with chew marks	% of wax tags with chew marks
Rat	6	60
Mouse	3	30
Possum	0	0

**Plant communities:***Vegetation structure:*

- A total of 16 species was recorded across all vegetation tiers
- Cabbage trees were present in the subcanopy but no other native species were present in the subcanopy or canopy
- Nine native species were regenerating

Species	Seedlings	Saplings	Shrubs	Subcanopy	Canopy	Emergent
<i>Coprosma lucida</i>	2	2	3			
<i>Coprosma rhamnoides</i>			2			
<i>Coprosma robusta</i>	2	2	3			
<i>Cordyline australis</i>				2		
<i>Cyathodes juniperina</i>	2	2	3			
<i>Dianella nigra</i>		3				
<i>Geniostoma rupestre</i>	3	3	3			
<i>Hakea sericea</i> *				2		
<i>Leptospermum scoparium</i>	3	3	3			
<i>Leucopogon fasciculatus</i>	2	2	3			
<i>Ligustrum sinense</i> *	3	3	3			
<i>Melicytus ramiflorus</i>			2			
<i>Myrsine australis</i>	3	3	3			
<i>Paraserianthes lophantha</i> *	3	3	3			
<i>Pinus radiata</i> *	2	2	2	4	2	
<i>Podocarpus totara</i>	2	2	2			

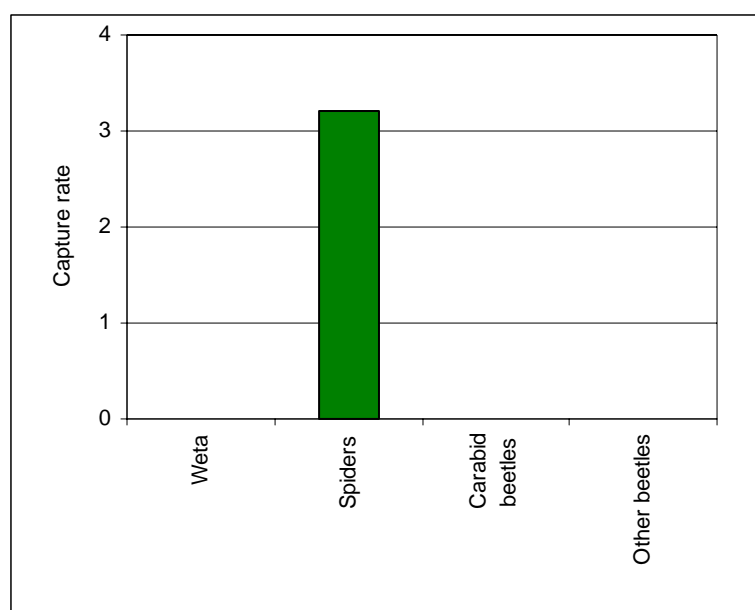
*Phenology:*

- Apart from summer 2004-5 when no species were observed flowering, at least five species were recorded flowering and at least four species were recorded fruiting during each survey

Species	Common name	Spring 2003		Winter 2004		Summer 2004-5	
		Flowering	Fruiting	Flowering	Fruiting	Flowering	Fruiting
<i>Coprosma lucida</i>	Shining karamu	✓	✓	✓			
<i>Coprosma robusta</i>	Karamu	✓	✓				✓
<i>Cyathodes juniperina</i>	Prickly mingimingi	✓			✓		✓
<i>Geniostoma rupestre</i>	Hangehange	✓	✓	✓			✓
<i>Kunzea ericoides</i>	Kanuka						✓
<i>Leptospermum scoparium</i>	Manuka	✓	✓	✓			✓
<i>Leucopogon fasciculatus</i>	Mingimingi		✓	✓			
<i>Ligustrum lucidum</i> *	Tree privet				✓		
<i>Ligustrum sinense</i> *	Chinese privet						✓
<i>Myrsine australis</i>	Red matipo				✓		✓
<i>Paraserianthes lophantha</i> *	Brush wattle		✓	✓			✓
<i>Solanum mauritianum</i> *	Woolly nightshade			✓	✓		

**Invertebrate communities:**

- Spiders were the only indicator group detected

**Site summary:**

The Hobsonville Esplanade monitoring site is primarily a kanuka-dominated riparian margin between open grassland along the inland boundary (Defence Department) and the tidal flats of the Waitemata Harbour along the foreshore. The combination of open grassland, regenerating kanuka forest and tidal flats provides foraging and nesting habitat for a wide range of native and introduced bird species.

