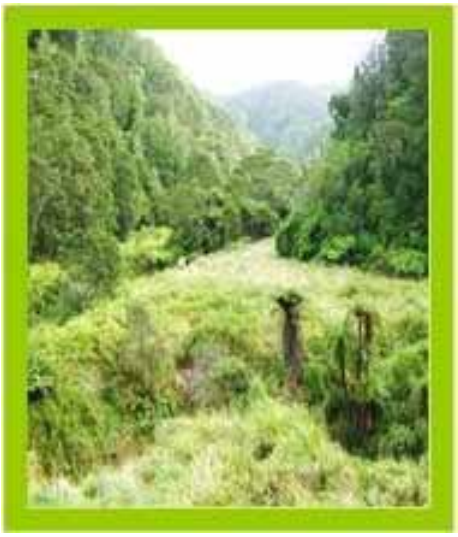


Environment Bay of Plenty
REGIONAL COUNCIL

Ohope Scenic Reserve – Small Bird Monitoring

Final Report

7th August 2009

Prepared by:
Amy Greaves and Conor Quinn

FWIF
First Words In Fauna

Contents

1 Executive Summary

Territorial authorities (such as Environment Bay of Plenty) need to know bird population trends for planning and environmental management purposes. This is because birds are prominent elements of the Ohope Scenic Reserve (OSR) biota and are sensitive to environmental changes. Environmental changes can take the form of pest control and their impacts, agricultural practices, pesticide use, industrial development, pollution, and climate change (Fuller et al. 1995; Campbell et al. 1997; Eeva et al. 1998; Gregory & Baillie 1998; Siriwardena et al. 1998; Crick et al. 1999; Krebs et al. 1999).

The set-up for this bird-monitoring project in the OSR began in April 2009. The main objective was to determine a baseline of bird abundance levels and to be able to compare subsequent bird-monitoring results.

Two methods were chosen; the Forest Bird Slow Walk Transects (Transect) method and the 5-MBC (5 minute bird count). Using a systematic random selection method, to ensure good coverage within the OSR and adherence to a scientific approach, 12 individual sites across the OSR were chosen as transect starting points. The majority of these starting points began at marked pest control station points and continued along these bait lines until a transect of 500 metres was achieved.

Twelve listening station sites for 5-MBCs were then chosen, using a systematic random selection method, in relation to each of the 12 transects. Selection of the listening stations also considered the following;

- Coverage of different vegetation types, if applicable.
- Stations not to be located on 500m transect lines. They could however be at the start or end of a transect, as long as the monitoring of the station had a minimum buffer time of 5 minutes between monitoring of the listening station or monitoring of the transect.
- Good visibility around the listening station to assist with bird identification by sight.

Figure 1. 3-dimensional Contour view of the OSR

Each transect and listening station was monitored 10 times each over a 4 week period (May-June 2009) to ensure robust measurement of bird abundance levels across the OSR.

A total of 240 monitoring sessions were conducted throughout this period, generally in clear weather well suited for bird monitoring.

The key findings are as follows:

- As complimentary methodologies, 5-MBC listening stations and transect lines succeeded in achieving good counts that will provide a solid monitoring baseline of bird abundance levels for the OSR for future comparative analysis.

- As the monitoring was conducted outside breeding season for most species, it is probable that monitoring conducted within the breeding window (August to November) for most species will result in higher numbers being monitored across all listening stations and transect lines.

- To achieve a true assessment of bird abundance numbers in the OSR a number of studies should be conducted, a minimum of one per year, with an identical methodological approach for each subsequent study. It is recommended that future small bird-monitoring projects in the OSR are conducted over a three-to five year period.

- Specifically, some listening stations and transect lines produced disproportionably high monitoring counts, compared across all listening stations and transect lines. A number of factors contributed to these results, including the proximity of excellent food sources, locations of prime habitat and ease of visibility.

- Of five native keystone species, four were observed during this monitoring project; Kereru, Tui, Bellbird and Silvereye.

- Three of the native keystone birds were monitored in high numbers. This bodes well for the overall ecological health of the reserve.

- It is recommended that Kereru, Tui, Bellbird and Silvereye are used as indicator species for bush vitality in the OSR.

- Data was analysed to determine the mean for each species, listening stations and transect lines. Variance and standard deviation was also determined for each of these data groups.

- Consistency in approach is also an important factor when considering comparative analysis from study to study.

- Future timings for re-measuring may be best suited by conducting separate projects in autumn and spring each year, perhaps taking into account the flowering periods of key native plant species.

- Re-measuring each year before and after pest control programmes have been conducted can provide an indication as to the impact of the programme on small bird species, and thus gain insight on the effectiveness of the programme in the OSR.

2 Introduction

The Ohope Scenic Reserve (OSR) is located in the Eastern Bay of Plenty, south of the Ohope Township. The land is owned by department of Conservation and is jointly managed by DOC and Te Runanga O Ngati Awa through the management committee Te Torotapu a Toi Identified by Environment Bay of Plenty as a "High Value Ecological site", OSR supports a nationally significant pohutukawa forest and the North Island brown kiwi.

The reserve is in the Taneatua Ecological District and supports one of the best examples of pohutukawa forest on the New Zealand mainland. It also contains significant populations of the nationally threatened species *Pimelea tomentosa* and the at-risk or sparse *Peperomia tetraphylla*[1].

When a remnant north island brown kiwi population was confirmed in OSR in 2000 work began to better provide for their protection. In 2005 the Whakatane Kiwi project was set up to ensure long-term viability of the Whakatane Kiwi. The project is endorsed and supported by EBOP, DOC, Ngati Awa the Whakatane Kiwi Trust and the BNZ Save the Kiwi Trust.

Apart from Kiwi-specific bird-monitoring, the OSR has not been the site of any previously conducted bird-monitoring projects. As a broad range of bird varieties are known to inhabit the Reserve, EBOP commissioned a scientific bird-monitoring study to determine a monitoring bird abundance baseline for the OSR.

Monitoring bird abundance numbers within the OSR will help provide insight into the overall health of the Reserve and provide a baseline for any future comparative studies. Specifically, the presence and absence of native birds in the OSR and any change of abundance levels between subsequent studies can provide practical indicators of the ecological health of the area that could feed into strategic decision making processes for pest control programmes. It has also been proven that native bird populations have higher nesting success and lower adult mortality following effective pest control[2].

In this regard there are two important roles birds undertake that maintains the linkage between birds, plants and the ecosystem;

1. Birds facilitate the reproduction and regeneration of many important native woody trees and shrubs through their role in pollination and seed dispersal and keep a check on invertebrate numbers.

2. Birds transfer nutrients within and across the landscape, creating local nutrient-rich sites that support distinctive plant and animal assemblages. (Landcare Research, 2005).

An ongoing bird monitoring programme could help detect significant changes in native forest bird populations over time and this information could feed into strategic planning for an overall management approach.

In addition to North Island brown kiwi, the OSR provides habitat for common native and introduced forest-dwelling bird species such as tui, bellbird, grey warbler, North Island fantail, silvereye, long-tailed cuckoo, shining cuckoo and morepork.

[1] Hitchmough et al 2007
[2] http://www.gw.govt.nz/council-publications/pdfs/Rewanui%20bird%20survey%20Feb%2009.pdf

Miskelly et al (2005) state "that it is important to document the rate of recolonisation by native forest birds into and between fragmented forest reserves, as the response of these birds to animal pest control may be applicable to restoration projects in many other parts of New Zealand".

As well as native birds, birds identified as endemic play a vital role in sustaining bush vitality. Endemic birds are defined as an indigenous species unique to New Zealand – breeds only here. Native birds are defined as self-introduced and occurring naturally in New Zealand – but also breed in other countries. The main reason for differentiating native and endemic birds is because four out of the five vertebrate keystone species are endemic.

The OSR is surrounded by land that is used for a variety of purposes, including residential, landfill, road reserve and farming. Ongoing management of pest plants and animals in the OSR and on neighbouring private properties is needed to ensure that the health of the reserve is protected and enhanced[3].

Due to this variation of habitat the OSR is home to a wide variety of native, endemic and introduced (exotic) species. "Most introduced birds prefer forest edge, open woodland and grassland habitats, where their main diet includes invertebrates, seeds and fruits. Native and introduced bird habitats overlap in the dynamic and productive forest edge zone, from where both significantly reduce potential agricultural insect pests and contribute to the dispersal of fruit bearing native and introduced shrubs and trees", (Janssen, 2006).

In some cases introduced species have filled new niches which were not able to be filled by native species, but which were well suited to the new arrivals. As competition from native species was negligible a large number of introduced species have developed into being more successful in New Zealand than their country of origin (Dr P. C. Bull, pers. comm. 1982).

This project is designed to scientifically monitor birds in the OSR to produce a baseline of bird abundance numbers, as part of an overall programme to ensure the Ohope Scenic Reserve continues to thrive.

This report details the set-up of transects and listening stations for bird monitoring throughout the OSR, as well as results of the initial monitoring phase and recommendations for subsequent monitoring phases.

[3] http://www.doc.govt.nz/getting-involved/sponsorships-and-partnerships/regional-sponsorships-and-partnerships/te-tapatoru-a-toi/ohope-scenic-reserve/

3 Method

This bird-monitoring project has followed a scientific approach to ensure future studies can be replicated to determine a robust comparative analysis of bird abundance levels in the OSR**.**

3.1 Research Objectives

For this project, the overarching objective was to provide bird-monitoring data, based on a scientific methodology that would be used to determine baseline bird abundance populations for the OSR.

Other specific objectives were to:

a) Obtain data on all native bird and introduced species that inhabit the reserve;

b) Obtain robust data for future comparative studies.

3.2 Research Method

3.2.1 Scientific Methods for Bird-monitoring

Bird abundance monitoring can be challenging and there are considerable difficulties in getting reliable estimates of changes in bird abundance. These estimates require careful design of monitoring and careful assessment in the field (Handford, 2002).

The most common methods used to monitor bird abundance are walking counts, (transect counts) and 5-minute bird counts, (5-MBC). In a Notornis journal article, written by Dawson & Bull (1975) bird counting methods were studied. The methods studied were walking counts, (transect counts), 5-MBC and 10-MBC.

Dawson and Bull, (2002) wrote that, "Observers differ in their ability to see, hear and identify birds and in their judgement as to the number present, and these abilities may change with time... and also there can be considerable error introduced into bird monitoring from different observers having differing abilities in bird identification."

To overcome such a bias for this project, only one, highly skilled observer conducted each and every monitoring session.

3.2.2 Bird Count Methods used for this Project

1. Forest Bird Slow Walk Transects (Transect)

The observer walked at a constant (slow) pace along the transect and counted all the birds seen or heard within 0 – 10 m, 10 – 20 m, and > 20 m, perpendicular to the transect. Eleven of the twelve transects measured 500m in length. The only exception is transect 2, which measures 400 m in length. This was due to steep and unsuitable terrain between the 400 – 500 m stage. The climb from the gully, up the face to the ridge is very steep, and therefore the transect could not be completed to the desired 500m.

'*Figure 3, 3-dimensional Contour View of Transect 2*' (See page 13) shows a contour view of transect 2 and provides an indication of the terrain. Consideration was given to replacing transect 2 with one in more suitable terrain. However, the initial monitoring results from this transect were very positive and it was therefore decided that this transect would be

maintained as is. The transect also covers different vegetation types, crosses a stream and has good numbers of native tree species, some of which include, puriri, nikau, tree ferns and supplejack, and are desirable food sources for birds.

