

# Waitakere City Biodiversity Monitoring Programme:

Five-minute bird counts

May 2004



**Waitakere City Biodiversity  
Monitoring Programme:**

**Five-minute bird counts**

**May 2004**

*Bibliographic Reference:*

Chapman, S.; Alexander, J. 2004. Waitakere City Biodiversity Monitoring Programme: five minute bird counts. Unpublished report for the Waitakere City Council.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 - Environmental and Resource Consultants  
45 Turanga Road Waiatarua, Waitakere City, New Zealand  
Phone/Fax: +64 9 837 8266  
Website: [www.envirologic.co.nz](http://www.envirologic.co.nz)      Email: [info@envirologic.co.nz](mailto:info@envirologic.co.nz)

*Date:* May 2004

*Status:* Final

---

## Executive Summary

1. Under the 1991 Resource Management Act (RMA) the Waitakere City Council has a statutory obligation to monitor the environmental health of the City. In addition, Waitakere City Council's commitment to creating a sustainable future for the City requires effective monitoring of the City's biodiversity.
2. In the summer of 1996-7 the Waitakere City Council initiated a bird monitoring programme at five urban forest remnants. The aim of the monitoring was to measure the state of urban forest fragments and the health of urban bird populations. The programme was expanded in 2002 to include a total of 15 bird monitoring sites and was further expanded in 2003 to cover 27 bird monitoring sites.
3. The aims of the research described in this report are: 1) to provide data on the status of bird populations in Waitakere City, and 2) to analyse and interpret bird counts from 2003-4 and to compare the data with previous years to determine population trends.
4. A total of 35 bird species, 16 of which were native, were recorded during 110 five-minute counts undertaken at the 27 monitoring sites. The most conspicuous native bird species in descending order of conspicuousness were tui, silvereye, grey warbler and kingfisher.
5. Kereru were present at three of the 27 monitoring sites: Mountain Road Esplanade, Tram Valley Road and Rahui Kahika Reserve. This is a decline from the previous year when kereru were recorded at four sites. Tuis were present at most monitoring sites but numbers appeared to be low.
6. The most concerning finding of this round of counts is that a decline in fantail conspicuousness noted in previous years appears to be continuing. We recommend that fantails are included in the more detailed distance-sampling currently only used for monitoring tui and kereru populations.

---

## Table of Contents

1. Introduction.....	5
2. Methods.....	6
3. Results.....	13
4. Discussion and recommendations.....	24
5. References.....	29
6. Appendices.....	31
Bird monitoring database card.....	32
Conspicuousness of native birds at Waitakere City reserves.....	35
Glossary.....	38
CD-Rom.....	40

## 1. Introduction

Waitakere City is endowed with a natural heritage rich in ecological treasures that provide ecosystem services (see glossary), are of immense intrinsic value and contribute to our quality of life. Unfortunately, many important habitat refugees have become degraded through the impacts of weeds, animal pests, pollution, urban development and other disturbances (WCC 2001). These impacts have led to the local extinction of at least 10 plant species and 11 bird species and many of Waitakere City's remaining species have an uncertain future (WCC 2001). During 1993, in response to concerns about the state of the City's biodiversity, the Waitakere City Council (WCC) voluntarily adopted the International Convention on Biological Diversity (CBD) and embarked on an ambitious biodiversity protection programme (e.g., the Green Network; WCC 1999).

The WCC's Green Network or 'healthy habitat for a city' strategy during the last decade has utilised a wide range of measures to combat the City's biodiversity crisis. 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)

The WCC's commitment to halt the decline of the City's indigenous biodiversity was further strengthened by the introduction of the Resource Management Act 1991, and more recently, the national adoption of the New Zealand Biodiversity Strategy (2000). WCC's approach to environmental management has been strongly underpinned by the philosophy of close collaborations and partnerships with the community and other government agencies.

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. Indigenous birds are thought to be good indicators of environmental health because they are sensitive to a range of pressures including those resulting from predation and habitat modification. For example, kereru are considered a measure of forest health because they are the only dispersal agent for a number of large fruited trees (Froude 1998). Measuring the conspicuousness of native birds will provide council with information that can be used to indicate whether management activities are effectively halting the decline of native bird species.

During 1998 WCC commenced a bird monitoring programme that would monitor both the quality and ecological health of urban habitat remnants and populations of bird species. This report presents the latest results from the annual bird monitoring programme and provides a discussion of the overall current state of biodiversity in Waitakere City.

## 2. Methods

### Survey methodology

Bird populations were sampled at 27 sites throughout Waitakere City (Figure 1) during November and December 2003. 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. The other site is owned by the Department of Conservation.

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 in previous bird monitoring. To ensure that counts were independent, counting stations were at least 200m apart and counts were undertaken at least 15 minutes apart. Two counts were undertaken at each station – one during November and the other during December. To avoid changes in bird conspicuousness during dawn and dusk, counts were undertaken between 7:30 am and 5:30 pm. Counts were not be 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 fine.

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 (Appendix 2). Data were then transferred to a spreadsheet (Microsoft Excel) for analysis. Bird monitoring data were compared with the following previous bird surveys:

*a) 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. 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. In descending order of conspicuousness, the bird species detected were:

- fantail
- silvereeye
- tui
- grey warbler
- thrush
- blackbird
- sparrow
- kereru
- kingfisher
- finch

Lisa Eve's research was funded by the Waitakere City Council and forms part of the WCC bird monitoring program.

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

Julian *et al.* (1998) undertook bird surveys as part of a 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. 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. A total of 28 bird species were detected, 14 of which, were native species. The ten most conspicuous birds across all sites (in descending order) were:

- silvereeye
- chaffinch
- kingfisher
- Indian myna
- tui
- blackbird
- grey warbler
- house sparrow
- fantail
- redpoll

*c) Waitakere City Council bird monitoring programme 1998, 1999, 2001 & 2002*

In 1998 WCC initiated an annual programme of native bird monitoring. The surveys were not undertaken in 2000 but the reasons for this are unclear. The purpose of the programme was to measure the conspicuousness of native bird species. Conspicuousness of bird species was utilised by the 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: silvereeye, 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.

Notable findings of the programme as of March 2001 included (WCC 2001):

- a slight decrease in the conspicuousness of fantails
- a slight increase in the conspicuousness of silvereyes and kingfishers
- consistently low conspicuousness of kereru
- significant decrease in the conspicuousness of tui at four of the five sites

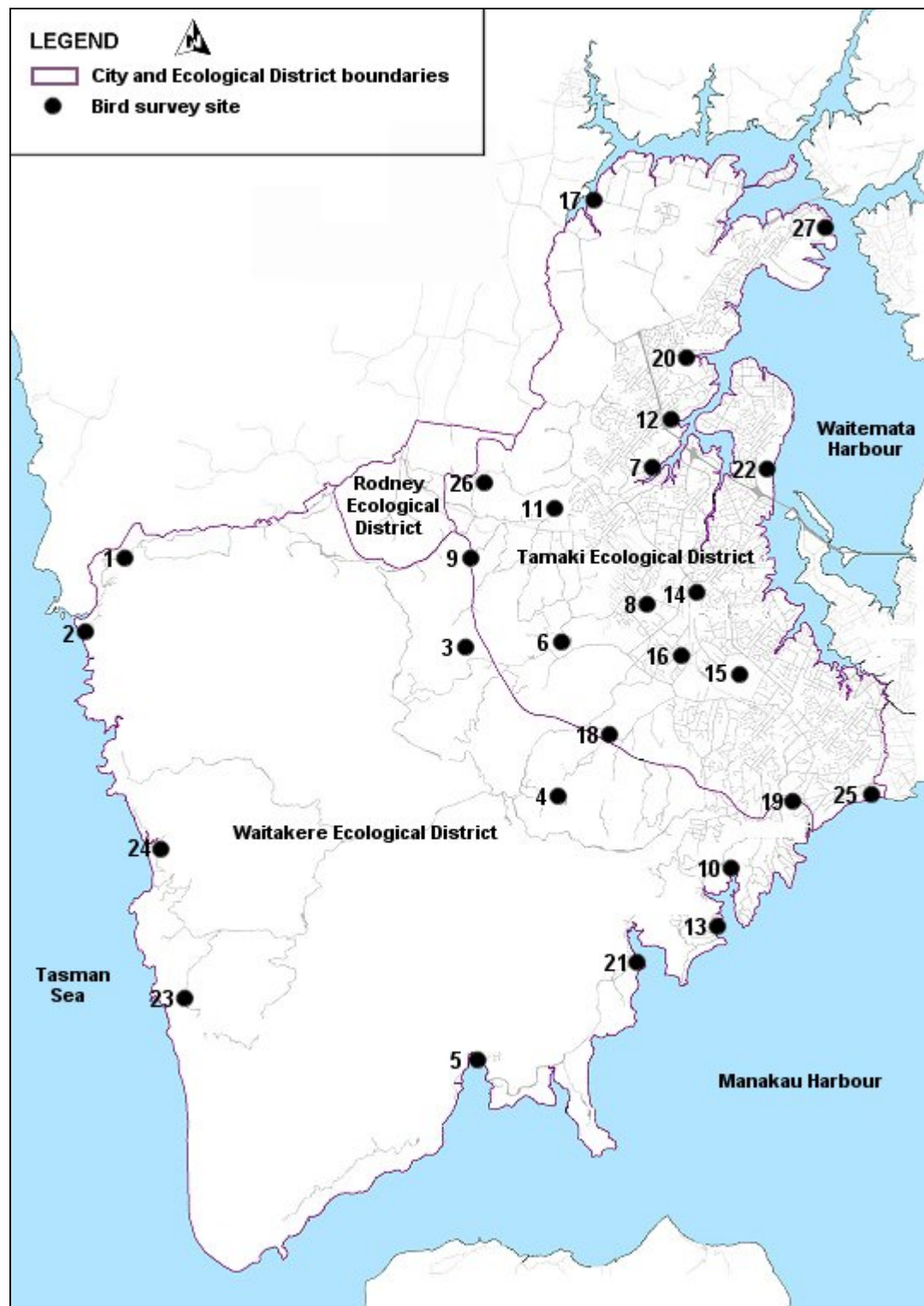


Figure 1. Location of bird monitoring sites in Waitakere City (2003; See Table 1 for site names and descriptions).

Table 1. Bird monitoring sites (2004).