With the exception of kereru which has not been detected at the site, all native bird indicator species have fluctuated considerably in conspicuousness from survey to survey. However, all were more conspicuous during the summer 2005-6 survey than they were when monitoring began during summer 2002-3. Distance sampling revealed that tui, fantails and grey warblers populations are at relatively low density.

Rodents and possums are present at the site. While these pests are probably adversely affecting the flora and fauna of the site, the site is of lower priority for predator control compared with many of the other sites. The lack of three of the four terrestrial macroinvertebrate indicator groups shows that a healthy leaf litter is yet to form beneath the regenerating kanuka forest.

## 4. Survey Overview

### Avifauna

Thirty-four bird species were detected during the 147 five-minute bird counts that were undertaken at the 55 counting stations spread over the 27 sampling sites. The most conspicuous native bird species in descending order of conspicuousness were silvereye, tui, grey warbler, kingfisher and fantail. The most conspicuous introduced bird species in descending order of conspicuousness were sparrow, myna, mallard, goldfinch, blackbird and chaffinch.

Tuis were recorded at all of the 27 sampling sites. Average calls per count were highest at Douglas Scenic Reserve (5.0), Claude Abel Reserve (4.3), Te Henga Wetland (4.2), Rahui Kahika (3.9), and Karekare Beach (3.8).

Kereru were recorded at eight of the 27 monitoring sites (up from three sites in the summer 2004-5 surveys): Warner Park (average population density = 1.1 per hectare), Douglas Scenic Reserve (0.8), Tram Valley Road (0.8), Mountain Road Esplanade (0.4), Rahui Kahika Reserve (0.3), Takaranga Reserve (0.3), Henderson Valley Scenic Reserve (0.3) and Kay Road Balefill (0.2).

Fantails were present at 24 of the 27 monitoring sites. Fantails were relatively abundant at: Tram Valley Road, Mountain Rd Esplanade, Kay Road Balefill, Kellys Bridge Esplanade, Waikumete Cemetery, Catherine Esplanade and Brigham Creek Recreational Reserve. Sites without fantails were: Bethells Beach, Harbourview - Orangihina and Karaka Park / Green Bay Beach.

Grey warblers were present at 24 of the 27 monitoring sites. Grey Warblers were relatively abundant at: Rahui Kahika Reserve, Mountain Rd Esplanade, Tram Valley Road, Claude Abel Reserve, Te Henga Wetland and Karekare Beach. Sites without grey warblers were: Catherine Esplanade, Huia Reserve, and Harbourview - Orangihina.

While it is difficult to make generalisations about bird population trends across the network of monitoring sites, it is worthwhile summarising the patterns observed. The overall 5-year trend of each native bird indicator species at each site is shown in Table 5. The trend data is further analysed in Table 6 in which trends of indicator species are summarised by the number of monitoring sites at which each trend type was observed.

Sites where three or more native bird indicator species increased in conspicuousness between the summer 2002-3 survey (when Envirologic Limited took over the monitoring programme) and the most recent survey (summer 2005-6) latest survey included: Douglas Scenic Reserve, Chorley Reserve, Lowtherhurst Reserve, Oratia Esplanade, Takaranga Reserve and Karaka Park. Only two sites had three or more native bird indicator species that decreased in conspicuousness over the same period: Huia Reserve and Henderson Scenic Reserve.