2. 5-MBC (5 minute bird count)

The observer stood at the listening station and, after standing silent for one minute, recorded every bird heard or seen over a 5-minute period, noting birds seen or heard within 10m, 20m, or more than 20m. If a bird was seen and heard it was recorded as seen.

The starting time for each monitoring session was rounded up to the nearest five minute period. One 5-MBC was completed and then one transect count was completed, or vice versa, depending on location, order and weather conditions.

3.2.3 Methodology Considerations

According to Handford (2002), it would also be more desirable to complete a series of measurements over a month, rather than intensively over a few days. The fieldwork for this project was conducted over a four week period, from the 25th May 2009 to 19th June 2009.

Seasonal variation is another factor which should be taken into consideration, especially for future bird-monitoring projects. Birds may be active and vocal during the early breeding season, but be secretive during moulting (Handford, 2002). In the OSR these times fluctuate depending on species, however monitoring between August and November annually would likely provide more robust data. If adult birds are regularly searching for food to feed their fledglings this may result in a higher chance of encountering those birds and them being included in the survey, as well as more overall species being observed.

Considering the range of topography and how the density of vegetation changes in the OSR there are advantages for both transect counts and the 5-MBC.

Therefore this project was conducted using both methodologies to compliment one another.

Using both methodologies will give the truest reflection of the bird population within the OSR.

Handford (2002) developed the following notes as useful pointers for bird monitoring and, besides point three, each was adhered to during this project;

- Complete the surveys over a period, for example, over one month, not just a number of days, and also survey at the same time each year;
- Ensure that surveys are completed in the same weather conditions, perfect weather conditions would be fine and still;
- Identify when bird species are most visible (this is usually during their breeding season between August and November);
- Use methods that reduce identification which relies on bird calls alone.

On transect lines a large proportion of birds can be identified by sight and a fixed area is assessed to give an indication of density. Transect lines are also suited to sampling large areas of relatively open, homogeneous habitat. Due to the differing types of terrain in the OSR, and the desire to ensure transects and 5-MBCs had random, even coverage across the

OSR, transect lines could not always be located in a relatively open, homogenous habitat and distance markers on either side of the transect could not always be marked.

3.2.4 Establishment of transect lines and 5-MBC listening stations

Establishment of transect lines and 5-MBC listening stations began in mid-April 2009. Transect lines and stations were marked using pink and white plastic triangles (arranged in a star shape, see the figures below) and bright pink coloured flagging tape.

Figure 2. Transect 10 Marker

Figure 3. A 10 Metre Marker

Although it was estimated that a minimum of one day was allocated to establishing a transect line, due to inclement weather conditions and difficult terrain, a number of transects took 2 days or more to be completed.

Establishment of transect lines included:

- Measurement of the 500 metre transect line with a hip chain and/or use of bait stations (which are generally spaced 75 metres apart in the OSR) to measure the 500 metre transect line;

- Marking of the transect every 100 metres;

- Marking 10 metres either side of the transect at the start, then at 200–300 metre intervals, where terrain and vegetation allowed, so the observer is able to calibrate their estimates of 10 metres from the transect;

- Permanently marking the transect location and directions to the transect from the nearest bait line/track, so the transect can be located and monitored subsequent to this project.

5-MBC listening stations were set up in conjunction with the transect lines. Each listening station was permanently marked at the listening station, with obvious directional marking to and from the station in relation to the nearest bait line/track.

3.2.5 Number and Location of Transect Lines and Listening Stations

- 12 transect lines and 12 listening stations were established across the OSR.

- The location of each transact line and each listening station was chosen using a systematic random selection method to ensure good coverage within the OSR and adherence to a scientific approach.

- The location of each listening station was chosen in relation to the nearest transect line using a systematic random selection method.

- A location overview of each transect and listening station can be found in the appendices, entitled 'Directions for Locations to 5-MBC Listening Stations and Transect Lines for Small Bird Monitoring at Ohope Scenic Reserve April-July 2009' Instructions on how to reach each transect line and listening station are also included, as well as a difficulty grading for each.

Locations of all transect lines and listening stations can be viewed in Figure 1 overleaf.

Figure 2 is a 3-dimensional map displaying the contours of the OSR and shows a number of transect lines and listening stations established in the central part of the reserve.

Figure 3 displays transect 2 (encircled) and the steepness of the terrain.

Figure 4 is a textured contour view of the OSR. From this view the number of ravines and gullies are easily visible. Throughout the OSR the majority of ravines and gullies with free flowing water proved to be unsuitable terrain for establishing transects and monitoring. The arrows in this figure follow routes that were explored for transect establishment and found the terrain to be largely unsuitable for a bird-monitoring project.

Figure 4. Locations of Transects and Listening Stations in the Ohope Scenic Reserve

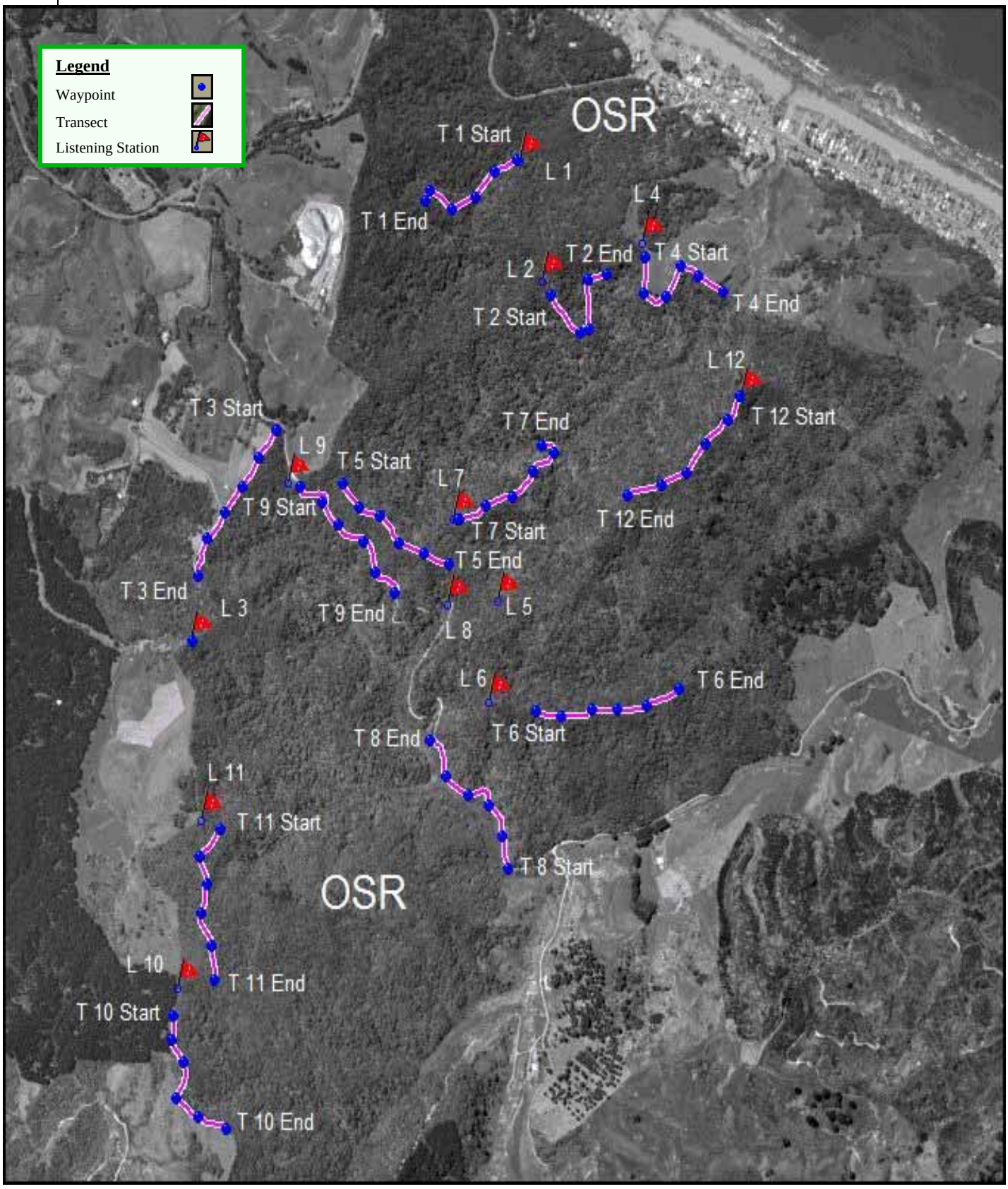


Figure 5. 3-dimensional Contour View of Transects and Listening Stations from the Rear of the Ohope Scenic Reserve