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	
2	1	Bethells Beach	Sand dune	Bethells Road, Te Henga	Revegetation
2	2	Bethells Beach	Sand dune, dune shrubland	Bethells Road, Te Henga	
3	1	Mountain Road Esplanade	Regenerating kanuka-podocarp-forest	Mountain Road, Henderson Valley	
3	2	Mountain Road Esplanade	Lowland stream, regenerating kanuka-podocarp forest	Mountain Road, Henderson Valley	
4	1	Douglas Scenic Reserve	Mamaku-mixed broadleaf forest	Raroa Terrace, Waitatarua	
5	1	Huia Reserve	Grassland, marine tidal flats	Huia Road, Huia	
6	1	Henderson Valley Scenic Reserve	Lowland stream, secondary podocarp-broadleaf forest	Candia Road, Henderson Valley	
6	2	Henderson Valley Scenic Reserve	Lowland stream, secondary podocarp-broadleaf forest	Candia Road, Henderson Valley	
7	1	Chorley Reserve / Sunline Park	Pasture/grassland	Sunline Avenue, Massey West	
7	2	Chorley Reserve / Sunline Park	Mamaku-mixed broadleaf forest	Sunline Avenue, Massey West	
7	3	Chorley Reserve / Sunline Park	Intertidal mudflats, mangrove shrubland	Sunline Avenue, Massey West	
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	
8	3	Shona Esplanade	Mature and regenerating podocarp-hardwood forest	Border Road, Henderson	
8	4	Shona Esplanade	Mature and regenerating podocarp-hardwood forest	Border Road, Henderson	
8	5	Shona Esplanade	Mature and regenerating podocarp-hardwood forest	Claret Terrace, Western Heights	
9	1	Tram Valley Road	Secondary podocarp-broadleaf forest	Tram Valley Road, Swanson	
9	2	Tram Valley Road	Secondary podocarp-broadleaf forest	Tram Valley Road, Swanson	
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	
12	1	Lowtherhurst Reserve	Secondary kanuka-broadleaf forest	Lowtherhurst Road, Massey East	
13	1	Warner Park	Marine tidal flats	Laingholm Drive, Laingholm	
13	2	Warner Park	Marine tidal flats	Laingholm Drive, Laingholm	
13	3	Warner Park	Puriri composite-pohutukawa forest	Laingholm Drive, Laingholm	
14	1	Catherine Esplanade	Exotic-regenerating native mix	Vitasovich Avenue, Henderson	
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 number	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	
19	2	Rahui Kahika Reserve	Secondary podocarp-broadleaf forest	Pendlebury Street, Green Bay	
19	3	Rahui Kahika Reserve	Secondary puriri composite forest	Pendlebury Street, Green Bay	
20	1	Moire Park	Marine tidal flats, mangrove shrubland	Lorena Place, West Harbour	
20	2	Moire Park	Grassland-exotic mix	Granville Drive, Massey East	
20	3	Moire Park	Regenerating kanuka forest	Granville Drive, Massey East	
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	
23	2	Karekare Beach	Pohutukawa forest	Watchmans Road, Karekare	
24	1	Claude Abel Reserve	Wetland, pohutukawa forest	Garden Road, Piha	
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	
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	
26	3	Kay Road Balefill	Secondary kauri-tanekaha-rimu forest	Kay Road, Swanson	
27	1	Hobsonville Esplanade	Regenerating kanuka forest	Hudson Bay Road, Hobsonville	
27	2	Hobsonville Esplanade	Intertidal mudflats, mangrove shrubland	Hudson Bay Road, Hobsonville	

Table 3. Summary of annual bird monitoring effort (1997-2004).

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>
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							✓
28	Te Atatu Peninsula mangroves		+					
29	Collwill Esplanade		+					

<sup>1</sup> 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; <sup>5</sup> 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.

### 3. Results

A total of 35 bird species were recorded during the 110 five-minute counts undertaken at the 27 monitoring sites over the summer of 2003-4. Sixteen (46%) of the 35 species were native, endemic or self-introduced. The total number of species recorded was an increase of one over the total recorded the previous summer. The species recorded during 2002-3 but not during 2003-4 were fernbird, pied stilt, pitpit and red-billed gull. Species recorded during 2003-4 but not during the previous summer were domestic pigeon, dunnock, peafowl, redpoll and shining cuckoo.

Over the five years of monitoring, the conspicuousness of tuis declined at Moire Park and Tram Valley Reserve while remaining more consistent at Lowtherhurst and Swanson Scenic Reserve. Tui conspicuousness has been low in all counts at Chorley Reserve except for a one-off peak during 2002-3. At the remaining sites (where monitoring began more recently), tui conspicuousness appears to have remained relatively steady with seemingly minor increases or decreases being the norm.

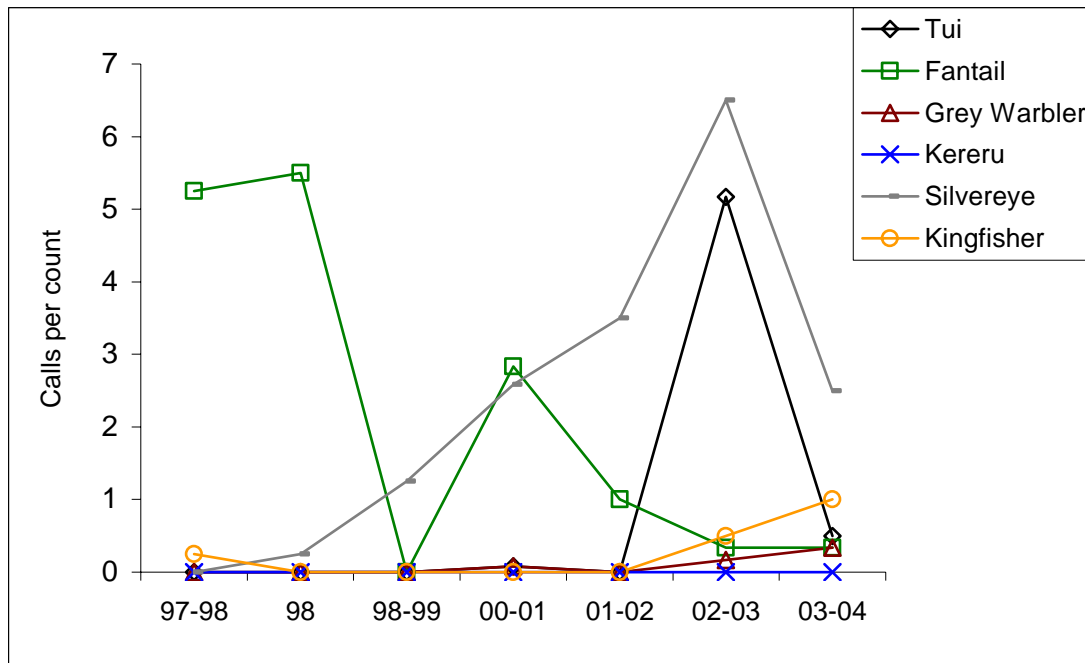
Fantail conspicuousness declined across nearly all monitoring sites. At the few sites where fantail conspicuousness increased or remained steady, they were relatively inconspicuous. Grey warbler populations appear to be doing better than fantails with counts revealing increased or steady conspicuousness at nearly all sites. Kereru were only recorded at three sites: Mountain Road Esplanade, Rahui Kahika Reserve and Tram Valley Road. Only one kereru was recorded at each of those sites.

Silvereye conspicuousness varied considerably from site to site with short-term fluctuations possibly masking a longer-term decline. Kingfishers were relatively inconspicuous across most sites but counts were more consistent from year to year compared with the other native species.

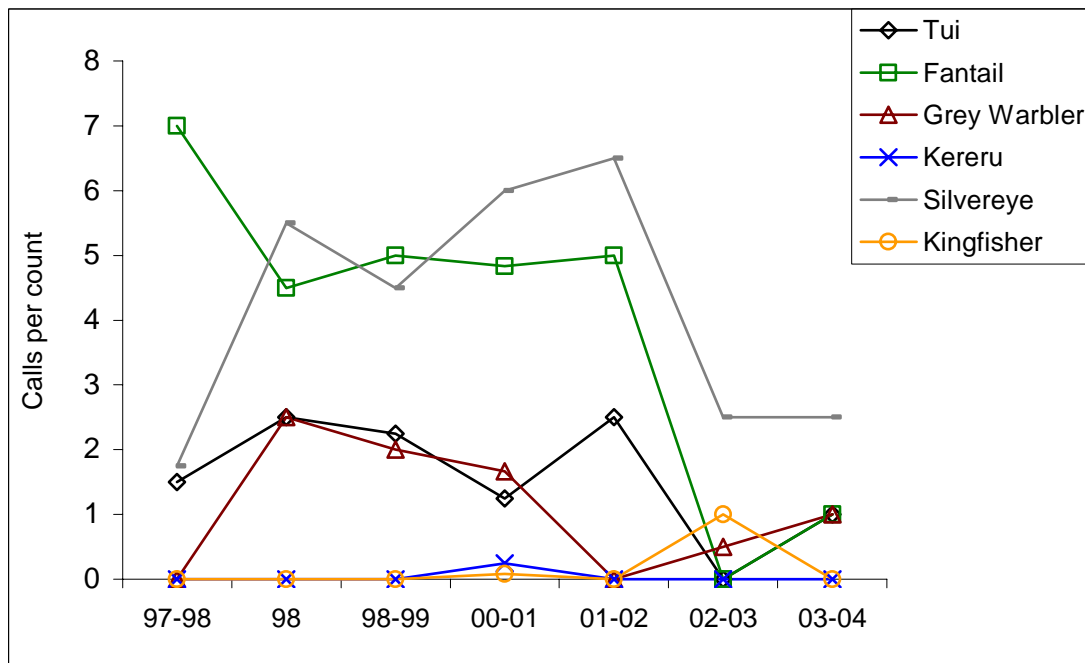
The sharp declines in native species apparent at the longer-term monitoring sites from 2001-2 to 2002-3 have not continued. Counts of most native species improved slightly in 2003-4 at the longer-term sites although in many cases counts were still lower than they were prior to the declines detected in 2002-3.

Figures 2a-e. Trends in conspicuousness of native bird species at five Waitakere City reserves monitored since the summer of 1997-1998.