Table 5. Summary of native bird indicator species' population trends since summer 2002-3. (↑ = increase; ↓ = decrease; → = stable; ↔ = no clear trend; - = absent)

Site	Species					
	Tui	Fantail	Grey warbler	Kereru	Silvereeye	Kingfisher
Te Henga Wetland	↑	→	↑	-	→	↔
Bethells Beach	→	↓	↔	-	↑	↑
Mountain Rd Esplanade	→	↓	↑	→	↓	↑
Douglas Scenic Reserve	→	↓	↑	↑	↓	↑
Huia Reserve	↓	↑	↔	-	↓	↓
Henderson Valley Scenic Reserve	↓	↓	→	-	↓	↑
Chorley Reserve / Sunline Park	↔	↑	↑	-	↓	↑
Shona Esplanade	↓	→	→	↓	→	↑
Tram Valley Road	↓	→	→	→	→	↑
Gill Esplanade	↔	↓	↓	-	↑	↔
Swanson Scenic Reserve	→	→	↓	-	↑	↑
Lowtherhurst Reserve	↑	↔	↑	-	↑	↔
Warner Park	↓	↑	→	→	↑	→
Catherine Esplanade	↔	↑	-	-	↑	↑
Waikumete Cemetery	→	↔	→	-	→	→
Oratia Esplanade	↑	↑	→	-	↑	↑
Brigham Creek Reserve	↑	↑	→	-	↓	↑
Kellys Bridge Esplanade	↓	↑	→	-	↔	↔
Rahui Kahika Reserve	→	→	↑	→	↑	→
Moire Park	↑	↑	→	-	→	→
Takaranga Reserve	↔	↑	→	-	↑	↑
Harbourview Park	↑	-	-	-	↑	→
Karekare Beach	↓	→	→	→	→	↑
Claude Abel Reserve	→	→	↔	-	↑	↔
Karaka Park / Green Bay Beach	→	→	↑	-	↑	↑
Kay Road Balefill	→	↔	↔	-	↑	↔
Hobsonville Esplanade	→	↑	↔	-	↑	↔

Table 6. Summary of trends in native bird indicator species conspicuousness since summer 2002-3.

Species	Number of monitoring sites				
	Increasing (↑)	Decreasing (↓)	Stable (→)	No clear trend (↔)	Absent (-)
Tui	6	7	10	4	0
Fantail	10	5	8	3	1
<b>Grey warbler</b>	<b>7</b>	<b>2</b>	<b>11</b>	5	2
<b>Kereru</b>	<b>1</b>	<b>1</b>	5	0	20
<b>Silvereye</b>	<b>14</b>	6	6	1	0
<b>Kingfisher</b>	14	1	5	7	0

Table 7. Occurrence of tui and kereru during distance sampling 2003 to 2006 (Includes all individuals - not just those within 20m of the transect)

Site name	Tui recorded by DS* during spring 2003	Tui recorded by DS during winter 2004	Tui recorded by DS during summer 2004-5	Tui recorded by DS during summer 2005-6	Kereru recorded by DS during spring 2003	Kereru recorded by DS during winter 2004	Kereru recorded by DS during summer 2004-5	Kereru recorded by DS during summer 2005-6
Te Henga Wetland		✓	✓	✓		✓		
Bethells Beach		✓	✓	✓				
Mountain Rd Esplanade	✓	✓	✓	✓				✓
Douglas Scenic Reserve	✓	NS*	✓	✓	✓	NS*	✓	✓
Huia Reserve		✓	✓	✓				
Henderson Valley Reserve	✓	✓	✓	✓		✓		✓
Chorley Reserve		✓	✓	✓				
Shona Esplanade	✓	✓	✓	✓				
Tram Valley Road	✓	✓	✓	✓				✓
Gill Esplanade	✓	✓	✓	✓				
Swanson Scenic Reserve	✓	✓	✓	✓		✓		
Lowtherhurst Reserve	✓	✓	✓	✓	✓			
Warner Park	✓	✓	✓	✓	✓		✓	✓
Catherine Esplanade	✓		✓	✓				
Waikumete Cemetery	✓	✓	✓	✓				
Oratia Esplanade	✓	✓	✓	✓				
Brigham Creek Reserve	✓	✓		✓				
Kellys Bridge Esplanade	✓		✓	✓				
Rahui Kahika Reserve	✓	✓	✓	✓	✓	✓		✓
Moire Park	✓	✓	✓	✓				
Takaranga Reserve	✓	✓	✓	✓		✓		
Harbourview Park		✓						
Karekare Beach	✓	✓	✓	✓				
Claude Abel Reserve	✓	✓	✓	✓	✓	✓	✓	✓
Karaka Park	✓	✓	✓	✓	✓			
Kay Road Balefill	✓	✓	✓	✓	✓			✓
Hobsonville Esplanade		✓						