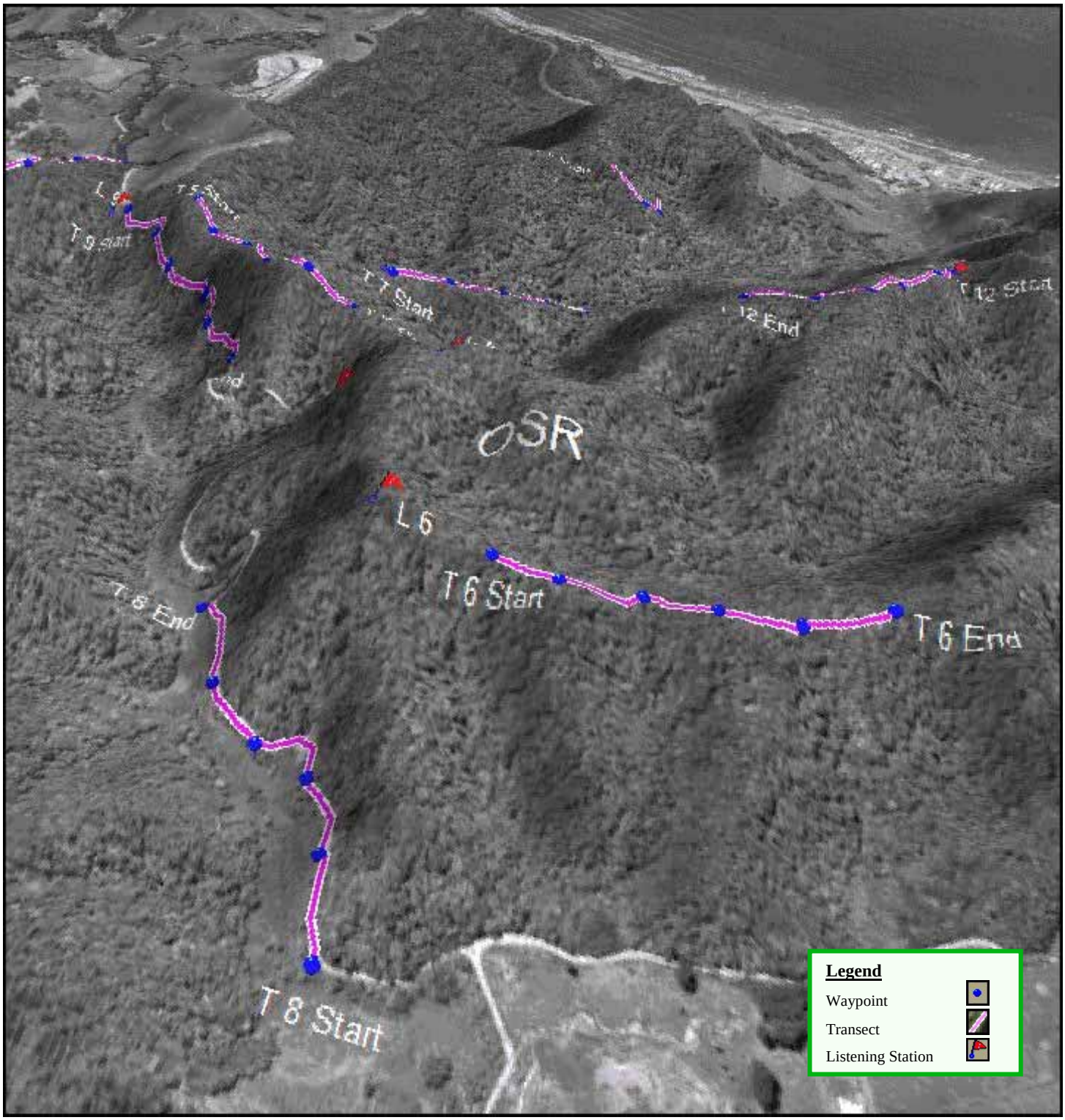


Figure 6. 3-dimensional Contour View of Transect 2

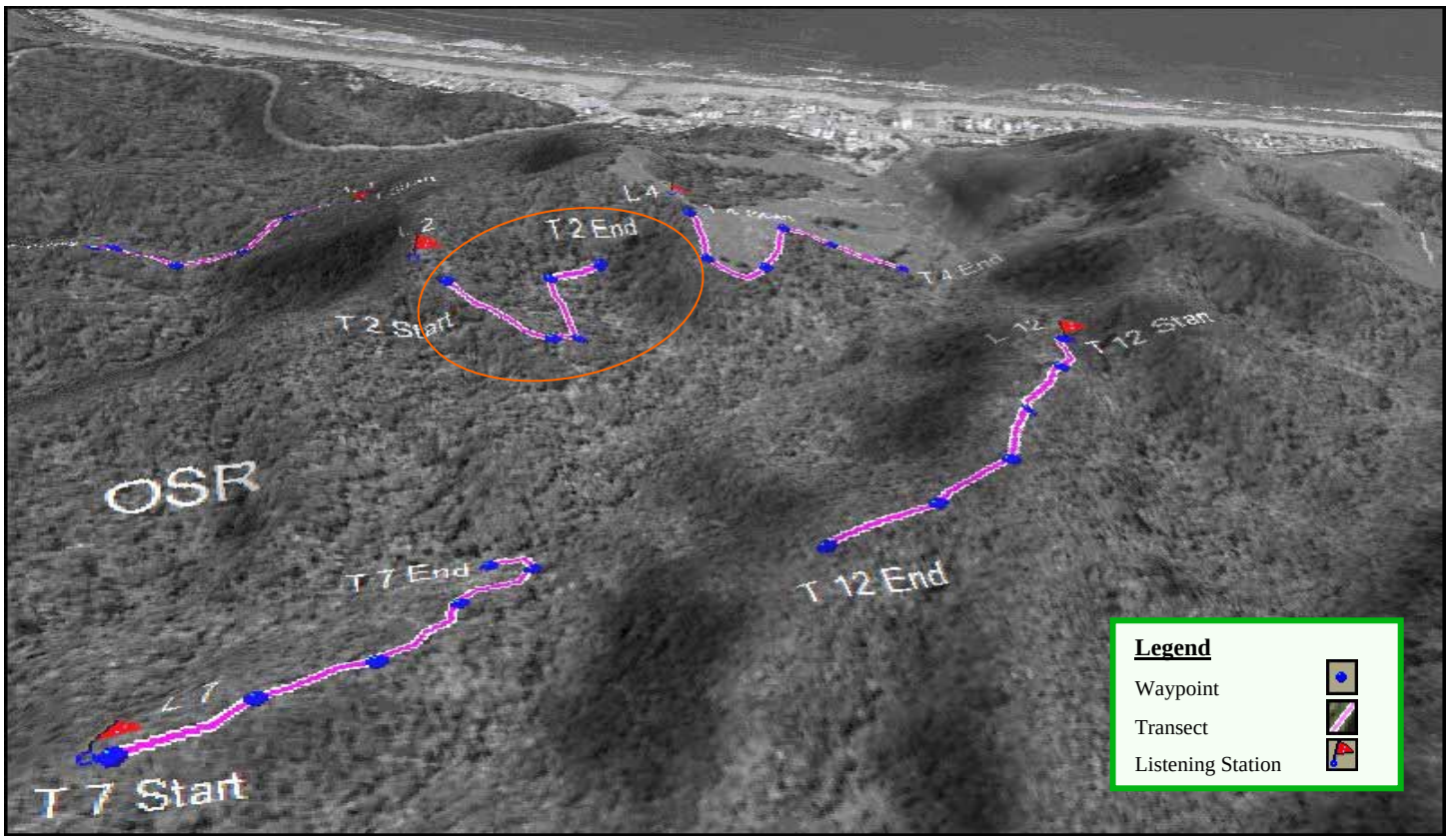
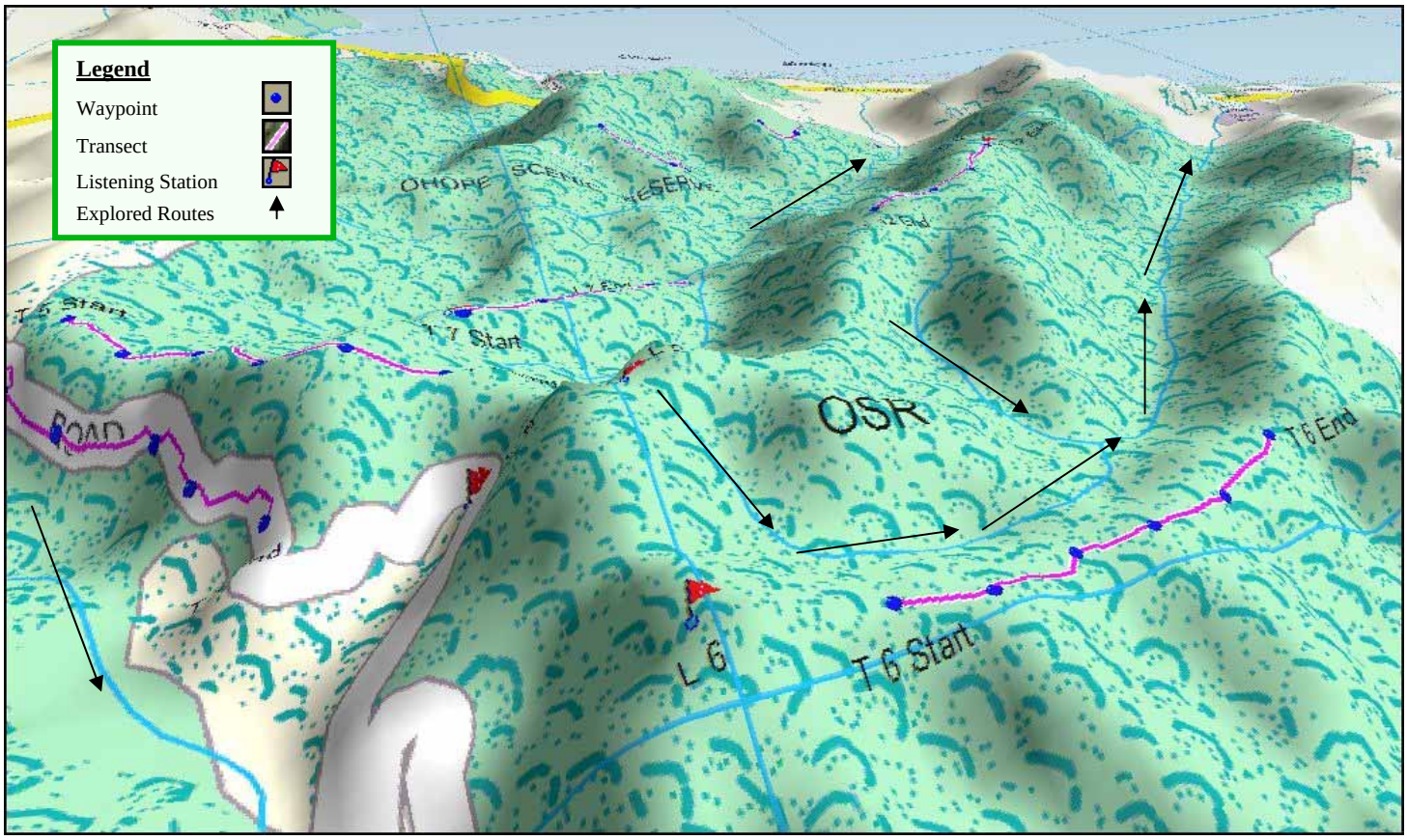


Figure 7. 3-dimensional Textured Contour View of Transects and Listening Stations from above intersection of Burma and Maraetotara Roads



3.2.6 Frequency and Repetition of Monitoring

- Each transect line was assessed 10 times during the fieldwork phase, for a total of 120 transect line monitoring sessions. For a sample size of 120 the margin of error is +/- 8.95%. *The margin of error for a sample of 120 indicates that 95 chances out of 100 will fall within 8.95% of a given result in any binomial distribution*.

- Each 5-MBC station was monitoring 10 times during the fieldwork phase, for a total of 120 monitoring sessions. For a sample size of 120 the margin of error is +/-8.95%. *The margin of error for a sample of 120 indicates that 95 chances out of 100 will fall within 8.95% of a given result in any binomial distribution*.

- This ensured sufficient data was obtained to provide a robust analysis.

- FWIF is well placed to conduct any statistical testing included within the project to ensure data validity. Statistical testing is standard practice on all FWIF projects to ensure that the sample data used is statistically robust. Before any analysis is conducted it is imperative to understand how statistically sound the data is and identify and remove/re-sample any data that is unacceptable. Typically we will test at the 95% confidence level, but will work in a range of 90%-99% where required.

- Statistical testing on the data obtained for this project included the determination of variance, standard deviation and means across all listening stations and transect lines.

Supporting evidence for our chosen number of 10 assessments per transect line and listening station;

- “The precision of the technique improves with both a larger average count and with a greater counting time. One hundred and twenty five counts will give useful results for the more abundant species...” (Dawson & Bull, 1975)

4 Results

Overall, the total number of observations for the transect lines far outnumbered the total number of observations for the 5-MBC listening stations, by over 2 to 1. As displayed in Table 1, listening stations provided a good mix of native, endemic and introduced birds. An overall total of 1,414 birds were monitored at the listening stations.