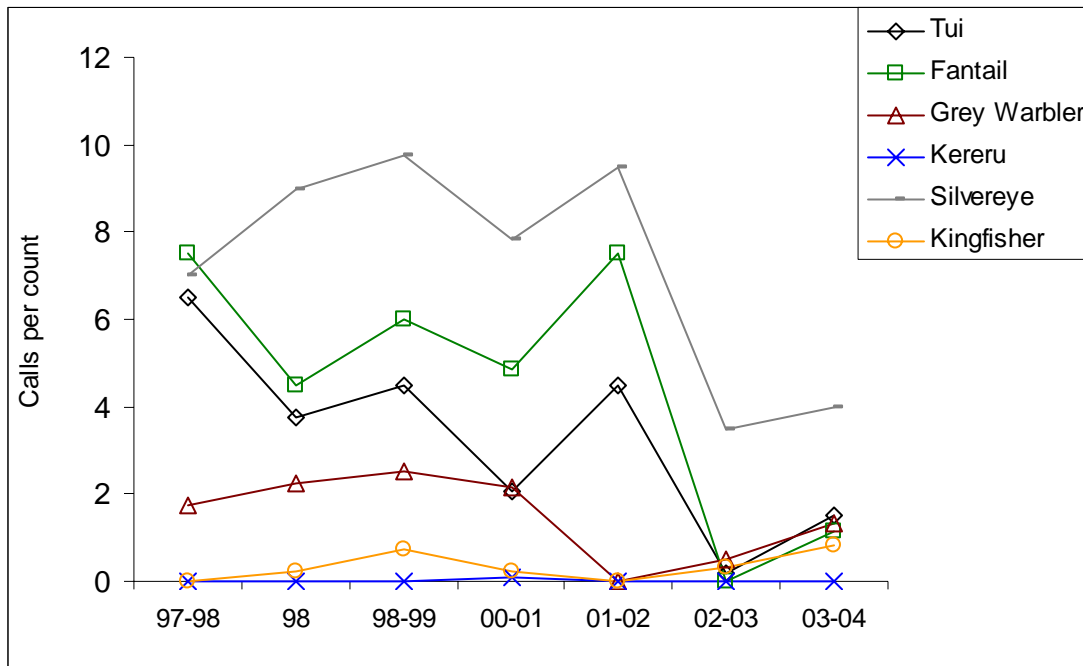
a) Chorley Reserve / Sunline Park



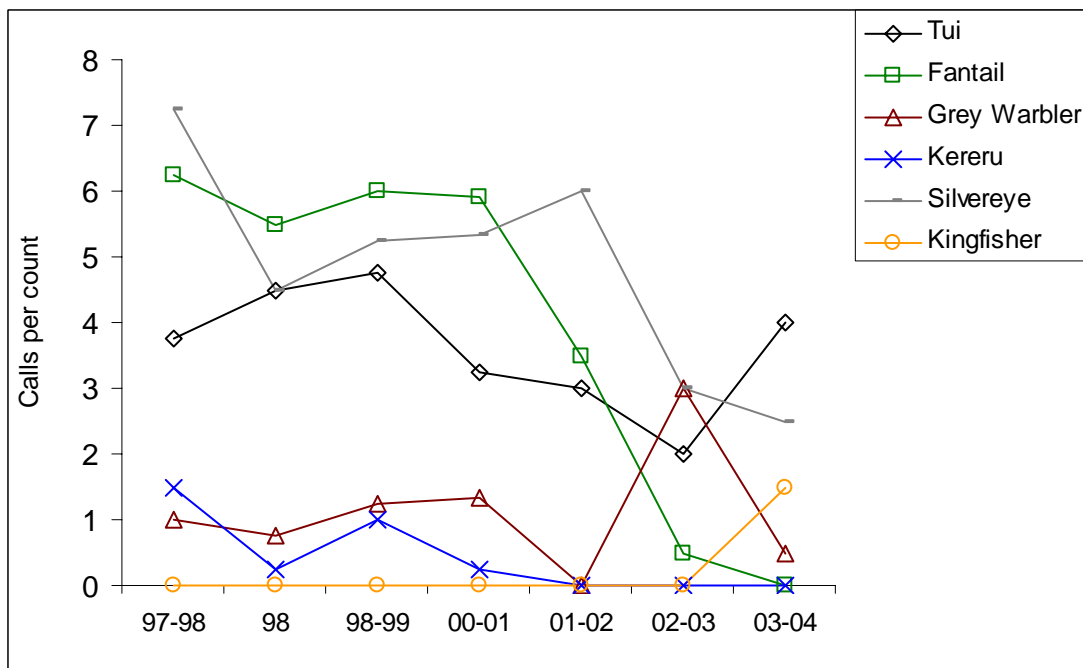
b) Lowtherhurst Reserve



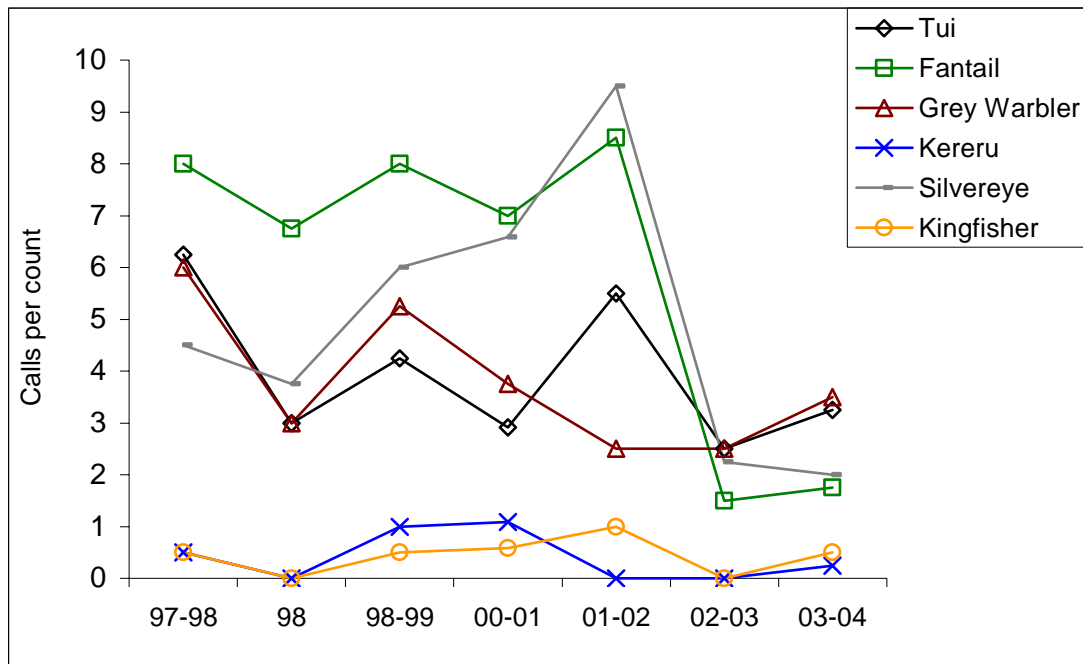
c) Moire Park



d) Swanson Scenic Reserve

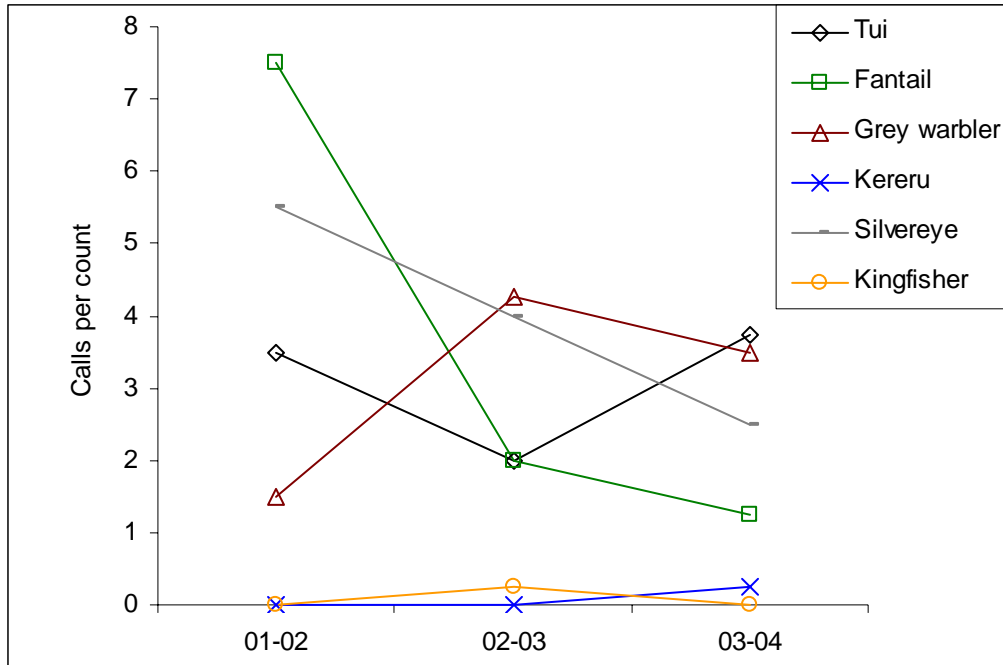


e) Tram Valley Road

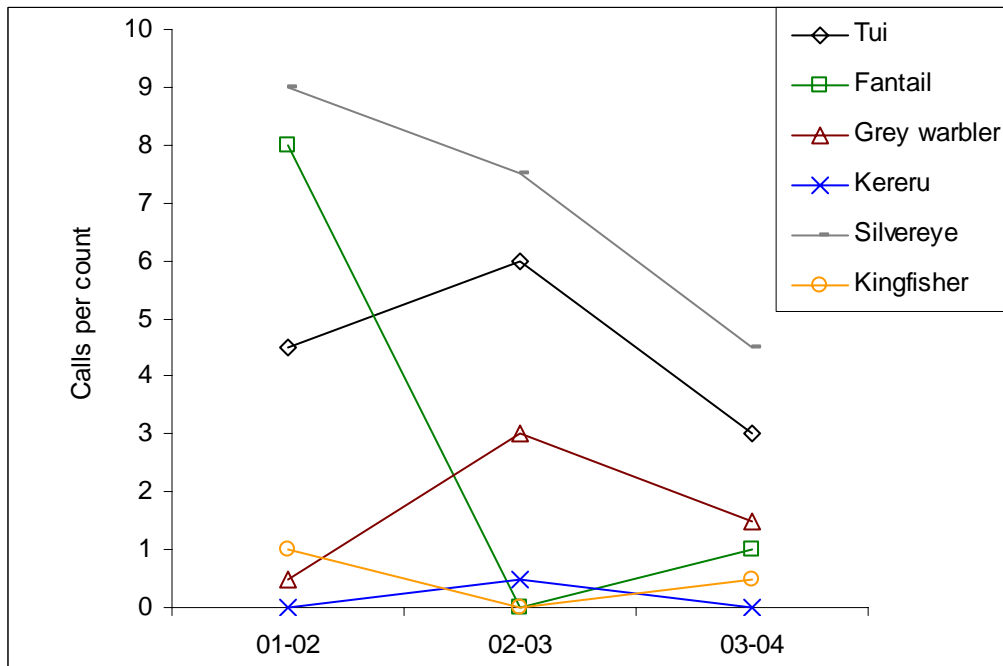


Figures 3a-j. Trends in conspicuousness of native bird species at 10 Waitakere City reserves monitored since the summer of 2001-2002.