Note: DS = Distance Sampling; NS = not surveyed

It is likely that variation in distance sampling results from survey to survey (see Table 7) indicates seasonal variation in tui and kereru use of sampling sites rather than population trends. Distinguishing between seasonal variation and population trends requires repeated annual sampling in all seasons. The conspicuousness (and probably abundance) of mobile birds with large home ranges such as tui and kereru is strongly influenced by food availability and the flowering and fruiting of individual trees or patches of vegetation. Tui and kereru undertake one-off or seasonal visits to some reserves to access individual trees with abundant nectar (e.g., kowhai) and / or fruits (e.g., miro). For example, tui can be very conspicuous at sites with abundant flowering flax (e.g., Claude Abel Reserve and Kay Road Balefill). A group of six kereru was observed feeding on a single pigeonwood tree at Douglas Scenic Reserve that was fruiting heavily. Similarly, certain individual exotic and native trees on private land also attract tui and kereru during flowering and / or fruiting.

### **Pest monitoring**

The tracking tunnel survey for pests has highlighted that rats, mice, and possums are present at most of the city-wide ecological monitoring sites (Table 8). When considering the results it is important to note that hedgehogs probably accessed the tracking tunnels and consumed the bait before other pests encountered the tracking tunnels. Therefore, rodent abundance may have been underestimated at sites with high hedgehog tracking rates (e.g., Mountain Road Esplanade and Shona Esplanade).

Rodents and possums prey on native fauna and impede the regeneration of native vegetation. Mice prey on invertebrates and small lizards and consume seeds and seedlings at or near ground level. Rats also prey on birds, eggs, lizards and invertebrates and consume seeds and seedlings. The larger size and superior climbing and swimming abilities of rats makes them more ecologically destructive than mice. Possum populations consume large quantities of foliage, flowers and fruits of their preferred food plants and are known to prey on birds and other fauna.

Collectively, rodents and possums alter the composition and structure of native forest and suppress or eliminate native fauna populations. Methods have been developed to control rodents and possums to sufficiently low levels to allow native flora and fauna to recover. Control programmes usually consist of regular, systematic application of trapping and / or poisoning regimes. One-off control applications are sometimes used in remote areas (e.g., aerial poison drops) or to eradicate pests from islands or predator-fenced areas. Given the relatively high cost and ongoing nature of pest control in typical urban reserve habitats, it is recommended that resources be targeted towards protecting the most ecologically valuable sites (e.g., sites with kereru) from the pests that threaten those ecological values (e.g., rats and possums).

Controlling mice is costly because their small home ranges means that a large number of traps or bait stations is required to cover a relatively small area. Therefore, mouse control is only recommended at sites that are important refuges for significant invertebrate or lizard populations. Mustelids were not detected. However, even low numbers of mustelids can have serious adverse impacts on native wildlife, especially birds, lizards and invertebrates. At sites where ecological values are sensitive to predators (e.g., kereru), predator control should be extended to target mustelids.

While not surveyed, cats (domestic and feral) almost certainly prey on native wildlife across city-wide biodiversity monitoring sites. The issue of reducing predation by domestic cats should be investigated but one possible option is to inform local residents bordering ecologically significant sites that they can contribute to ecological

restoration efforts in their area by desexing their cats, keeping them inside at night, and reporting any feral cats in the area.

Table 8. Pest detection rates recorded with tracking tunnels and wax tags.