Table 1. Total Bird Species Seen/Heard at Each Listening Station and Aggregated Listening Station Total Birds Seen/Heard

Bird Species (Common Name)	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	Mean
Australasian Harrier	3	2	2	1	2	-	-	-	2	12	1	5	2.50
Blackbird	11	3	6	4	-	-	2	-	7	3	10	4	4.17
Bellbird	27	9	12	10	8	9	18	6	23	8	8	9	12.25
Chaffinch	-	-	-	-	-	-	-	5	-	-	28	-	2.75
Fantail	41	11	20	43	11	21	22	10	23	19	30	16	22.25
Grey Warbler	11	5	5	4	6	3	6	5	11	3	8	7	6.17
Sparrow (H)	2	-	-	-	-	-	-	-	-	-	-	-	0.17
Kereru	1	-	2	4	-	-	-	1	1	-	-	-	0.75
Kingfisher	5	1	-	-	-	-	-	1	2	-	1	-	0.83
Magpie	9	4	3	11	2	1	3		4	11	11	5	5.33
Myna	4	-	3	-	-	-	-	1	10	-	2	-	1.67
Paradise Shelduck	-	-	-	-	-	-	-	-	-	-	-	-	0.00
Peacock	-	-	-	-	-	-	-	-	-	8	6	-	1.17
Pheasant	-	-	-	-	-	-	-	-	-	6	6	6	1.50
Pukeko	-	-	1	-	-	1	-	3	3	-	-	-	0.67
Seagull	6	13	6	9	8	-	17	-	-	6	4	5	6.17
Silvereye	24	4	3	11	-	12	4	11	33	6	14	11	11.08
Starling	2	-	1	-	-	-	-	-	1	-	4	-	0.67
Swallow, Welcome	-	-	-	2	-	-	-	-	3	5	6	-	1.33
Thrush, Song	6	-	-	1	1	-	-	-	1	-	4	1	1.17
Tui	56	26	35	32	21	22	31	34	54	19	28	20	31.50
Turkey	-	-	-	-	-	-	-	-	-	-	-	-	0.00
Tomtit	6	-	2	-	-	-	1	1	-	-	2	-	1.00
Yellow Hammer	-	-	-	-	-	-	-	-	-	30	-	-	2.50
Unknown	1	2	-	-	-	-	-	1	-	-	-	-	0.25
TOTAL	**215**	**80**	**101**	**132**	**59**	**69**	**104**	**78**	**178**	**136**	**173**	**89**	

= Statistically Significant

Twenty-two different species of birds were monitored across the 12 listening stations, with 4 unknown birds recorded. The listening stations L1, L 9 and L 11 produced the highest count numbers. Listening station one has been determined as statistically significant as the standard error was 2.0 above the mean. The Fantail mean had a standard error of 2.33 and the Tui had a standard error of 3.56.

The standard rule of thumb is that if there are more than four standard errors between two means then it is likely there is a real and significant difference. If there are two to four standard errors then it is possible there could be a difference (but expert statistical analysis is required to determine actual significant difference), while if there are fewer than two standard errors it is unlikely there is any significant difference (Handford, 2002).

Table 2 overleaf displays the total birds monitored across the 12 transect lines. Twenty-four different species of birds were monitored and 14 unknown birds were recorded. An overall total of 2,885 birds were monitored on the transect lines.

Transect lines 1, 3 and 4 produced the highest bird counts. Transect 4 produced a very high number of birds counted and is marked as statistically significant as the standard error was 2.32 above the mean.

Fantail and Tui also had high counts across the transect lines and have been marked as statistically significant, with standard errors of 2.71 and 2.74, respectively.

The aggregate number of birds monitored throughout the entire project was 4,299.

Table 2. Total Bird Species Seen/Heard at Each Transect and Aggregated Transect Total Birds Seen/Heard

Bird Species (Common Name)	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	Mean
Australasian Harrier	2	2	3	7	-	1	-	1	3	8	-	-	2.25
Blackbird	12	8	19	11	4	4	7	2	3	8	18	9	8.75
Bellbird	27	29	29	16	12	10	26	13	27	14	27	9	19.92
Chaffinch	9		14	115	-	-	-	-	-	30	8	-	14.67
Fantail	60	47	62	63	34	29	42	69	39	43	41	26	46.25
Grey Warbler	28	20	25	2	8	5	19	18	9	10	20	12	14.67
Sparrow (H)	-	-	3	-	2	1	-	-	-	-	1	-	0.58
Kereru	9	10	9	6		2	10	1	1	1	2	2	4.42
Kingfisher	4	3	5	4	1	-	-	-	-	-	1	1	1.58
Magpie	6	5	7	15	3	3	1	1	1	13	7	5	5.58
Myna	3	2	17	-	-	-	-	2	6	-	1	-	2.58
Paradise Shelduck	-	-	1	-	-	-	-	-	-	-	-	-	0.08
Peacock	-	-	-	-	-	-	-	-	-	10	-	-	0.83
Pheasant	1	1	-	-	-	-	-	-	-	22	-	-	2.00
Pukeko	-	-	2	-	-	4	-	16	4	-	-	-	2.17
Seagull	21	8	20	32	1	3	3		4	10	9	7	10.73
Silvereye	50	41	26	39	15	11	28	67	32	31	47	25	34.33
Starling	-	-	-	3	-	-	-	-	-	-	-	-	0.25
Swallow, Welcome	-	6	27	29	-	-	-	4	-	7	-	-	6.08
Thrush, Song	10	15	8	2	1	2	2	-	1	1	1	1	3.67
Tui	72	40	55	44	41	40	49	48	70	27	42	31	46.58
Turkey	-	-	-	5	-	-	-	-	-	6	-	-	0.92
Tomtit	7	11	7	-	-	4	4	-	3	-	9	-	3.75
Yellow Hammer	-	-	-	90	-	-	-	-	-	-	-	-	7.50
Unknown	1	-	2	-	1	-	-	4	4	-	1	1	1.17
TOTAL	**322**	**248**	**341**	**483**	**123**	**119**	**191**	**246**	**207**	**241**	**235**	**129**	

= Statistically Significant

Figure 8 is a comparison of native, endemic and introduced birds monitored across the 12 listening stations, with 6 native, 6 endemic and 11 introduced species monitored. Listening stations 1 and 9 produced high counts of endemic birds, while listening stations 1, 4 and 9 produced high counts of native birds. Listening stations 11 and 12 produced high counts of introduced birds.

Figure 8. Comparison of Total Native, Endemic and Introduced Birds at Each Listening Station

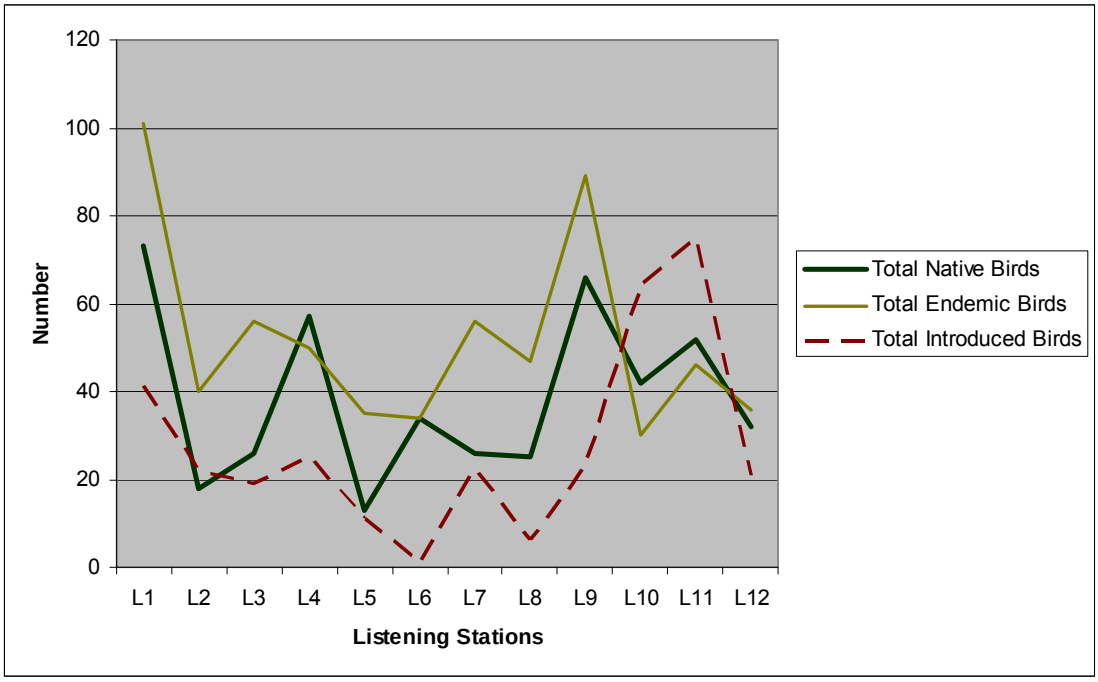
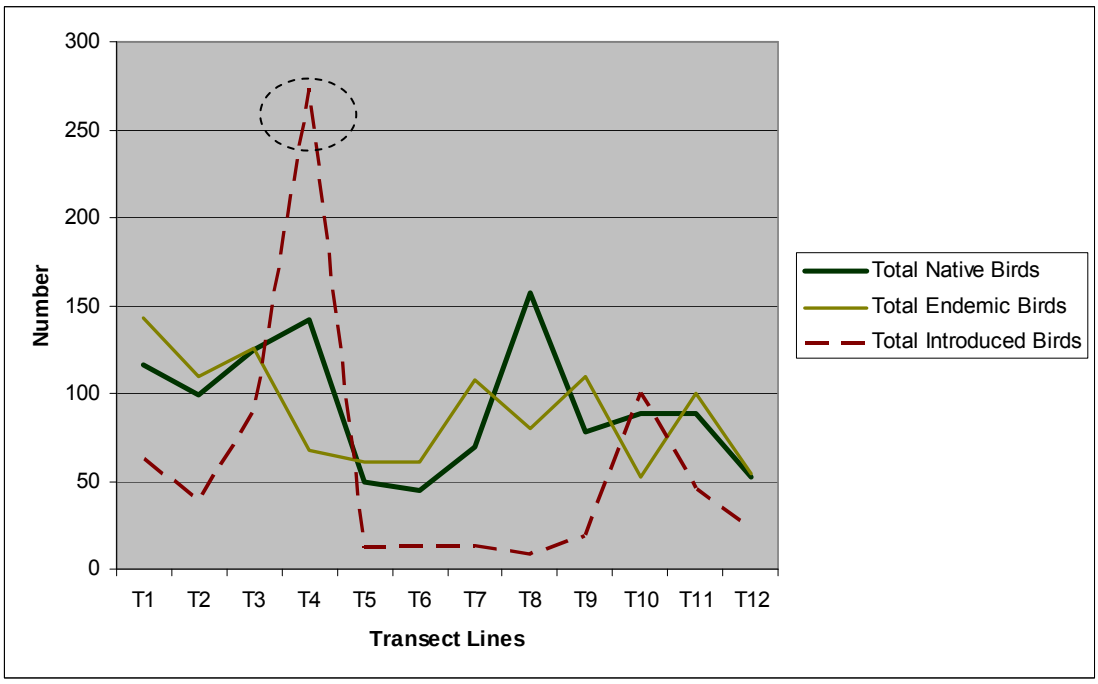


Figure 9 shows the same comparison for the transect lines. Transect 4 is circled as a result of interest due to the spike in introduced bird numbers. (Continued overleaf)

Figure 9. Comparison of Total Native, Endemic and Introduced Birds at Each Transect Line