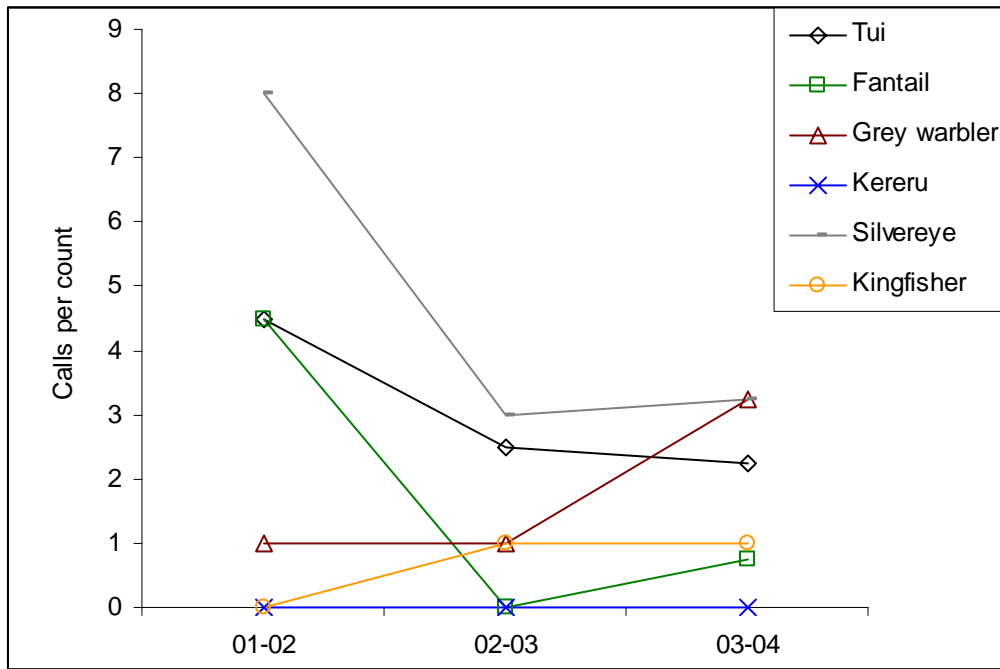
a) Mountain Road Esplanade



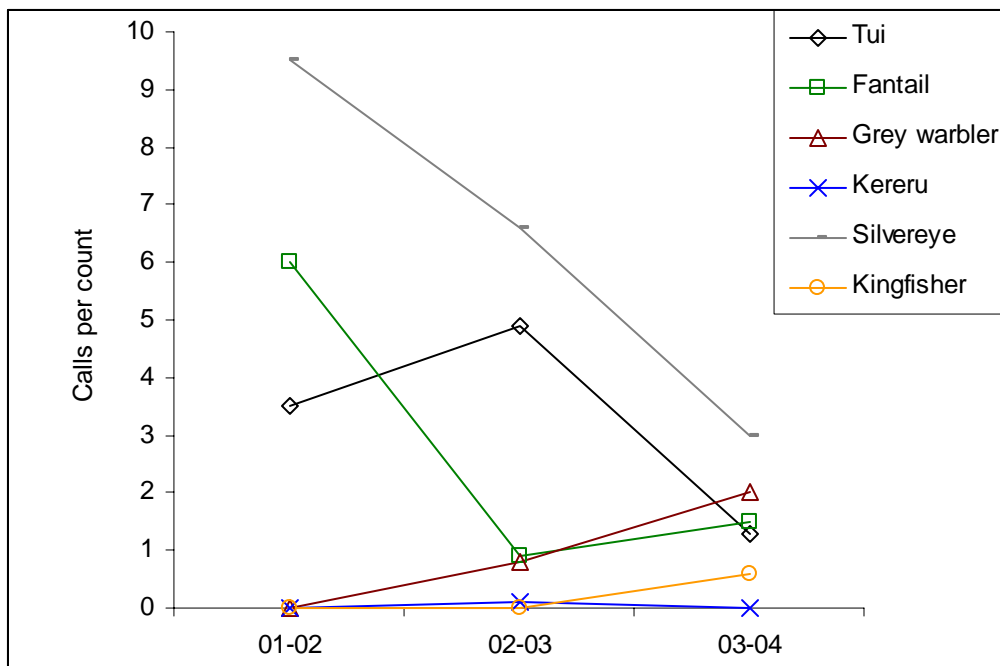
b) Douglas Scenic Reserve



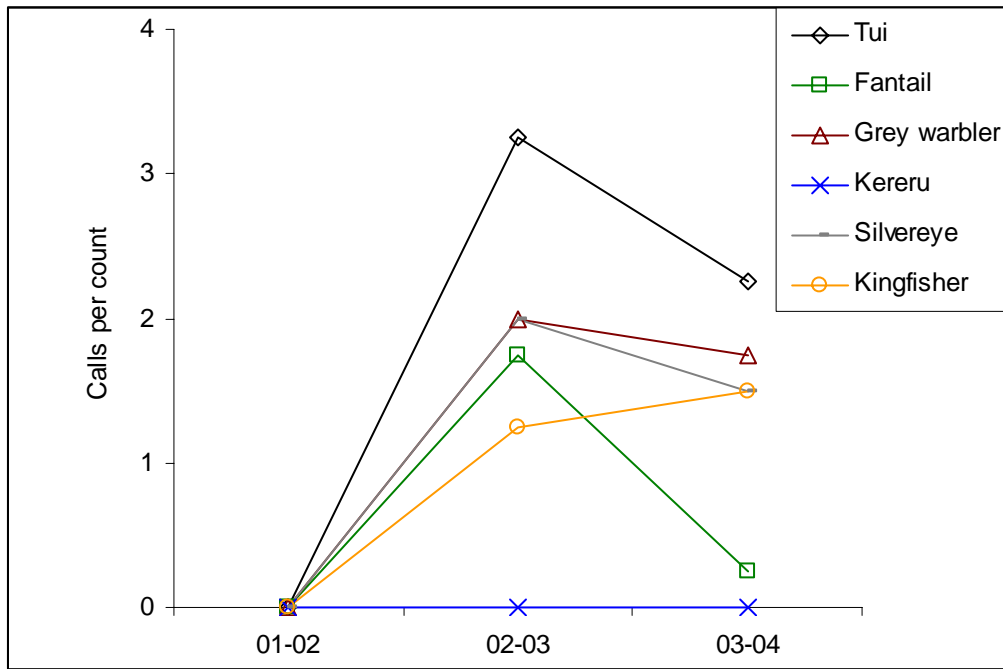
c) Henderson Valley Scenic Reserve



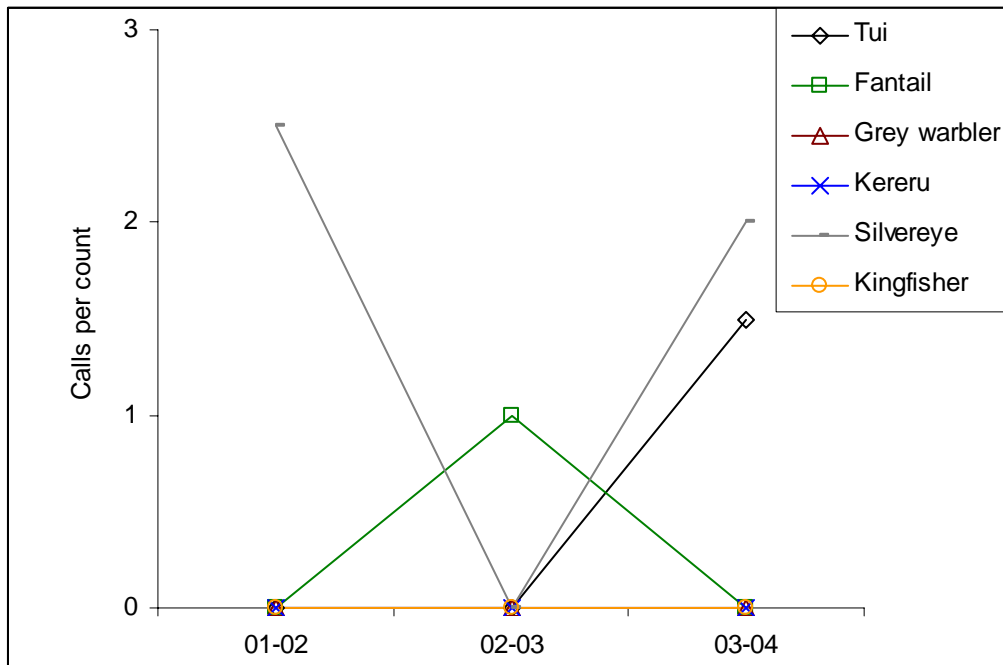
d) Shona Esplanade



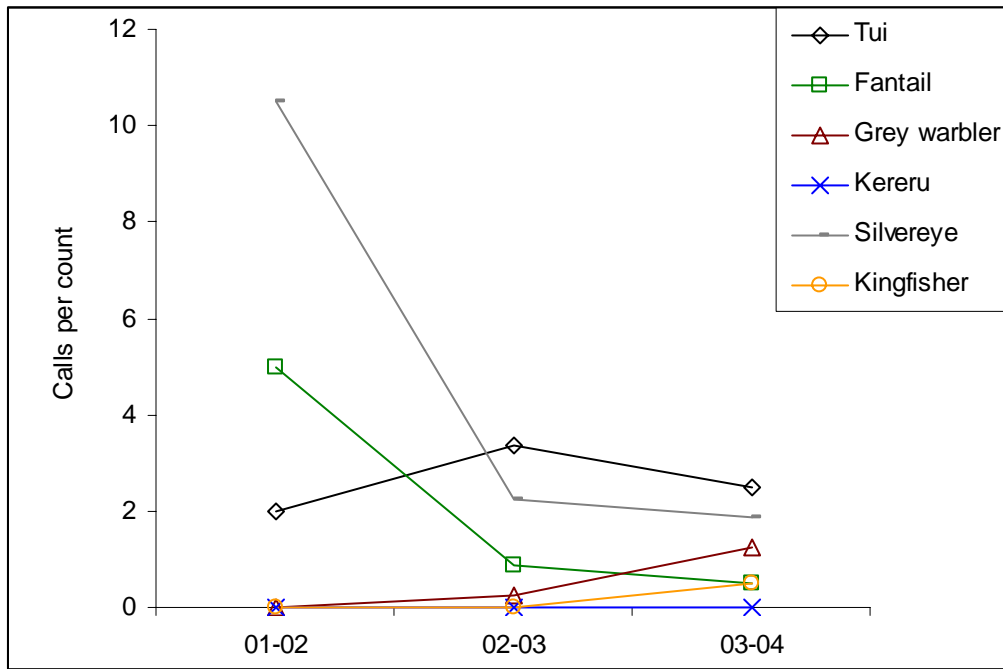
e) Gill Esplanade



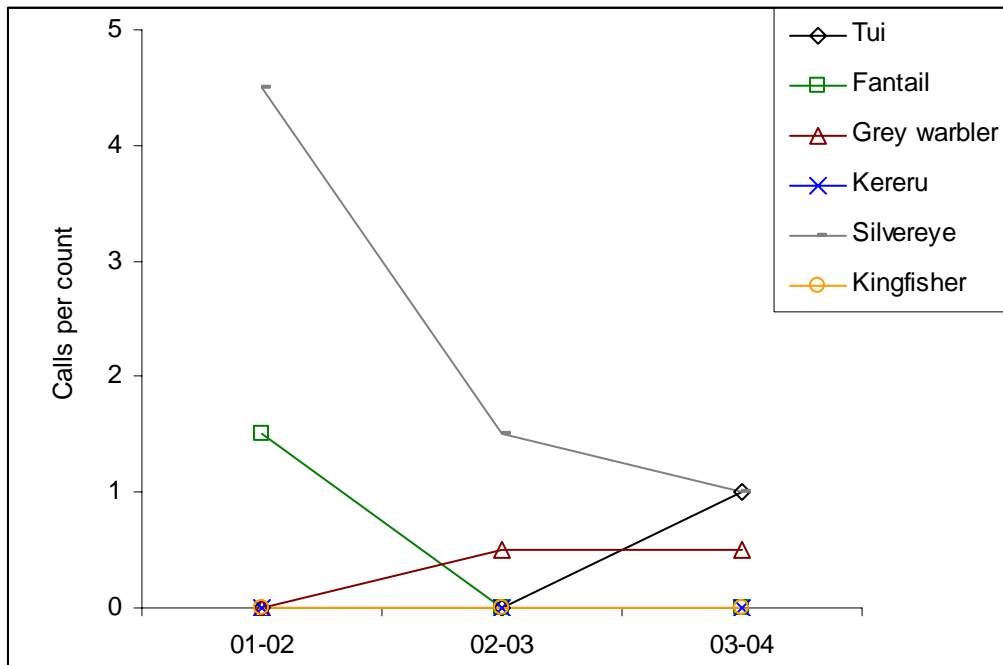
f) Catherine Esplanade