Site	Detection rates (%)*				
	Rat	Mouse	Possum	Mustelid	Hedgehog
Te Henga Wetland	0 / 22	100 / 56	0 / 0	0	20
Bethells Beach	0 / 0	20 / 22	0 / 0	0	40
Mountain Rd Esplanade	0 / 0	40 / 70	0 / 0	0	100
Douglas Scenic Reserve	75 / 14	100 / 29	0 / 0	0	0
Huia Reserve	-	-	-	-	-
Henderson Valley Scenic Reserve	0 / 20	40 / 10	40 / 10	0	0
Chorley Reserve / Sunline Park	25 / 0	25 / 17	0 / 33	0	50
Shona Esplanade	0 / 0	20 / 57	20 / 0	0	100
Tram Valley Road	0 / 11	20 / 33	0 / 0	0	100
Gill Esplanade	40 / 0	100 / 80	0 / 0	0	100
Swanson Scenic Reserve	40 / 50	80 / 50	20 / 0	0	0
Lowtherhurst Reserve	80 / 0	40 / 50	0 / 0	0	20
Warner Park	60 / 0	40 / 44	0 / 0	0	80
Catherine Esplanade	0 / 0	0 / 44	0 / 0	0	100
Waikumete Cemetery	0 / 0	20 / 50	40 / 0	0	80
Oratia Esplanade	80 / 20	60 / 30	20 / 0	0	100
Brigham Creek Recreational Reserve	80 / 56	60 / 44	20 / 0	0	20
Kellys Bridge Esplanade	0 / 60	33 / 40	0 / 0	0	100
Rahui Kahika Reserve	0 / 0	40 / 60	0 / 0	0	40
Moire Park	0 / 22	0 / 22	20 / 0	0	20
Takaranga Reserve	0 / 30	25 / 50	0 / 0	0	100
Harbourview Park	20 / 20	20 / 60	0 / 0	0	80
Karekare Beach	100 / 0	20 / 67	0 / 0	0	0
Claude Abel Reserve	60 / 0	40 / 56	0 / 11	0	100
Karaka Park / Green Bay Beach	0 / 13	75 / 50	0 / 0	0	0
Kay Road Balefill	100 / 56	0 / 22	20 / 0	0	0
Hobsonville Esplanade	0 / 60	0 / 30	60 / 0	0	0

\* For rat, mouse and possum, figures are % tracking tunnels with tracks and % wax tags with chew marks; for mustelid and hedgehog only % tracking tunnels with tracks is given.

## 5. General Discussion

### Value of biodiversity monitoring

Biodiversity is one of the important components of a healthy, functioning ecosystem. As a result, biodiversity monitoring has become a commonly used method for assessing the health of native ecosystems (Allen *et al.* 2003). Biodiversity monitoring is a versatile management tool which can be used across a range of taxa, from vegetation (e.g., Dickinson *et al.* 1992) through invertebrates (e.g., Curtis 2003) to avifauna (e.g., Mörtberg 2004).

### Value of green corridors

Negative impacts of habitat fragmentation can be lessened if the fragments are linked by corridors (Townsend and Levey 2005), linear tracts of habitat containing vegetation similar to that of the larger fragments. Corridors provide routes between spatially isolated resources such as food. Corridors therefore play an important role in maintaining biodiversity within a modified landscape such as that of Waitakere City. This has been recognised by WCC, which aims to increase the amount of corridor connectivity between habitat fragments as part of their Green Network revegetation programme. Furthermore, it has been noted that aside from acting as links between fragments, wider corridors may provide permanent habitats for smaller animal species (Sieving *et al.* 2000). This is a potentially important concept which should be considered when planning corridor establishment or enhancement in Waitakere City.

### Threats to biodiversity

Urbanisation is one of the greatest threats to biodiversity worldwide (Ricketts and Imhoff 2003), and habitat fragmentation is a common result of urban expansion. Loss of native biodiversity occurs as a result of pressures placed on the remaining ecosystem following fragmentation (Daily *et al.* 1997).