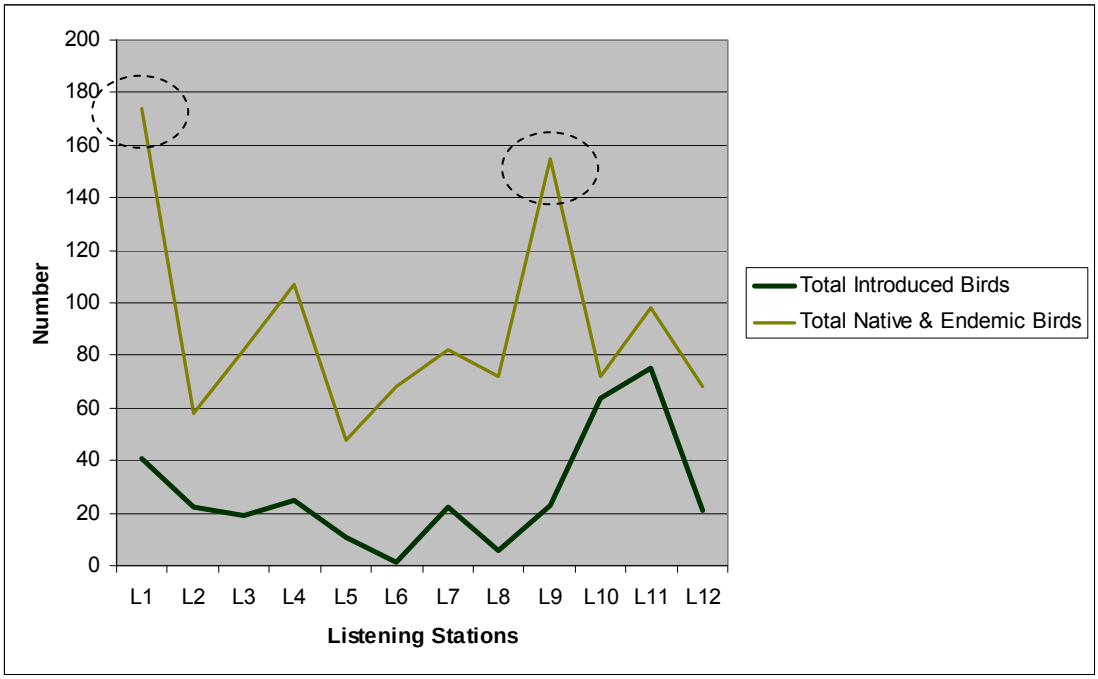


Other than transect 4 the count for introduced birds remained 100 or below. Counts for total native and endemic birds remained quite steady throughout, for the most part remaining between the 50 and 150 band. There was a small spike in the count for native birds at transect 8, where the count peaked at just over 150.

Figure 10 compares introduced birds against the aggregated total for native & endemic birds across the 12 listening stations. Circled as results of interest, listening stations 1 and 9 produced high totals for native & endemic birds, while total introduced birds generally remained below a 40 count, up until listening stations 10 and 11, where the counts peaked between 60 and 80.

As is illustrated by Figure 10, the count for total introduced birds is significantly lower than the count for native & endemic birds across the majority of the listening stations.

Figure 10. Comparison of Total Introduced Birds Vrs Total Native and Endemic Birds on Listening Stations



= Result of Interest

In Figure 11 (overleaf) introduced birds are compared against the aggregated total for native & endemic birds across the 12 transect lines. The introduced bird count for transect 4 has been marked as a result of interest due to the uncharacteristic spike in the count compared to the rest of the transect lines.

Besides this spike, the aggregated total of native & endemic birds is significantly higher across all transect lines. Also marked as a result of interest, at transect 10, is what appears to be an inverse relationship to the comparison counts for introduced birds and the aggregated total for native & endemic birds. That is, as the count for native & endemic birds declines at transect 10, the count for introduced birds rises.

Figure 11. Comparison of Total Introduced Birds Vrs Total Native and Endemic Birds on Transect Lines

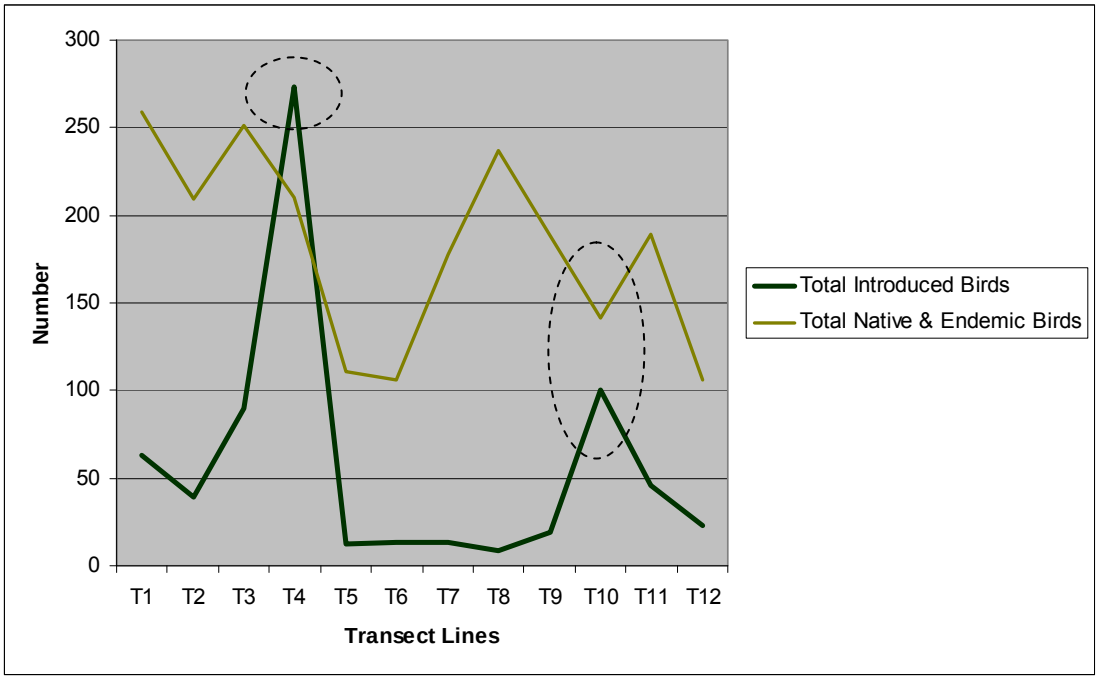


Figure 12 compares total bird count numbers between the listening stations and transect lines. Transect 4 is marked as a result of interest as there is a huge spike in the count. Besides this spike at transect 4, the counts for each of the transect lines generally rise and fall in the same proportions as the counts for the listening stations, with the counts for all transect lines noticeably higher than those of their listening station counterparts.

Figure 12. Comparison of Total Observations Listening Stations Vrs Transect Lines

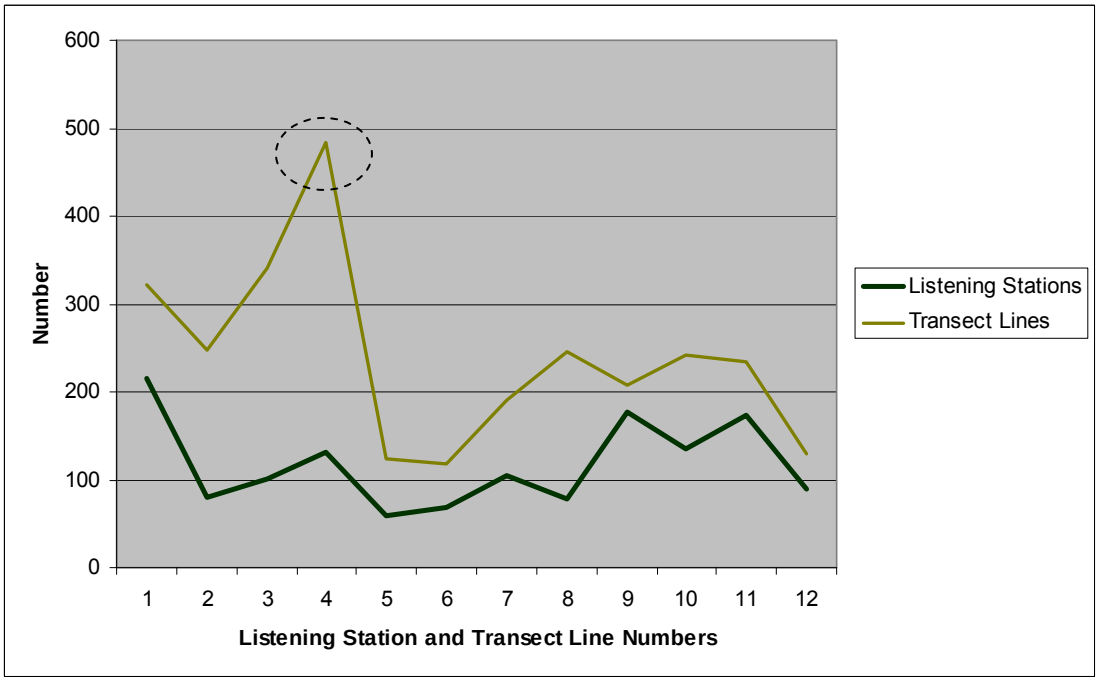
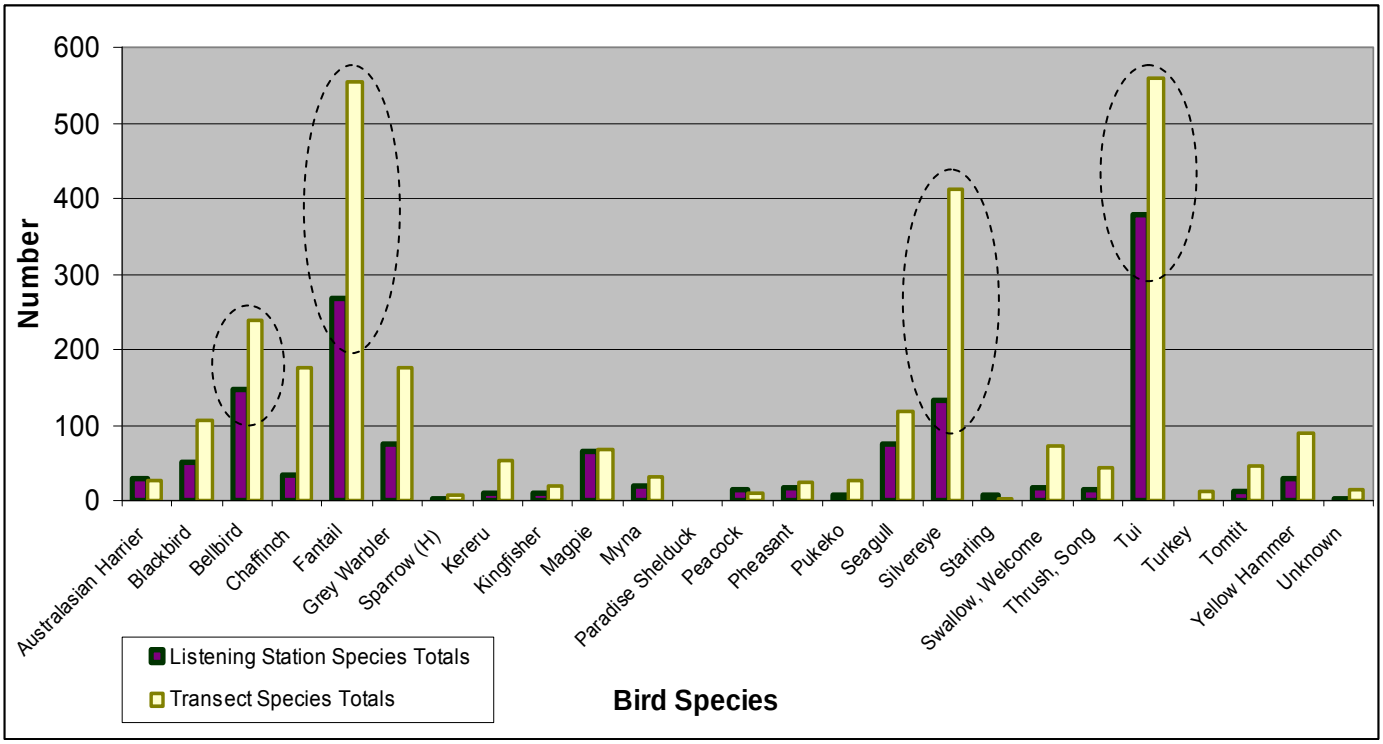


Figure 13. Total Bird Species Monitored on Listening Stations and Transects



= Result of Interest

Figure 13 displays all bird species monitored during the fieldwork phase. The four species with the highest totals are circled as results of interest. They are tui, fantail, silvereye and bellbird.