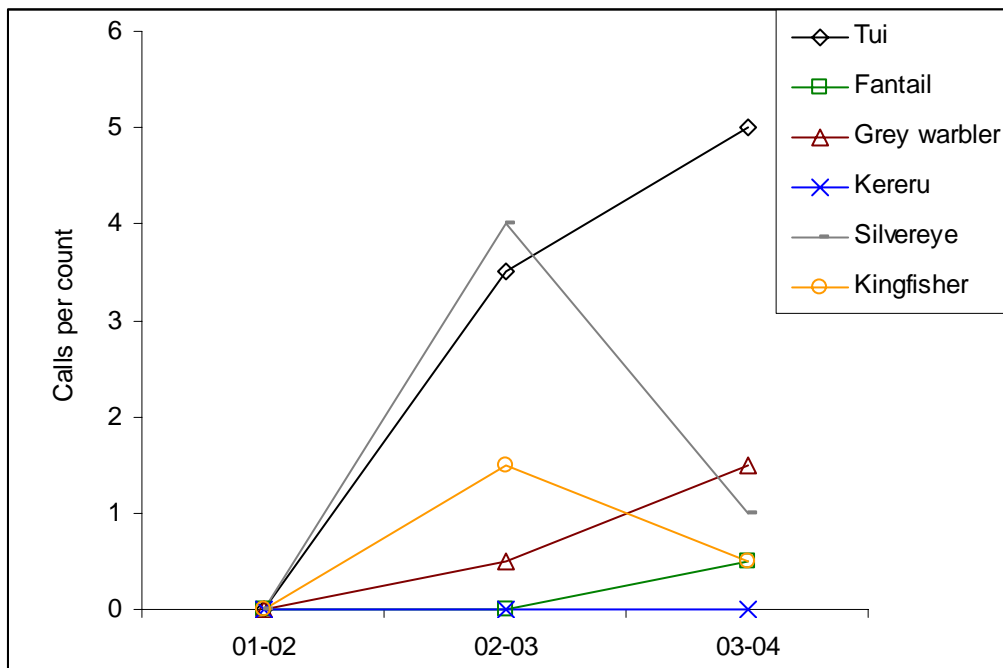
g) Waikumete Cemetery



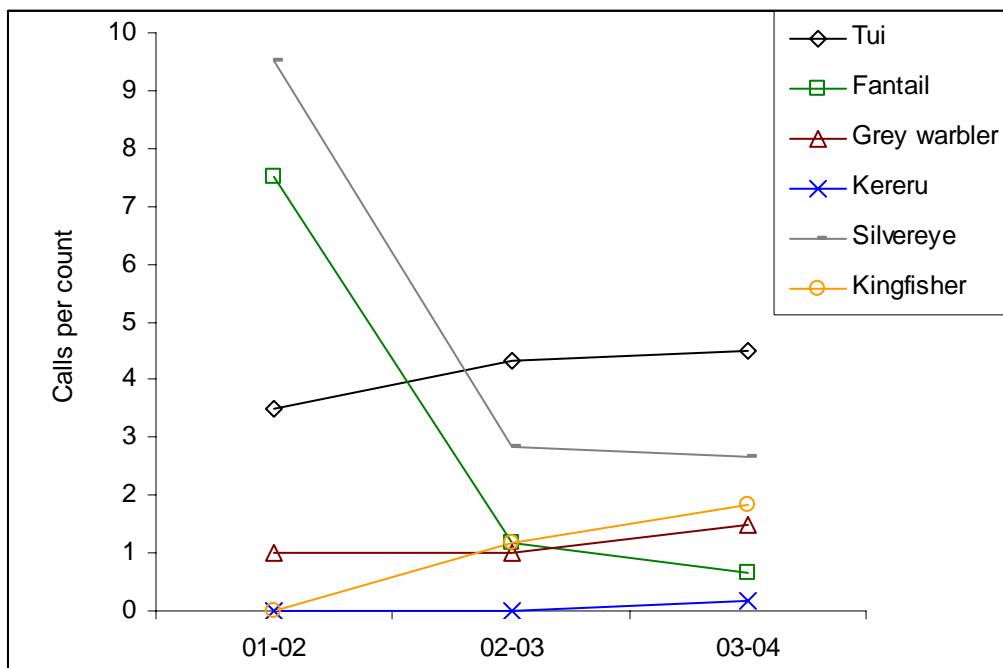
h) Oratia Esplanade



i) Kellys Bridge Esplanade

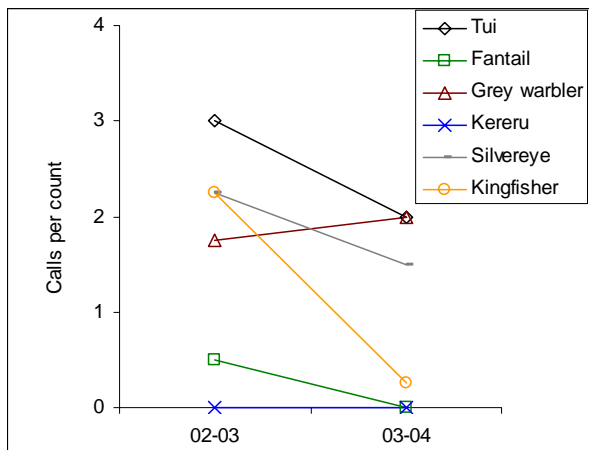


j) Rahui Kahika Reserve

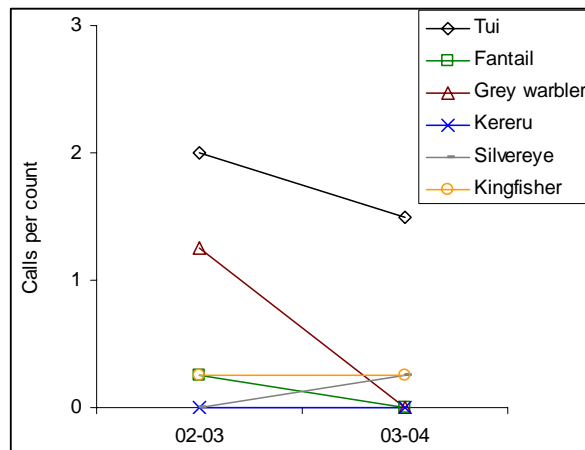


Figures 4a-l. Trends in conspicuousness of native bird species at 12 Waitakere City reserves monitored since the summer of 2002-2003.