Threats to biodiversity that have been associated with fragmented landscapes include:

- Replacement of native flora and fauna by introduced species
- Separation of breeding populations
- Loss of suitable breeding sites
- Increased predation by introduced mammalian predators
- Loss of plant species due to the absence of their animal pollinators or dispersers
- Increased edge:interior ratio resulting in smaller fragments being dominated by edge species
- Loss of traditional food supplies for specialist feeders
- Increased sedimentation of waterways resulting in smothering of plants and invertebrate habitat.
- Pollution and physical alteration of waterways

In Waitakere City the removal or fragmentation of habitat is placing pressure on local native biodiversity as described above. Careful monitoring and proactive management are vital (Dickinson *et al.* 1992) if the native biodiversity of Waitakere City is to be retained and enhanced.

## 6. Recommendations

### Biodiversity Monitoring

- Continue the Waitakere City Biodiversity Monitoring Programme.

The biodiversity monitoring programme provides information that can be used to evaluate the effectiveness of management actions - especially biodiversity protection initiatives - and guide future actions. The biodiversity monitoring programme also fulfils statutory obligations (e.g., Resource Management Act 1991) for territorial authorities to monitor biodiversity.

### Biodiversity Management

- Initiate a programme to recover kereru populations and maintain tui populations by controlling rodents and mustelids.

Tui and kereru are very important to the ecology of Waitakere City's bush areas. Many native trees depend on them for pollination and seed dispersal. If these species decline further or become locally extinct, many components of native vegetation communities will no longer be able to regenerate naturally. Controlling rodents and mustelids to protect tui and kereru will also benefit many other native species such as lizards, invertebrates and plants.

- Control rodents and mustelids at the following sites:
  - Te Henga Wetland
  - Karaka Park
  - Warner Park
  - Takaranga Park
  - Harbourview - Orangihina Wetland
  - Rahui Kahika Reserve
  - Shona Esplanade
  - Moire Park
  - Lowtherhurst Reserve
  - Kay Road Balefill

These sites provide breeding habitat for rare (e.g., fernbird) and/or ecologically important (e.g., kereru) species. Protecting faunal communities there will ensure that local extinction is avoided. As Waitakere City's extensive areas of revegetation develop there will be local sources of native fauna to colonise the restored habitat.

- Predator control at the above sites should be undertaken during the breeding season for native birds (November to February).

It is the eggs and chicks of native birds that are most vulnerable to predation. Rather than controlling rodents and mustelids all year round, resources should be targeted to the period when the greatest benefit can be achieved.

- Revegetation projects should increase the focus on providing habitat and year-round food for native birds by including greater proportions of the following species:
  - Kanuka: Grows quickly and provides bird nesting sites and habitat for native geckos.
  - Puriri: Fruits and flowers throughout the year and from a young age.

- Flax: A combination of NZ flax and mountain flax provides a sustained nectar source for tuis when their energy requirements are highest for breeding. Provides excellent habitat for native lizards and wetas.
  - Red matipo: Provides berries throughout much of the year. A good replacement for the privet that occupies many of Waitakere City parks and reserves. Provides habitat for geckos and good nest sites for small native birds.
  - Karamu: A source of berries throughout much of the year. Fruits from a young age.
  - Lacebark: Leaf buds provide a source of food for kereru in early spring when other food sources are scarce.
  - Cabbage tree: A good source of berries for kereru and other frugiverous birds leading into winter.
- Opportunities for large-scale revegetation at the monitoring sites are limited but the focus on the above plant species list should also be applied to other Waitakere City parks and reserves, and at sites where revegetation is included in resource consent conditions.
  - Native birds, lizards and invertebrates can occur at sites that seem degraded or devoid of native vegetation. Rank grassland, industrial areas and weed infested sites are sometimes important refuges for native fauna. Ecological assessments should be required for consent applications even where habitat quality may appear to be marginal. Council staff processing resource consents should ensure that ecological assessments include information on lizards, bats, and invertebrates.
  - Activities such as large-scale revegetation and weed removal (including associated site clean-ups) can have adverse impacts on native fauna - particularly lizards and invertebrates. Planning for such projects should include an assessment of potential adverse impacts.