5 Discussion

Due to inherent timings in each of the complimentary methodologies, that is, there is a longer time period spent monitoring on transect lines than on 5-MBC listening stations, there were significantly higher counts across the board for transect lines over 5-MBC listening stations. However, both these methodologies succeeded in achieving good counts that will provide a solid monitoring baseline of bird abundance levels for the Ohope Scenic Reserve (OSR). Therefore, the results from this project should provide good data for comparative analysis with any future monitoring studies.

The tables and charts displayed in the results provide for an excellent overall picture of bird numbers in the OSR and allow for comparison across a number of variables. These variables, such as endemic & native compared to introduced and total observations compared between listening stations and transects, will provide for an excellent platform from which to perform comparative analysis in subsequent small bird-monitoring projects in the OSR.

Depending upon the frequency of subsequent monitoring projects, it may take up to five years of comparative monitoring before a true assessment of bird abundance is achieved for the OSR. It is preferable that bird monitoring studies are conducted annually, at the same time every year (during the breeding season), and are conducted using identical methodologies from study to study. It is also preferable that similarly experienced observers, if not the same observers, are used for each monitoring study to ensure consistency of observation.

The monitoring provided a wide range of species capture, which is evident by the twenty plus species recorded for both methodologies. As the monitoring was conducted outside breeding season for most species, it is probable that monitoring conducted within the breeding window (August to November) for most species will result in higher numbers being monitored across the OSR.

The monitoring results also showed there are a high proportion of native and endemic birds inhabiting the OSR. This is especially important as native keystone birds distribute native plant seeds, pollinate flowers and keep a check on invertebrate numbers, whereas introduced species do not play a major role in pollination of native fauna, especially pohutukawa.

An article published in the American Journal of Botany by Schmidt in 2000, regarding pollinators of pohutukawa, found that “there were clear differences in the relative frequencies of visitation by endemic and introduced species. The pohutukawa stands … were almost exclusively visited by birds endemic to New Zealand. Two of the honeyeaters, tui and bellbird, were most frequently observed”.

This is directly relevant to the OSR, as it supports a nationally significant pohutukawa forest, and a significant increase in endemic bird numbers could indicate that overall forest health is improving. This would also suggest that pest management strategies were having a positive impact in the OSR.

In total there are five native keystone bird species; kereru, tui, bellbird, stitchbird and silvereye (Janssen, 2006). Of these five, four were monitored during this monitoring project; kereru, tui, bellbird and silvereye. Besides the kereru, which was monitored in low numbers, the other three native keystone birds that inhabit the OSR were monitored in high numbers. This bodes well for the overall ecological health of the reserve.

As is evident throughout the results, some listening stations and transect lines produced disproportionably high monitoring counts. There are a variety of possible reasons for these results.

Transect 4 recorded the highest number of birds for transects but also produced a high number of introduced bird species. This was mainly due to the high counts of chaffinches (115) and yellowhammers (90). This transect runs along a portion of boundary fence line which separates the OSR from farmland and is a desirable habitat for chaffinches. Chaffinches also form flocks of several hundred birds in autumn and winter, (Crowe, 2007). Similarly, yellowhammers are also very common in open country, scrub and sand dunes. Very large flocks congregate in winter to feed on paddocks, (Crowe, 2007). Encountering these large flocks of chaffinches and yellowhammers led to very high counts of introduced bird species on a number of separate monitoring sessions, as is evident by the count spikes at transect 4.

Transects 1 and 3 have ample food supplies, are close to water (small lake or a stream), have portions of open vegetation and have minimal shade, which ensures good light levels. Consequently these transects offer a variety of different habitats and provided for good monitoring counts in these locations.

Listening 1 recorded the highest number of birds for listening stations and the majority of species were endemic or native. This station had the highest number of tui and bellbird, was first equal for the highest number of grey warbler, and the second highest number of fantail.

At the time of monitoring there were abundant food supplies in this area, including nectar from kohekohe and puriri, rata and fruit from nikau palm, *rhopalostylis sapida*, mapou *myrsine australis*, pate, *schefflera digitata,* supplejack *ripogonum scandens*, karamu, *coprosma robusta* and mahoe, *melicytus ramiflorus* among others. The site is elevated and open, has good light levels, is close to water (stream), and is surrounded by a wide variety of native plant species. Transect 1 recorded the third highest count for transect lines mainly due to the same environmental factors.

Listening 9 recorded the second highest number of birds for listening stations. The major species recorded in descending order were tui, silvereye, bellbird and fantail. This listening station is located near the carpark at the top of Burma Road and overlooks the reserve. It benefits from excellent sunshine hours and has an elevation of approximately 152m, which assists in easier identification of birds by sight and their calls. It was also surrounded by abundant food supplies, such as mature puriri trees, and rata was also in full flower. The combination of these factors, especially the nectar available from the flowering vines and trees, would explain the high number of tui, silvereye and bellbird recorded. The playful behaviour of the fantail adds to their conspicuous and this behaviour is especially so on the forest edge where they are more visible.

Listening 11 is located very near to the forest edge adjoining farmland. The major species recorded were fantail, tui, chaffinch and silvereye. There were also 11 magpies recorded. Similar magpie numbers were recorded at L4 & L10. These three listening stations are on the forest edge and bordering farmland. Magpies preferred habitat is open country, especially farm pastures with trees. In 2003, Landcare Research stated that although magpies are a threat to native birds when guarding territories during the breeding season, thereby limiting the feeding range of the native birds, they may not cause actual native bird numbers to decline[4].

[4] http://www.landcareresearch.co.nz/news

The inverse relationship detailed in Figure 11 as a result of interest, where the number of native and endemic birds declined while the number of introduced species increased, was likely the result of the location of the transect. Transect 10 is located on the forest edge, close to adjoining farmland and areas of deforestation. This terrain is favoured by introduced species which prefer scrub, open country and farmland. Specifically the introduced species in question with high counts were chaffinch and pheasant, whose main diet consists of seeds, fruits and insects and seeds, fruits, green shoots, leaves and insects, respectively. This type of terrain is usually not favoured by native and endemic birds except, in this case, for the fantail, silvereye and welcome swallow. Fantail and welcome swallow are *aboreal insectivorous* while the silvereye also includes insects, grubs and spiders in its diet.

Overall the highest number of bird species recorded at the listening stations were tui and fantail. For transects the highest number of bird species recorded were again tui and fantail.

Tui

Tui, are honeyeaters and were the most abundant bird recorded during monitoring. Tui are endemic to New Zealand and are widespread on the main islands and in the Auckland, Chatham and Kermadec Islands (Dawson & Lucas, 2007). Individual birds set up breeding and feeding territories, and defend them fervently. “Tui, the most nectarivorous of the New Zealand honeyeaters, occupy higher feeding levels in the canopy than bellbird and stitchbird”. (Atkinson and Millener, 1991). In addition, the two smaller honeyeater species are regularly chased by tui (Rasch and Craig, 1988).

Tui migrate to forest remnants to pollinate kowhai, harakeke (flax) and kotukutuku. They are one of the five bird ‘vertebrate keystone species’ and assist in keeping native bush healthy. They are key dispersers of smaller native plant seeds outside of their native bush patches (Janssen, 2006).

Fantail

The second most abundant bird recorded during monitoring was the fantail. Fantail are widespread and very common, are arboreal insectivores and are native to New Zealand. The fantail is one of New Zealand’s best-known birds. Its appeal lies in its large fan-like tail and erratic darting movements that often bring it quite close to its observers. Mating pairs are strongly territorial during the mating season but sometimes gather in flocks during the winter. The fantail mostly captures insects and other invertebrates on the wing and uses its fanned tail to stop in mid-air before darting in another direction (Dawson & Lucas, 2007). The fantail has benefited from the large-scale clearance of forest and the creation of forest edge and scrub habitats (Heather and Robertson, 2005). Variance in population numbers due to severe climatic changes is common however, as demonstrated by the numbers observed in the OSR, the climate there is favourable for fantail.

Silvereye

The third most abundant bird recorded during monitoring was the silvereye. Silvereye are termed as ‘generalisers’ as their diet is so consistently varied. They are native to New Zealand and very common in native and exotic forests, scrub, orchards and suburban gardens (Moon, 2006). The silvereye was the most abundant species observed in the 2007 garden bird survey published by Landcare Research and second after the sparrow in 2008.

They are one of the five bird ‘vertebrate keystone species’ and assist in keeping native bush healthy.

They have been in New Zealand since the early 1800s and colonised the country in large numbers. Mating pairs are strongly territorial during the mating season but join flocks during the winter (Dawson & Lucas, 2007). Their diet includes insects, grubs, spiders, small fruits and nectar. Silvereye are commonly recorded in higher numbers than other native and endemic species during bird monitoring as their propensity to join flocks in winter makes them easily visible.

It should be noted that the silvereye is 'one of the most abundant of New Zealand birds and is found everywhere except open grassland habitats'. It has also been named as the greatest 'culprit' in distributing seeds around the countryside and throughout the bush. In the autumn and winter they move about in quite large flocks, descending upon a species and stripping them or their berries. Because their numbers can be far greater than any other bird species, it is likely that the silvereye has had a significant impact on native forest habitats by changing the seed dispersal pattern and by competing with other animals as well as birds for fruit, nectar and insects[5].

Bellbird

The fourth most abundant bird recorded during monitoring was the bellbird. Bellbird are endemic to New Zealand and are widespread south of Northland, including the Auckland Islands (Dawson & Lucas, 2007). The bellbird is a honeyeater and, like the tui, sets up breeding and feeding territories and defends them fervently. Their diet consists of nectar, honeydew, insects and fruit. They are one of the five bird 'vertebrate keystone species' and assist in keeping native bush healthy. As habitat loss and predation has driven stitchbird numbers to dangerously low levels, the bellbird has taken over as New Zealand's most effective native plant-pollinating bird. Their preferred habitat niche is the upper forest story, but they can sometimes be found in scrub and gardens.