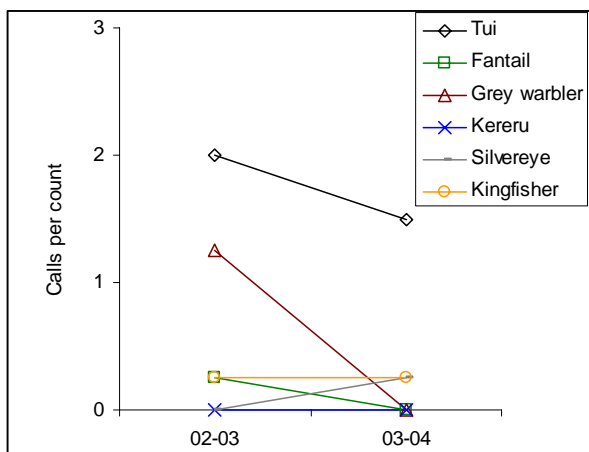
a) Te Henga Wetland



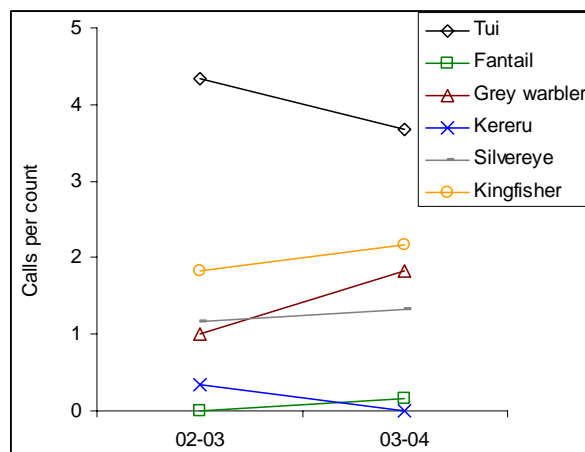
d) Warner Park



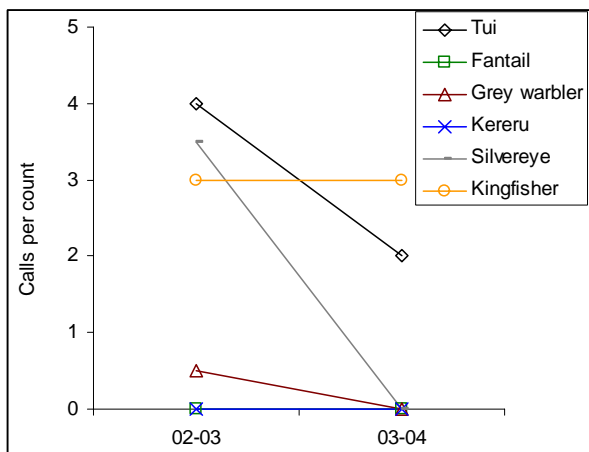
b) Bethells Beach



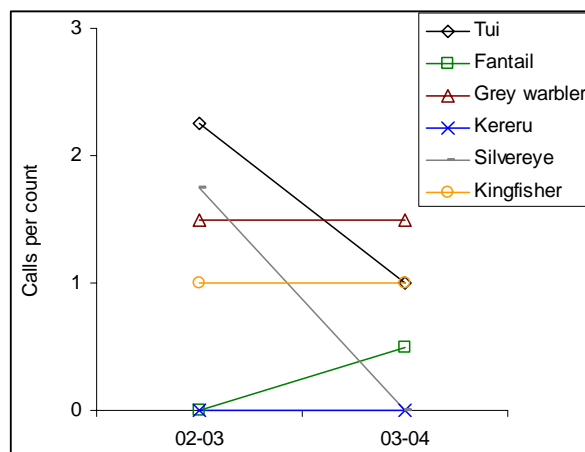
e) Brigham Creek Reserve



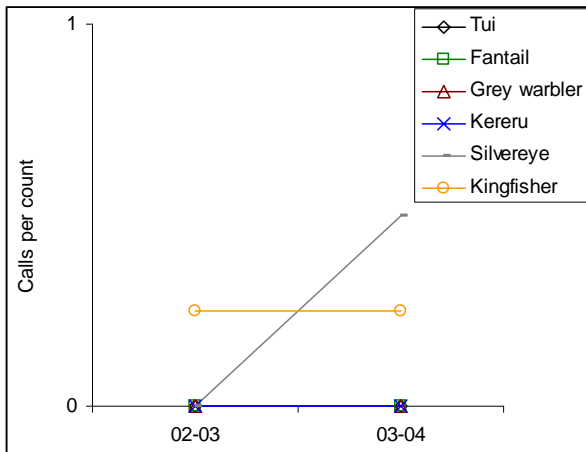
c) Huia Reserve



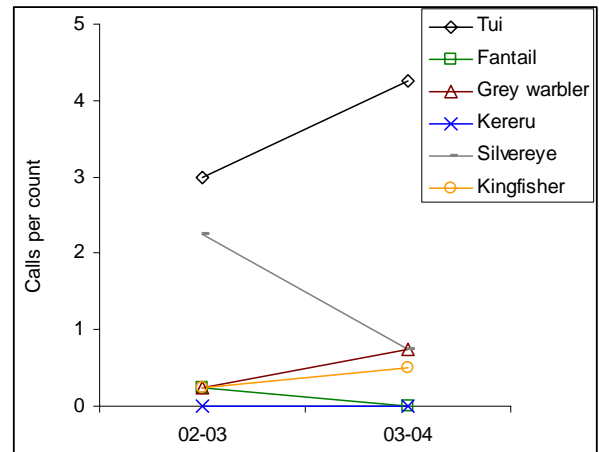
f) Takaranga Reserve



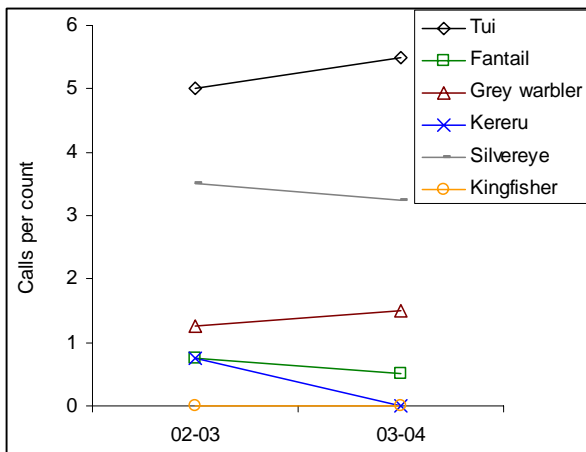
g) Harbourview Park



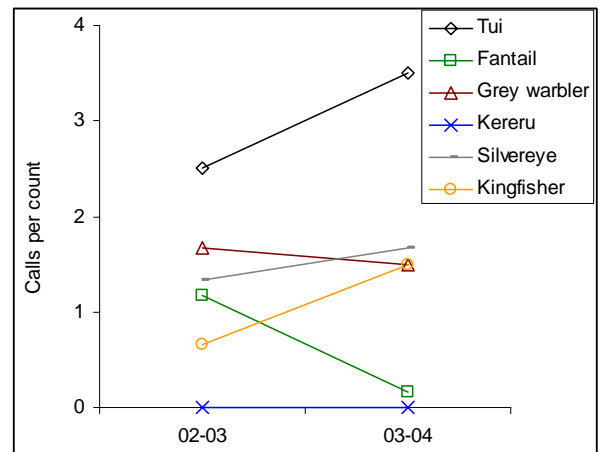
j) Karaka Park



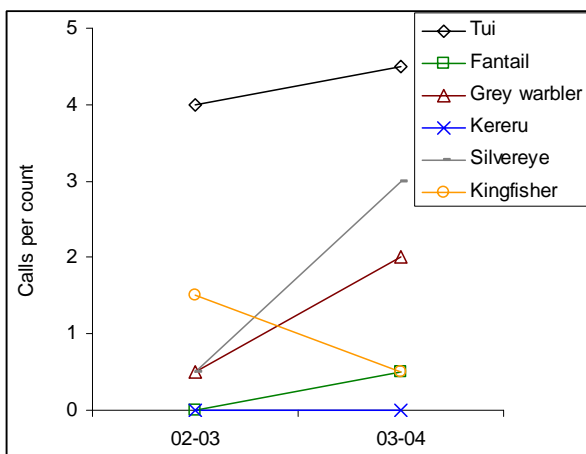
h) Karekare Beach



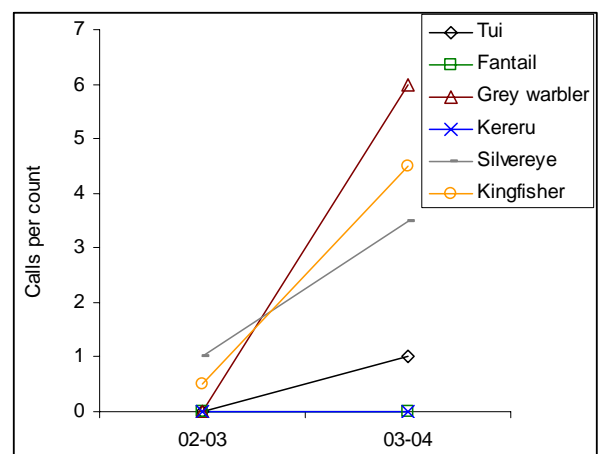
k) Kay Road Balefill



i) Claude Abel Reserve



l) Hobsonville Esplanade



#### 4. Discussion and Recommendations

##### **Key findings from the 2003-4 bird monitoring programme**

Five-minute bird counts have become a core feature of the WCC's biodiversity monitoring programme. While five-minute counts cannot provide an accurate census of bird populations, as a component of a carefully planned and implemented programme they provide a cost-effective method of monitoring the state of the environment across Waitakere City. The WCC's annual bird monitoring programme complements the ARC's annual five minute bird counts that are focused on the Waitakere Ranges forest bird populations (ARC & WCC 2003). The WCC's bird monitoring programme has highlighted:

- sites with populations of significant species (e.g. shining cuckoo at Kay Road Balefill, fernbird at Te Henga Wetland)
- sites where ecological restoration measure may have led to an improvements in counts of native birds (e.g., Gill Esplanade, Rahui Kahika Reserve)
- species which may be declining at certain sites or across the city (e.g., tui, kereru, fantail)
- sites at which a range of species may be declining (e.g., Moire Park, Tram Valley Road)
- sites where more thorough / specialised bird monitoring methods should be applied (e.g., Harbourview Park, Te Henga Wetland)

Low tui and kereru counts continue to be a major concern - especially given the important ecological role those species play. Tuis are important pollinators and dispersers of a broad range of native plant species (Anderson 1997). Kereru disperse the seeds of over 70 native plant species and are probably the sole dispersers of large-fruited native plant species (Clout & Craig 1998). The processes of regeneration of native vegetation are likely to be adversely impacted unless the declines in tui and kereru populations are reversed. However, a detailed programme using distance sampling has been implemented to monitor tui and kereru populations more closely than is possible with five-minute counts.

A feature of five-minute count bird monitoring programme is an ongoing decline in fantail counts that appears to be a city-wide phenomenon. As an insectivorous species, it may be that the availability of the food supply for fantails has been adversely affected by aerial applications of BTK spray as part of the attempt to eradicate the painted apple moth. We consider this to be unlikely because the toxin contained in the spray is specific to the caterpillar phase of moths and butterflies. Fantails consume a wide range of invertebrates thus any reduction in food supply would probably be small enough to be compensated for by consuming more prey items from other invertebrate groups. Furthermore, fantail counts have declined at monitoring sites well outside the spray zone (e.g., Mountain Road Esplanade, Douglas Scenic Reserve) and the most heavily sprayed sites (e.g., Waikumete Cemetery, Chorley Reserve) did not have the most dramatic declines. Chapman and Alexander (2003) first highlighted the fantail decline and hypothesised that predation was a likely cause.

The declines in urban bird populations are coupled with the loss of indigenous vegetation from the lowlands. In some areas up to thirty percent of the vegetation has been lost in the seven year period between 1993 and 2000 (WCC 2001). Habitat fragmentation in Waitakere City is arguably the most important determinate of the

City's current state of biodiversity. Habitat fragmentation involves the direct removal of suitable habitat, reduction in habitat fragment size and connections between fragments, and increases in forest edge to interior ratio. This reduces the potential for native bird dispersal and colonisation, and intensifies existing predation and competition from pests. These changes affect the composition of bird populations. For example, while overall species diversity may remain high, native forest specialists (e.g., kereru) tend to be replaced by introduced cosmopolitan species (e.g., sparrow) (Clout and Craig 1998). It can be anticipated that the cumulative impacts of unsympathetic land management practices will lead to additional declines in the City's bird populations.

There is insufficient information to ascertain whether the current trend in the conspicuousness and distribution of urban bird populations reflects similar changes in other fauna. However, there are at least twenty-one uncommon and threatened bird species that were not detected during this study (due to the rapid assessment survey methods) (e.g., Slaven 1989; Julian *et al.* 1998). If these species mirror the declines in those species sampled during this study then their situation may be perilous and there is the possibility that additional extinctions may have occurred undetected.

### **The need to extend Waitakere City's biodiversity monitoring programme**

Up-to-date species monitoring data is necessary to meet the requirements of the RMA 1991 (and amendments 2002). In particular, the planning, identifying and securing of significant natural areas by local territorial authorities require that quality data, that can be used to meet a wide range of reporting requirements, be collected. The paucity of accurate biodiversity information has been identified as a significant barrier to achieving protection of the City's biodiversity (WCC 2001) and the absence of up-to-date monitoring data is recognised as a national impediment to halting New Zealand's biodiversity crisis (Kneebone *et al.* 2000; DoC & MfE 2000).