### **Information dissemination**

- Ensure that the information in this report (and previous biodiversity monitoring reports) is provided to council staff such as park managers, resource managers and consent teams.

It is important that council staff with responsibilities for Waitakere City's environment are aware of the biodiversity monitoring programme and the recommendations arising from the programme. One way of achieving this is through a regular (e.g., annual) presentation about the programme, and its outcomes, to WCC staff with biodiversity-related roles (e.g., park management, consent processing / monitoring, environmental monitoring).

## 7. References

- Adams, L. 2001. The threat of collection to our gecko populations. *Rare Bits - The Newsletter About Threatened Species Work* 19: 1-2.
- Allen, R.B., Bellingham, P.J.; Wisser, S. K. 2003. Developing a forest biodiversity monitoring approach for New Zealand. *New Zealand Journal of Ecology* 27: 207-220.
- Anderson, A.N.; Fisher, A.; Hoffmann, B.D.; Read, J.L.; Richards, R. 2004. Use of terrestrial invertebrates for biodiversity monitoring in Australian rangelands, with particular reference to ants. *Austral Ecology* 29(1): 87-92.
- Chapman, S.; Alexander, J. 2003. Waitakere City Biodiversity Monitoring Programme: birds, lizards and frogs. Unpublished report for the Waitakere City Council.
- Chapman, S.; Alexander, J. 2004. Waitakere City Biodiversity Monitoring Programme: five minute bird counts. Unpublished report for the Waitakere City Council.
- Clout, M.N.; Hay, J.R. 1989. The importance of birds as browsers, pollinators and seed dispersers in New Zealand forests. *NZ Journal of Ecology* 12: 27-32.
- Curtis, C.L. 2003. *Terrestrial invertebrates as bioindicators of habitat restoration*. Unpubl. MSc Thesis, The University of Auckland, Auckland.
- Daily, G.C.; Alexander, S.; Ehrlich, P.R.; Goulder, L.; Lubchenco, J.; Matson, P.A.; Mooney, H.A.; Postel, S.; Schneider, S.H.; Tillman, D.; Woodwell, G.M. 1997. *Issues in Ecology #2. Ecosystem services: Benefits supplied to human societies by natural ecosystems*. Ecological Society of America, Washington DC.
- Dawson, D.G.; Bull, P.C. 1975. Counting birds in New Zealand forests. *Notornis* 22: 101-109.
- Denyer, K.; Cutting, M.; Campbell, G.; Green, C.; Hilton, M. 1993. Waitakere ecological district: survey report for the protected natural areas programme. Auckland Regional Council, Auckland.
- Department of Conservation; Ministry for the Environment. 2000. The New Zealand biodiversity strategy; our chance to turn the tide. Ministry for the Environment, Wellington, New Zealand.
- Dickinson, K.J.M.; Mark, A.F.; Lee, W.G. 1992. Long-term monitoring of non-forest communities for biological conservation. *New Zealand Journal of Botany* 30: 163-179.
- Eve, L. 1997. Ecological aspects of urban forest fragment. Unpublished M.Sc. thesis. University of Auckland.
- Froude, V. 1998. Environmental performance indicators: an analysis of potential indicators for terrestrial biodiversity. Technical paper number: 47. Ministry for the Environment, New Zealand.

Gill, B.; Whitaker, T. 1996. New Zealand Frogs and Reptiles. David Bateman, Auckland. 112 p.

Green, C. 2000. Pitfall trapping for long-term monitoring of invertebrates. *Ecological Management* 8: 73-93.

Handford, P. 2004. FORMAK Forest Monitoring Manual [www.formak.co.nz](http://www.formak.co.nz)

Heather, B.; Robertson, H. 1997. *Field guide to the birds of New Zealand*. Oxford University Press, New York.