Isolated forest population of bellbird are doomed without corridor connections (Janssen, 2006). Ensuring as many of these corridors as possible connect to the OSR should enhance bellbird breeding and long term survival in the OSR and surrounding areas.

To maximise bellbird numbers in the OSR and corridor connections, maintaining of effective pest control management strategies are required.

Notable absent species

The species listed below were not observed during monitoring. This does not imply that these species are not present within the OSR, just that they were not observed during monitoring.

- New Zealand Robin – Is an indicator species of habitat intactness and give a good indication of the life supporting capacity and pest pressures on native forest remnants.

- Kaka - Is another indicator species of habitat intactness, their diet includes berries of all kinds, seeds, and the nectar of kowhai, rata and flax. Kaka play an important role in the forest by pollinating flowers.

[5] http://www.nzbirds.com/birds/tauhou.html

- Whitehead - Is another indicator species of habitat intactness. Their preferred habitat is kanuka or beech. They are a very sociable bird and move into podocarp forest over winter. Their diet includes insects, seeds and fruit from ground level to canopy (Janssen, 2006).

Indicator Species

The endemic and native birds within the OSR play a vital role in sustaining bush vitality and can also be used as an indicator for habitat intactness. According to (Janssen, 2006), there are six vertebrate keystone species which can be used as indicators for **sustaining bush vitality**. Five are birds, and the sixth is the Wellington green gecko. "Keystone species have numerous important symbiotic links to other species. The local extinction of which undermine the vitality of dependent local populations. They have a prominent role, often as symbiotic organisms, in sustaining ecosystem processes", (Janssen, 2006). The bird species and the role that they perform are shown below. Four of the five bird species are present in the OSR:

Table 3. Bird Species Indicators for Sustaining Bush Vitality

Name	Endemic or Native	Group	Role	Breeding Season
Kereru	Endemic	Arboreal herbivore	Seasonal migrants. They disperse the larger seeds of tawa, miro, matai, hinau, pigeonwood and karaka	Late Aug to Mar
Bellbird (Korimako)	Endemic	Honeyeater	One of the most effective native plant-pollinating birds. They disperse seeds of many native trees and shrubs. Their preferred habitat niche is the upper forest storey	Sept and Jan
Tui	Endemic	Honeyeater	Seasonal migrants. They pollinate kowhai, kotukutuku and harakeke (flax). They also are prime dispersers of smaller native plant seeds	Sept to Jan
Hihi (Stitchbird)	Endemic	Honeyeater	Not present in the OSR – they play a vital role in pollination and seed dispersal	Oct to Jan
Silvereye	Native	Generaliser (Varied diet)	Has adapted to native and introduced plants. Preferred diet includes insects, fruit and nectar and assist in small fruit dispersal	

Therefore Kereru, Bellbird, Tui and Silvereye could all be used as indicators for sustaining bush vitality in the OSR. Hihi is discounted as it is not present in the OSR.

There are ten endemic and native birds which are used as indicators for **habitat intactness**. Habit intactness equals; good habitat size; community composition and low pest pressure (Janssen, 2006). The birds are;

- New Zealand Robin;
- Kaka;
- Tomtit;
- Kakariki;
- Kiwi;
- Rifleman;
- Kokako;
- Whitehead;

- Fernbird;
- Brown teal.

One of the above bird species was observed during monitoring and one species is known to be present in the OSR. These two species are shown below;

Table 3. Bird Species Indicators for Sustaining Bush Vitality

Name	Endemic or Native	Group	Role	Breeding Season
Tomtit	Endemic	Arboreal insectivore	As with the New Zealand Robin, if found in native forest remnants, they are direct descendants from ancestors that have survived earlier bush clearance. Tomtits provide an indication of the life-supporting capacity and pressures on native forest remnants	Aug to Jan
Kiwi	Endemic	Ground insectivore	N/A	The main breeding season runs from June to March, when food is most plentiful. The exception is brown kiwi, which can lay eggs in any month

Therefore the tomtit and kiwi can be used as indicators for habitat intactness in the OSR.

6 Conclusions and Recommendations

- Transect lines and listening stations are well placed across the OSR to provide opportunities to observe a wide variety of endemic, native and introduced bird species. The transect lines and listening stations cover a good range of different terrain and varying habitats. Fantail and tui were the species observed most frequently at listening stations and transect lines.
    - It is recommended that future small bird-monitoring projects in the OSR are conducted over a three-to-five year period. Rationale for this is that bird populations are temporally variable due to environmental factors and therefore long term trend data are necessary to distinguish any real management induced population change, (Fea, 2009).
- Consistency in the skill level of the observer(s) is also paramount to ensure the integrity of data comparison from study to study. Dawson and Bull, (2002) wrote that, "Observers differ in their ability to see, hear and identify birds and in their judgement as to the number present, and these abilities may change with time... and also there can be considerable error introduced into bird monitoring from different observers having differing abilities in bird identification."
    - It is therefore recommended that the same observer(s) is used from study to study.
- Consistency in approach is also an important factor when considering comparative analysis from study to study.
    - It is recommended that re-measuring is conducted over a similar time period as this study (one month) and that all listening stations and transect lines are re-measured ten times each to maintain a consistent sample from study to study.
- Future timings for re-measuring may be best suited by conducting separate projects in autumn and spring each year, perhaps taking into account the flowering periods of key native plant species. However, it would also be beneficial to take into account the timings of pest control programmes before determining a definitive timeline for re-measuring. Re-measuring each year before and after pest control programmes have been conducted can provide an indication as to the impact of the programme on small bird species.
    - It is recommended that when a definitive timeline for re-measuring has been determined that the monitoring takes place at exactly the same time each year.
- A good number of keystone bird species were monitored during the project and it was determined that Kereru, Bellbird, Tui and Silvereye could all be used as indicators for sustaining bush vitality in the OSR.
    - It is recommended that each of these bird species is used as indicator species for bush vitality in the OSR.

7 References

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8 Appendices

Appendix A is the 5-MBC and Transect Bird Count Sheet Master used for counting birds observed at each listening station and transect line.

Appendix B provides GPS grid references for every waypoint established on the project across all listening stations and transect lines.

Appendix C displays Directions for Locations to each 5-MBC Listening Station and Transect Line established for the project.

Appendix D provides the overall data entry counts for every listening station and transect line in Excel format, including all bird species and numbers observed.

Appendix A

Date: **Observer:**

Location: Ohope Scenic Reserve **Grid Refs: E** **N**

Listening Station No. Transect No.
Time:
Sun: Temp: Wind: Other Noise: Rain:

Bird Species	S/H	S/H	S/H	S/H	S/H	S/H	S/H	S/H	S/H	S/H	S/H	S/H
Aus Harrier												
Blackbird												
Bellbird												
Chaffinch												
NZ Falcon												
Fantail												
Fernbird												
Grey Warbler												
Sparrow (H)												
Kereru												
Kingfisher												
Magpie												
Myna												
NZ Robin												
Pheasant												
Pukeko												
Seagull												
Silvereye												
Starling												
Song Thrush												
Swallow (W)												
Tui												
Tomtit												
Quail												

Appendix B

ALL GPS GRID REFERENCES FOR SMALL BIRD MONITORING AT OHOPE SCENIC RESERVE APRIL – JULY 2009

5-MBC No.	Transect No.	Bait Station No.	Grid Ref Easting	Grid Ref Northing	Notes
L1		D8	1953985	5790237	
	TR1		1953985	5790237	
	Start	D8	1953985	5790237	
	100m	-	1953907	5790200	
	200m	-	1953841	5790129	
	300m	-	1953763	5790093	
	400m	-	1953688	5790144	
	500m /end		1953674	5790118	
L2		-	1954067	5789873	L2 not at a bait station
	TR2				
	Start	H1	1954099	5789842	
	100m	H3	1954198	5789734	
	200m	H5	1954230	5789741	
	300m	H7	1954222	5789886	
Ends 400m	400m /end	H9	1954291	5789902	
L3		A11	1952882	5788830	
	TR3				
	Start	A1	1953166	5789445	
	100m	-	1953108	5789365	
	200m	-	1953053	5789281	
	300m	A5	1952993	5789206	
	400m	-	1952933	5789129	
	500m / end	-	1952903	5789023	
L4		J55	1954407	5789993	
	TR4				
	Start	-	1954421	5789950	
	100m	-	1954414	5789848	
	200m	E18	1954488	5789835	
	300m	C33	1954540	5789924	
	400m	-	1954601	5789897	
	500m / end	K Line + E21	1954686	5789849	
L5		-	1953916	5788942	L5 not at a bait station
	TR5				
	Start	G1	1953390	5789289	
	100m	-	1953445	5789219	
	200m	-	1953517	5789193	
	300m	-	1953584	5789117	
	400m	G7	1953668	5789083	
	500m / end	M4	1953754	5789054	

5-MBC No.	Transect No.	Bait Station No.	Grid Ref Easting	Grid Ref Northing	Notes
L6		-	1953888	5788648	L6 not at a bait station
	TR6				
	Start	U5	1954049	5788624	
	100m	-	1954134	5788608	
	200m	-	1954236	5788628	
	300m	U9	1954324	5788627	
	400m	-	1954425	5788640	
	500m / end	U12	1954533	5788689	
L7		G9	1953784	5789184	
	TR7				
	Start	G9	1953784	5789184	
	100m	-	1953879	5789227	
	200m		1953970	5789252	
	300m	G13	1954038	5789327	
	400m	-	1954108	5789379	
	500m / end	-	1954069	5789400	
L8		-	1953745	5788933	L8 is not at a bait station
	TR8				
	Start	-	1953954	5788161	
	100m	-	1953931	5788258	
	200m	-	1953889	5788350	
	300m	-	1953816	5788376	
	400m	-	1953740	5788436	
	500m / end	BN6	1953686	5788539	
L9		-	1953206	5789291	L9 is not at a bait station
	TR9				
	Start		1953248	5789282	
	100m	-	1953324	5789233	
	200m	-	1953375	5789169	
	300m	-	1953463	5789123	
	400m	-	1953504	5789031	
	500m / end	-	1953567	5788968	
L10		A28	1952829	5787812	
	TR10				
	Start	A29	1952818	5787735	
	100m	A30	1952813	5787661	
	200m	A31	1952849	5787600	
	300m	-	1952824	5787494	
	400m	-	1952901	5787438	
	500m / end	A36	1952995	5787399	
L11		A19	1952912	5788306	
	TR11				
	Start	F1	1952974	5788279	
	100m	-	1952907	5788200	
	200m	-	1952930	5788117	
	300m	-	1952912	5788034	
	400m	F8	1952944	5787940	
	500m / end		1952953	5787837	

5-MBC No.	Transect No.	Bait Station No.	Grid Ref Easting	Grid Ref Northing	Notes
L12		-	1954745	5789544	L12 is not at a bait station
	TR12				
	Start	M19	1954741	5789545	
	100m	-	1954696	5789475	
	200m	-	1954625	5789406	
	300m	M15	1954561	5789322	
	400m	-	1954472	5789285	
	500m / end	-	1954359	5789257	