The most comprehensive and systematic collection of biodiversity data within Waitakere City were the surveys undertaken for the Protected Natural Areas Programme (PNAP). The PNAP identified natural areas worthy of protection and faunal surveys were undertaken in the Waitakere Ranges (Denyer *et al.* 1993) and the Waitakere City lowlands (Julian *et al.* 1998). However, time and resource constraints provided incomplete coverage of fauna (Slaven 1989; Julian *et al.* 1998). For example, in the Waitakere Ranges PNAP, the information utilised to construct a landsnails species list and indicate relative abundance was based solely on historical data from Goulstone (1982). Neither an entomological survey nor a comprehensive entomological review was undertaken for the PNAP. In addition, the information presented on the herpetofauna was based on an informal lizard survey conducted by members of the New Zealand Herpetological Society during the 1980s (Slaven 1989). The only other recent surveys of native herpetofauna in the Waitakere Ranges have been a master's thesis on Hochstetter's frog (Ziegler 1999) and lizard surveys at four sites within the Tamaki Ecological District as part of Waitakere City Council's Biodiversity Monitoring Programme (Chapman and Alexander 2003).

Care needs to be taken not to rely on the PNAP data to meet RMA requirements. Particularly in the case of the Waitakere Ranges Ecological District for which the fieldwork component of the PNAP was undertaken prior to 1989, more than 15 years ago. A similar situation existed in the Rodney Ecological District. To ensure that

information used to develop the district plan was current fourteen years following the original PNAP survey (1983-1984) a resurvey was undertaken in 1997-1998 ([www.qualityplanning.org.nz](http://www.qualityplanning.org.nz)). An update of the fauna section of the Waitakere Ranges PNAP is strongly recommended. It is suggested that detailed fauna monitoring of areas that have been identified through the PNAP as biodiversity hotspots and priority sites for protection should take precedence (e.g., Te Henga Wetland, Manukau Harbour foreshore and West Coast foreshore). While the species lists contained within the PNAP are not useful for determining whether species are increasing or declining in number, they may provide baseline data against which future surveys can determine whether species recorded during the PNAP have persisted in Waitakere City (ARC & WCC 2003).

Extending the current level of biodiversity monitoring and protection will only be feasible if there is greater collaboration between WCC, DoC and the ARC. The Waitakere Ranges Protection Project (WRPP) is a promising initiative whereby “... *a partnership of iwi, Waitakere City Council, Auckland Regional Council, Rodney District Council and local Members of Parliament, and in close consultation with stakeholders, to find and implement ways of achieving better long-term protection for the natural and landscape values of the Waitakere Ranges and West Coast*”(ARC 2004).

The collaborative approach adopted for the WRPP should be applied to all biodiversity monitoring and protection initiatives. Such an approach reduces financial costs and limits duplication of work, ensuring that environmental monitoring and management activities are as effective as possible, and compatible with other similar initiatives being undertaken in the Auckland Region.

### **State of the environment reporting, establishing baselines and setting targets**

The WCC bird monitoring programme is now able to contribute cost-effective indices of Waitakere City's bird populations to the state of the environment reporting process (i.e., average number of bird calls per count for common species and number of birds per hectare for tui and kereru). Baseline counts coupled with an understanding of year-to-year background fluctuations in counts enables the WCC to set realistic targets relating to environmental improvements from management measures. Environmental management actions are often better assessed through measuring the follow-on benefits rather than measuring the management action *per se*. For example, the effectiveness of a predator control operation should be measured by measuring changes in the environmental attributes being protected/enhanced (native birds, invertebrates, etc.) rather than by measuring the number of predators (stoats, rats, etc.) eliminated (Wellington Regional Council 2001). Given the baseline bird count datasets obtained from across Waitakere City, the WCC will be in a position by 2005 to determine the relative benefits for local bird populations of their primary biodiversity protection/enhancement methods and combinations of those methods.

### **Waitakere City Council's commitment to biodiversity protection**

Since the WCC adopted the eco-city vision, Waitakere City has benefited from a focus on developing and implementing sustainable practices. As a result, there has been considerable progress towards protecting natural ecosystems. Recently WCC has initiated a number of programmes that have improved our understanding of the current state of the City's biodiversity. For, example, in addition to the annual bird

monitoring programme, the council also funds an annual study of urban fish communities (Boffa Miskell 2002). Furthermore, WCC, in partnership with Landcare Research and the community, embarked on the Twin Streams Project during 2001. The project involves restoring the waterways and stream corridors within the Opanuku, Oratia and Swanson catchments. During 2004 baseline monitoring of invertebrates, vegetation, avifauna, herpetofauna and the threatened New Zealand long-tailed bat (*Chalinolobus tuberculatus*) will be undertaken within the project area. These monitoring initiatives build upon and allow assessments of the effectiveness of the WCC's longer-term biodiversity protection and habitat restoration mechanisms such as:

- Pest control (e.g., possum control using Timms traps at 57 Waitakere City parks during 2004)
- Weeding and planting (e.g., 70000+ ecosourced native trees planted annually in Waitakere City)
- Covenants and fencing
- Controls on vegetation clearance and development

However, Waitakere City continues to reflect the general trend of declining indigenous biodiversity occurring throughout most of New Zealand (WCC 2001). Fifteen bird species have become extinct from the urban and foothill areas and nine bird species have been lost from the Waitakere Ranges. Unless the decline is halted, an additional twenty-three bird species in Waitakere City are at risk of extinction in the medium to long term (Chapman & Alexander 2003). Predators such as rodents, mustelids, cats and possums are probably the greatest barrier to restoration of native bird populations. While re-planting and regenerating native vegetation is beneficial to bird communities, the presence of predatory mammals can preclude the recovery of native wildlife populations (Clout & Craig 1998).

The implementation of predator control at priority sites where the key ecological assets are protected from the greatest threats to those assets is urgently required. Significant biodiversity hotspots and the recommended priority actions required to restore biodiversity in Waitakere City have been clearly described in other reports (e.g., Julian *et al.* 1998; Denyer *et al.* 1993). We strongly recommend the immediate commencement of predator control (targeting mustelids and rodents), in partnership with local communities, at the following sites:

- Te Henga Wetland
- Manukau Harbour foreshore reserves (especially Karaka and Warner Park)
- Harbourview Wetland
- Rahui Kahika Reserve
- Opanuku and Oratia Stream corridors (especially Shona Esplanade)

The Ministry for the Environment is currently developing a National Policy Statement on indigenous biodiversity. The policy statement will give councils direction on how to address biodiversity issues. The intention to develop the national policy statement was announced during 2000 and it was expected to be publicly notified during 2003. However, as the consultation process has not been completed it could be several years before the National Policy Statement is adopted by parliament ([www.mfe.govt.nz](http://www.mfe.govt.nz)). In the meantime it is strongly recommended that Waitakere City Council continue to expand the Waitakere City Biodiversity Monitoring Programme and, in partnership

with relevant organisations, continue to pursue initiatives that will contribute to halting the City's biodiversity crisis.

## 5. References

- Anderson, S. 1997. *Changes in native ecosystem processes: The dynamics of pollination and dispersal in New Zealand forests*. Unpublished MSc Thesis, University of Auckland.
- Auckland Regional Council. 2004. *Strategic policy committee: Tuesday 9 March agenda item*. Unpublished Auckland Regional Council report.
- Boffa Miskell. 2002. *Waitakere freshwater fisheries monitoring programme*. Unpublished Waitakere City Council Report.
- Chapman, S.; Alexander, J. 2003. *Waitakere City biodiversity monitoring programme: birds, lizards and frogs*. Unpublished report for the Waitakere City Council.
- Clout, M.; Craig, J. 1998. *Restoration for vertebrates. Restoring the health & wealth of ecosystems: A Conference on Ecological Restoration in New Zealand*. Unpublished proceedings of conference held at Christchurch, New Zealand, 28-30 September 1998.
- 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.
- Froude, V. 1998. Environmental performance indicators: an analysis of potential indicators for terrestrial biodiversity. *Technical paper number: 47*. Ministry for the Environment, New Zealand.
- Goulstone, J.F. 1982. *Waitakere land snails*. Unpublished Auckland Regional Authority report.
- Julian, A.; Davis, A.; Tyrrell, M. 1998. Draft report: ecological survey of Waitakere City lowlands: north-western portion of Tamaki Ecological District. Unpublished Waitakere City Council report.
- Slaven, O.C. 1989. *Wildlife report for the protected natural areas programme*. Unpublished Auckland Regional Council report.
- 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.

Wellington Regional Council. 2001. *Monitoring strategy for the Wellington Region*. Wellington Regional Council. Wellington, New Zealand.

Ziegler, S. 1999. *Distribution, abundance and habitat preferences of Hochstetter's frog in the Waitakere Ranges, Auckland*. Unpublished M.Sc. thesis. University of Auckland.

## **Appendices**



*Five minute bird counts: Categories, Definitions and Descriptions*

**Sex:** Record the sex (Male, Female, or Unknown) of the bird wherever possible.

**Age:** Record the age category (Adult, Juvenile, or Unknown) of the bird wherever possible.

**Flock Size:** For most species, each individual bird will be treated independently as a separate observation, but for species that usually occur in clusters or flocks, the appropriate unit is the cluster or flock, and not the individual bird.

**Flyover:** The number of birds of a particular species that fly above the top of the vegetation canopy, and do not appear to be foraging, displaying, or behaving in any other way that might suggest a link to the habitat below them.

**Prev. Plot:** (Previous Plot?) Place an X in this column if it is thought that the bird was already detected during a previous count during the same sampling period.

**Clouds (0-100):** Record percent cloud cover, rounded off to the nearest 10 percent. This should be a number between 0 (no clouds) and 100 (complete overcast).

Temp (°C)	Explanation
1	0-5, cold
2	5-11, cool
3	11-16, mild
4	16-22, warm
5	>22, hot

Wind Code	Explanation
0	calm (< 2 km/h)
1	smoke drifts (2-5 km/h)
2	light breeze felt on face, leaves rustle (6-12 km/h)

3	leaves and twigs in constant motion (13-19 km/h)
4	small branches move, raises loose paper, dust rises (20-29 km/h)
5	fresh breeze, small trees sway (30-39 km/h)
6	strong breeze, large branches moving, wind whistling (40-50 km/h)

Precip. Code	Explanation
0	no rain
1	mist or fog, dripping foliage
2	light drizzle
3	light rain
4	heavy rain; difficult to hear birds

Noise Code	Explanation
0	quiet; normal background noises; no interference
1	low noise; might be missing some high-pitched songs/calls of distant birds
2	medium noise; detection radius is probably substantially reduced
3	high noise; probably detecting only the loudest/closest birds

DT Code	Explanation
1	heard first, but not seen (i.e., detected initially by sound) during the 5-min count
2	seen first (regardless of whether it was later heard or not) during the 5-min count
3	heard first, but then seen (a DT of 1 can be changed to a 4) during the 5-min count
4	heard, but not during the 5-minute sampling period
5	seen, but not during the 5-minute sampling period

**Appendix 2. Conspicuousness of birds present at 27 Waitakere City bird monitoring sites (summer 2003-04)**

<b>Te Henga Wetland</b>	
Tui	2.00
Grey warbler	2.00
Silvereye	1.50
Mallard	1.25
Blackbird	1.25
Pheasant	1.25
Goldfinch	1.00
Myna	1.00
Sparrow	0.50
Starling	0.50
Rosella	0.50
Pukeko	0.50
Plover	0.50
Kingfisher	0.25
Thrush	0.25
Swallow	0.25
Black shag	0.25
Dunnock	0.25