Julian, A.; Davis, A.; Tyrrell, M. 1998. Draft report: ecological survey of Waitakere City lowlands: northwestern portion of Tamaki Ecological District. Unpublished Waitakere City Council report.

Mörtberg, U. 2004. *Landscape Ecological analysis and assessment in an urbanising environment – forest birds as biodiversity indicators*. Unpubl. PhD Thesis, Royal Institute of Technology, Stockholm.

Peace, J.E. 2004. *Distribution, habitat use, breeding and behavioural ecology of rainbow skinks (Lampropholis delicata) in New Zealand*. Unpubl. MSc Thesis, The University of Auckland, Auckland.

Ricketts, T.; Imhoff, M. 2003. Biodiversity, urban areas, and agriculture: locating priority ecoregions for conservation. *Conservation Ecology* 8: 1-3

Sieving, K.E.; Wilson, M.F.; De Santo, T.L. 2000. Defining corridor functions for endemic birds in fragmented south-temperate rainforest. *Conservation Biology* 14: 1120-1132.

Spurr, E.B.; Powlesland, R.G. 2000. Monitoring the impacts of vertebrate pest control operations on non-target wildlife species. *Department of Conservation Technical series 24*. Wellington, New Zealand.

Tewksbury, J.J.; Levey, D.J.; Haddad, N.M.; Sargent, S.; Orrock, J.L.; Weldon, A.; Danielson, B.J.; Brinkerhoff, J.; Damschen, E.I.; Townsend, P. 2002. Corridors affect plants, animals and their interactions in fragmented landscapes. *Proceedings of the National Academy of Sciences* 99: 12923-12926.

Townsend, P.A.; Levey, D.J. 2005. An experimental test of whether corridors affect pollen transfer. *Ecology* 86: 466-475.

Waitakere City Council. 1999. *Greenprint*. Waitakere City Council. Waitakere City, New Zealand.

Waitakere City Council. 2001. *State of the city report*. Waitakere City Council. Waitakere City, New Zealand.

Waitakere City Council. 2003. *Long term council community plan*. Waitakere City Council. Waitakere City, New Zealand.

Waitakere Ranges Protection Society. 1978. Wainamu - Te Henga: A Study. Waitakere Ranges Protection Society, Auckland.

Whitaker, A.H. 1987. The roles of lizards in New Zealand plant reproductive strategies. *New Zealand Journal of Botany* 25: 315-328.

## **8. Appendices**



**Waitakere City Council – Wildlife Survey Form**

Site name	Site No.	Date	Observers	Start time	Finish time	Total time	Species	Number	Encounter rate	Comments (weather, location, etc)
-----------	----------	------	-----------	------------	-------------	------------	---------	--------	----------------	-----------------------------------

**Comments:**

---

## Glossary

<b>Biodiversity</b>	The variability among living organisms and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
<b>Ecological restoration</b>	The active intervention and management of degraded biotic communities, landforms and landscapes in order to restore biological character, ecological and physical processes and their cultural and visual qualities.
<b>Ecological services</b>	Activities of a species that benefit other species or the biological community as a whole.
<b>Ecology</b>	The study of organisms in relation to one another and their surroundings.
<b>Ecosystem</b>	An interacting system of living and non-living parts such as sunlight, air, water, minerals and nutrients. Ecosystems can be small and short-lived, for example, water-filled tree holes or rotting logs on a forest floor, or large and long-lived such as forests or lakes.
<b>Habitat</b>	The place where an organism naturally occurs.
<b>Healthy ecosystem</b>	An ecosystem that is stable and sustainable, maintaining its organisation and autonomy over time and its resilience to stress.
<b>Indigenous species (or native)</b>	A plant or animal species which occurs naturally in New Zealand.
<b>Monitoring</b>	To systematically and repeatedly measure conditions in order to track changes.
<b>Species</b>	A population of individuals that are more or less alike, and that are able to breed and produce fertile offspring under natural conditions.
<b>Survey</b>	Systematically observing, counting or measuring characteristics at a defined location over a defined period of time.

Note: Most of these definitions are adapted from the New Zealand Biodiversity Strategy