<b>Bethells Beach</b>	
Skylark	3.00
Goldfinch	2.25
Tui	1.50
Swallow	1.50
Black-backed Gull	1.00
Black shag	0.75
Oystercatcher	0.75
Yellowhammer	0.50
Dunnock	0.50
Sparrow	0.25
Silvereye	0.25
Kingfisher	0.25
Pheasant	0.25
Harrier	0.25
Redpoll	0.25

<b>Mountain Rd Esplanade</b>	
Tui	3.75
Grey warbler	3.50
Silvereye	2.50
Rosella	1.50
Fantail	1.25
Blackbird	0.50
Myna	0.25
Pheasant	0.25
Kereru	0.25

<b>Douglas Scenic Reserve</b>	
Silvereye	9.00
Tui	6.00
Myna	4.00
Grey warbler	3.00
Fantail	2.00
Blackbird	1.00
Kingfisher	1.00

<b>Huia Reserve</b>	
Mallard	9.00
Paradise Shelduck	5.50
Kingfisher	3.00
Tui	2.00
Myna	2.00
Blackbird	1.50
Sparrow	1.00
Plover	1.00
Starling	0.50
Swallow	0.50

<b>Henderson Valley Reserve</b>	
Silvereye	3.25
Grey warbler	3.25
Tui	2.25
Kingfisher	1.00
Fantail	0.75
Pukeko	0.75
Blackbird	0.50
Cuckoo	0.50
Sparrow	0.25
Myna	0.25
Thrush	0.25
Harrier	0.25

<b>Chorley Reserve</b>	
Sparrow	4.83
Goldfinch	4.00
Myna	3.00
Silvereye	2.50
Blackbird	1.50
Starling	1.33
Rosella	1.17
Kingfisher	1.00
Tui	0.50
Grey warbler	0.33
Fantail	0.33
Swallow	0.33
Chaffinch	0.33
Harrier	0.17

<b>Shona Esplanade</b>	
Sparrow	3.70
Silvereye	3.00
Grey warbler	2.00
Myna	1.60
Fantail	1.50
Tui	1.30
Starling	1.30
Blackbird	0.80
Tui	0.70
Mallard	0.60
Kingfisher	0.60
Rosella	0.60
Thrush	0.50
Redpoll	0.40
Chaffinch	0.30
Yellowhammer	0.30

<b>Tram Valley Road</b>	
Grey warbler	3.50
Tui	3.25
Myna	2.25
Silvereye	2.00
Fantail	1.75
Rosella	1.25
Blackbird	0.75
Kingfisher	0.50
Thrush	0.50
Starling	0.25
Pheasant	0.25
Kereru	0.25
Peacock	0.25

<b>Gill Esplanade</b>	
Sparrow	3.00
Blackbird	2.75
Tui	2.25
Grey warbler	1.75
Myna	1.75
Silvereye	1.50
Kingfisher	1.50
Starling	1.50
Pukeko	1.00
Rosella	0.75
Yellowhammer	0.75
Thrush	0.50
Goldfinch	0.25
Fantail	0.25
Heron	0.25
Harrier	0.25
Rooster	0.25

<b>Swanson Scenic Reserve</b>	
Tui	4.00
Sparrow	3.50
Myna	3.00
Silvereye	2.50
Rosella	2.00
Kingfisher	1.50
Mallard	1.00
Blackbird	1.00
Starling	1.00
Grey warbler	0.50
Thrush	0.50
Swallow	0.50

<b>Lowtherhurst Reserve</b>	
Sparrow	9.50
Goldfinch	4.00
Silvereye	2.50
Myna	2.00
Blackbird	2.00
Starling	2.00
Tui	1.00
Grey warbler	1.00
Fantail	1.00
Thrush	1.00
Chaffinch	1.00
Rosella	0.50
Black-backed Gull	0.50
Yellowhammer	0.50
Domestic Pigeon	0.50

<b>Warner Park</b>	
Mallard	16.00
Tui	3.67
Sparrow	3.00
Myna	2.50
Blackbird	2.17
Kingfisher	2.17
Grey warbler	1.83
Silvereye	1.33
Rosella	0.67
Starling	0.33
Paradise Shelduck	0.33
Fantail	0.17
Chaffinch	0.17
Redpoll	0.17

<b>Catherine Esplanade</b>	
Sparrow	10.00
Mallard	3.50
Myna	2.50
Silvereye	2.00
Tui	1.50
Blackbird	0.50

<b>Waikumete Cemetery</b>	
Sparrow	4.00
Tui	2.50
Goldfinch	2.13
Silvereye	1.88
Grey warbler	1.25
Blackbird	1.25
Myna	1.00
Starling	0.88
Kingfisher	0.50
Fantail	0.50
Rosella	0.50
Chaffinch	0.38
Thrush	0.13
Swallow	0.13
Skylark	0.13

<b>Oratia Esplanade</b>	
Sparrow	8.50
Goldfinch	3.50
Mallard	1.50
Blackbird	1.50
Tui	1.00
Silvereye	1.00
Myna	1.00
Thrush	1.00
Grey warbler	0.50
Rosella	0.50
Dunnock	0.50

<b>Brigham Creek Reserve</b>	
Kingfisher	4.00
Blackbird	3.00
Silvereye	2.50
Grey warbler	2.00
Mallard	1.50
Goldfinch	1.50
Fantail	1.00
Sparrow	0.50
Starling	0.50
Rosella	0.50
Thrush	0.50
Pukeko	0.50
Heron	0.50

<b>Kellys Bridge Esplanade</b>	
Tui	5.00
Goldfinch	2.50
Grey warbler	1.50
Myna	1.50
Starling	1.50
Silvereye	1.00
Blackbird	0.50
Kingfisher	0.50
Fantail	0.50
Swallow	0.50

<b>Rahui Kahika Reserve</b>	
Tui	4.50
Silvereye	2.67
Sparrow	1.83
Kingfisher	1.83
Grey warbler	1.50
Blackbird	1.50
Myna	1.33
Rosella	1.00
Goldfinch	0.67
Fantail	0.67
Starling	0.50
Mallard	0.33
Thrush	0.17
Chaffinch	0.17
Kereru	0.17

<b>Moire Park</b>	
Silvereye	4.00
Sparrow	3.83
Goldfinch	2.17
Myna	1.83
Chaffinch	1.67
Tui	1.50
Grey warbler	1.33
Fantail	1.17
Kingfisher	0.83
Blackbird	0.67
Rosella	0.33
Magpie	0.33
Starling	0.17
Thrush	0.17
Pheasant	0.17

<b>Takaranga Reserve</b>	
Mallard	7.25
Black-backed Gull	3.00
Sparrow	2.50
Blackbird	2.00
Black shag	2.00
Heron	2.00
Starling	1.75
Grey warbler	1.50
Myna	1.50
Swallow	1.25
Tui	1.00
Kingfisher	1.00
Chaffinch	1.00
Oystercatcher	1.00
Fantail	0.50
Rosella	0.50
Thrush	0.25

<b>Harbourview Park</b>	
Goldfinch	19.00
Mallard	18.75
Black shag	1.50
Skylark	1.50
Sparrow	1.25
Swallow	1.25
Pukeko	1.00
Myna	0.75
Starling	0.75
Harrier	0.75
Silvereye	0.50
Blackbird	0.50
Heron	0.50
Kingfisher	0.25
Black-backed Gull	0.25
Pheasant	0.25

<b>Karekare Beach</b>	
Tui	5.50
Silvereye	3.25
Grey warbler	1.50
Blackbird	1.50
Chaffinch	0.75
Fantail	0.50
Thrush	0.50
Swallow	0.25
Yellowhammer	0.25
Pheasant	0.25
Quail	0.25

<b>Claude Abel Reserve</b>	
Mallard	27.50
Tui	4.50
Silvereye	3.00
Grey warbler	2.00
Black shag	1.50
Sparrow	1.00
Thrush	1.00
Chaffinch	1.00
Myna	0.50
Blackbird	0.50
Kingfisher	0.50
Fantail	0.50
Pukeko	0.50
Heron	0.50
Yellowhammer	0.50

<b>Karaka Park</b>	
Sparrow	5.75
Tui	4.25
Blackbird	2.25
Starling	2.25
Myna	1.25
Silvereye	0.75
Grey warbler	0.75
Rosella	0.75
Thrush	0.75
Swallow	0.75
Mallard	0.50
Goldfinch	0.50
Kingfisher	0.50
Chaffinch	0.50
Heron	0.25

<b>Kay Road Balefill</b>	
Tui	3.50
Silvereye	1.67
Grey warbler	1.50
Kingfisher	1.50
Sparrow	1.00
Rosella	1.00
Myna	0.67
Blackbird	0.50
Thrush	0.50
Swallow	0.50
Goldfinch	0.33
Yellowhammer	0.33
Cuckoo	0.33
Starling	0.17
Fantail	0.17
Harrier	0.17
Quail	0.17

<b>Hobsonville Esplanade</b>	
Grey warbler	3.00
Kingfisher	2.25
Goldfinch	2.00
Silvereye	1.75
Myna	1.75
Skylark	1.50
Blackbird	1.25
Mallard	0.50
Tui	0.50
Starling	0.50
Swallow	0.25
Chaffinch	0.25
Black shag	0.25
Black-backed Gull	0.25
Harrier	0.25

---

### Appendix 3. 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>Community</b>	All the groups of organisms living together in the same area, usually interacting or depending on each other for existence.
<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>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>Ecosystem resilience</b>	The ability of an ecosystem to respond and adapt to external environmental stresses.
<b>Ecosystem services</b>	Activities of a species that benefit other species or the biological community as a whole.
<b>Endangered species</b>	Any species that is in danger of extinction throughout all or a significant portion of its range.
<b>Endemic species</b>	An indigenous species which breeds only within a specified region or locality and is unique to that area.
<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>Rare species</b>	Species with small world populations that are not at present endangered or vulnerable but are at risk.
<b>Specialist species</b>	A species that can survive only under a very narrow range of environmental conditions or habitats

<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.
<b>Sustainable Management</b>	Managing the use, development, and protection of natural and physical resources in a way or at a rate which enables people and communities to provide for their social, economic and cultural well-being and for their health and safety while (a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations, (b) safe-guarding the life-supporting capacity of air, water, soil, and ecosystems, and (c) avoiding, remedying, or mitigating any adverse effects of activities on the environment. <i>Resource Management Act 1991</i>
<b>Threatened species</b>	A term used to include rare, vulnerable, endangered and species of unknown conservation status.
<b>Vulnerable species</b>	A species that is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolution cease.

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

**Appendix 4.**

CD-Rom containing:

- Chapman, S.; Alexander, J. 2004. Waitakere City Biodiversity Monitoring Programme: five minute bird counts. Unpublished report for the Waitakere City Council. (PDF and Microsoft Word formats)
- Bird count data and analysis (1998-2004) (Microsoft Excel format)