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Appendix C

DIRECTIONS FOR LOCATIONS TO 5-MBC LISTENING STATIONS AND TRANSECT LINES FOR SMALL BIRD MONITORING AT OHOPE SCENIC RESERVE APRIL – JULY 2009

5-MBC No.	Transect No.	Grid Ref Easting	Grid Ref Northing	Directions	10 M Check	Left	10 M Check	Right	Notes	Transect Difficulty Grading 1 = Low 2 = Med 3 = High
L1		1953985	5790237	From the Ohope Rd & Pohutukawa Avenue & West End Rd entrance opposite the beach, follow the main track until the first track junction is reached. Follow the right hand loop track until you reach a double pink and white triangle on the right hand side of the track 'To D8'. Follow pink triangles and pink flagging to bait station **'D8', which is L1 and also the start of TR1** at a bearing of 240 ° mag.					At start of T1	
	TR1	1953985	5790237	Same as L1 above.	Start 100m 200m 300m 400m	✓ x x ✓ ✓	Start 100m 200m 300m 400m	✓ ✓ ✓ ✓ ✓	A section of the transect includes walking on the stream edge which floods after rain. Transect is very slippery after heavy rain – complete in dry conditions. Good bird numbers on this transect. Due to vegetation growth would suggest transect is re-cut prior to next monitoring session.	3

L2		1954067	5789873	Situated at 1st Kiwi Listening Station from Ohope side of reserve. Follow the instructions for TR2 below.						
	TR2	1954099	5789842	From the Ohope Rd & Pohutukawa Avenue & West End Rd entrance opposite the beach, follow the main track until the first track junction is reached. Follow either the right or left-hand loop track until they rejoin the main track. Then follow the main track until you reach the first Kiwi Listening Station wooden bench. Approx. 2 metres from the bench is a pink triangle on a tree at a bearing of 100 ° mag. Follow the pink flagging and triangles to the **start of TR2 at H1,** end is at H9. The transect runs at a bearing of 90 ° mag.	Start 100m 200m 300m 400m	x x ✓ x end	Start 100m 200m 300m 400m	x x ✓ x end	Medium difficulty grading until H6 – then to high. Dense vegetation, steep in places, stream crossing between H7 & H8 – monitor only in dry conditions. Ends at 400m due to terrain – refer to report. At the end of the transect it is possible to continue up the ridge in a northerly direction following the pink triangles, as it intersects with G line which is right beside the main track after approx 100 – 120 m. Please note the pink triangles are sparse – recommend a GPS is carried.	3
L3		1952882	5788830	Same as TR3 below – **L3 is at end of TR3.**						
	TR3	1953166	5789445	From top Burma Rd car park follow the main Nga Tapuwae O Toi track for approx. 50m. At the top of the first set of wooden steps on the right hand side follow the pink flagging to bait station A3, follow the bait line back to **A1 which is the start of TR3.** The transect runs at a bearing of 240 ° mag. After A3 follow the pink flagging and pink triangles, the transect rejoins the main track, follow the main track over the stile, follow the private road to the left approx. 10m until you see a pink triangle 'To A4', follow to A4 which rejoins TR3 – continue to end.	Start 100m 200m 300m 400m	✓ x x x ✓	Start 100m 200m 300m 400m	x x x x x	This transect runs parallel to the fence line, and borders a farm. There is also a small lake on the farm over the fence parallel to the transect.	1

L4		1954407	5789993	Same as TR4 below – But L4 is approx. **75m before start of TR4** on the fence line **at J55.**						
	TR4	1954421	5789950	From the Ohope Rd & Pohutukawa Avenue & West End Rd entrance opposite the beach, follow the main track until the first track junction is reached. Follow the left hand loop track, approx ¾ up the loop track, (20 mins from car park) until you reach a clearing on the left hand side of the track where the fence line and farm is visible. It is also marked with a white triangle and pink flagging on a tree on the LH side of the track 'To BM TR4 + BM L#4'. Cross the fence, turn right and follow the fence line at a bearing of approx. 90 ° mag until you reach a fence post with double pink and white triangles and double pink flagging with 'BM TR4 start'. This is the start of TR4. Note: E line follows the fence line.	Start 100m 200m 300m 400m		Start 100m 200m 300m 400m		This transect was also manually measured as the distances between bait stations fluctuated. This transect runs directly parallel to the fence line on the farm. It was not possible to establish a transect on the OSR side of the fence as the vegetation is very dense, and the terrain too steep for safe transect monitoring. 10m checks were not established due to vegetation density and unsuitable terrain.	1
L5		1953916	5788942	Same as TR5 below – when end of TR5 is reached, continue to approx **4m past M4** where L5 is located.						
	TR5	1953390	5789289	From top Burma Rd car park follow the main OSR track towards Ohope for approx. 100 m until you reach G line on the RH side. A tree on the RH side is marked with a white triangle 'To BM TR 5, 6 & 7 + L5, 6 & 7'. There is also a white triangle 'A Line'. Follow pink flagging and pink triangles to the **start** of **TR5** which is at **G1,** approx. 10m in. G line intersects with the M line between G7 and G8, TR5 end is between M1 & M2. The transect runs at a bearing of 132 ° mag.	Start 100m 200m 300m 400m	x x x ✓ x	Start 100m 200m 300m 400m	✓ x ✓ x ✓	10m check at 100m is only 5m due to terrain and vegetation density. Transect continues from G onto M line.	1
L6		1953888	5788648	Same as TR6 below but is located before TR6 start 15m – 20m past U3 on the RH side. Tree marked with white triangle 'To L6', also a second triangle 'To T17'.						
	TR6	1954049	5788624	From top Burma Rd car park follow the main OSR track towards Ohope for approx. 100 m until you reach G line on the RH side. A tree on the RH side is marked with a white triangle 'To BM TR 5, 6 & 7 + L5, 6 & 7'. Follow pink flagging, pink triangles and other white direction triangles to the U line. **TR6 starts at U5**, end is at U12. The transect runs at a bearing of 90 ° mag.	Start 100m 200m 300m 400m	x x ✓ x ✓	Start 100m 200m 300m 400m	x x ✓ x x		2

L7		1953784	5789184	Same as TR7 below – **L7 is at the start of TR7.**							
	TR7	1953784	5789184	From top Burma Rd car park follow the main OSR track towards Ohope for approx. 100 m until you reach G line on the RH side. A tree on the RH side is marked with a white triangle 'To BM TR 5, 6 & 7 + L5, 6 & 7'. Follow pink flagging, pink triangles and other white direction triangles, **TR7 starts at G9.** The transect runs at a bearing of 50 ° mag.	Start 100m 200m 300m 400m	✓ ✓ ✓ ✓ ✓	Start 100m 200m 300m 400m	x ✓ ✓ x x			3
L8		1953745	5788933	Same as TR8 below – L8 is approx. 675 m past the end of TR8 on the LH side of the road. Marked with double pink flagging 'BM L#8 5 MBC'.							
	TR8	1953954	5788161	Starts at the OSR boundary fence at the bottom of Burma Rd inside the lower gate. The transect follows the road. A tree on the LH side is marked with pink flagging and a double white and pink triangle, 'BM TR8 Start'. The transect runs at a bearing of 288 ° mag.	Start 100m 200m 300m 400m	x x x x x	Start 100m 200m 300m 400m	x x x x x	10m checks were not established due to unsuitable vegetation and steep terrain, but as the transect follows the road 10m checks can be estimated. 100m & 400m are not marked or flagged, as there was not any suitable vegetation at those points.		1

L9		1953206	5789291	In grassed area at top of Burma Rd car park overlooking the OSR before the gate at 252 ° mag. Marked with double pink flagging in a coprosma tree on the LH side.					No suitable trees to put triangle's on.		
	TR9	1953248	5789282	From top Burma Rd car park continue on Burma Rd approx 20 m past the gate. A tree on the RH side is marked with pink flagging tape and a white and pink triangle 'BM TR9 Start'. The tree also has a second pink triangle marked with 'C'.	Start 100m 200m 300m 400m	x x x x x	Start 100m 200m 300m 400m	x x x x x	10m checks were not established due to unsuitable vegetation and steep terrain, but as the transect follows the road 10m checks can be estimated. 100m, 200m, 300, 400m marked with pink flagging as no suitable trees available.	1
L10		1952829	5787812	Same as TR10 below – **L10 is at A28,** one bait station prior to the start of TR10.							
	TR10	1952818	5787735	From top Burma Rd car park follow the main Nga Tapuwae O Toi track to just before the stile goes over the fence and the track intersects with the private road. Follow pink flagging and pink triangles, this rejoins TR3. The line runs parallel to the fence line. Continue past the end of TR3 at A11; go past the farm house on the right hand side. Continue following the A Line until A19 is reached – then follow pink flagging to F1 which is the start of TR11. Follow TR10 to F9 then follow pink triangles and pink flagging to A29 beside the fence. **A29 is the start of TR10.** The transect runs at a bearing of 160 ° mag.	Start 100m 200m 300m 400m	x x x x x	Start 100m 200m 300m 400m	x x x x x	10m checks were not established due to unsuitable vegetation, but as the transect follows the fence line checks can be estimated.	
L11		1952912	5788306	Same as TR11 below, but **L11 is at A19** prior to the start of TR11.							
	TR11	1952974	5788279	From top Burma Rd car park follow the main Nga Tapuwae O Toi track to just before the stile goes over the fence and the track intersects with the private road. Follow pink flagging and pink triangles, this rejoins TR3. The line runs parallel to the fence line. Continue past the end of TR3 at A11; go past the farm house on the RH side. Continue following the A Line until A19 is reached – then follow pink flagging **to F1 which is the start of TR11.** The transect runs at a bearing of 106 ° mag. End is approx. 25m past F9.	Start 100m 200m 300m 400m	✓ x ✓ ✓ ✓	Start 100m 200m 300m 400m	✓ x x ✓ ✓		2

L12		1954745	5789544	Same as TR12 below – L12 is approx. 15 m past the start of TR12 between M19 & M18. Follow pink flagging from the transect.							
	TR12	1954741	5789545	There are two options to get to this transect **Option one:** From top Burma Rd car park follow the main OSR track towards Ohope for approx. 100 m until you reach G line on the RH side. A tree on the RH side is marked with a white triangle 'To BM TR 5, 6 & 7 + L5, L6 & L7'. Follow pink flagging and pink triangles until you reach the end of TR 5. Continue on the M line until you reach the end of TR12 which is between M11 & M12. **TR12 starts at M19.** **Option two:** From opposite the Ohope Mobil Service station on Pohutukawa Avenue go through the gate. Follow the grassed vehicle track on the left all the way to the top. At the top turn right in a westerly direction and follow the fence line until you see a stile over the fence and a white triangle 'To BM TR 12 & BM L12. Follow the pink flagging and directional markers to M19, which is **the start of TR12.** There are also two other pink triangles, 'M Line', E 25'. The transect runs at a bearing of 218 ° mag.	Start 100m 200m 300m 400m	✓ x ✓ ✓ x	Start 100m 200m 300m 400m	x x ✓ ✓ x		2

Appendix D

Listening Stations Species and Totals														
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	Mean	**TOTAL**
Australasian Harrier	3	2	2	1	2	0	0	0	2	12	1	5	2.50	**30**
Blackbird	11	3	6	4	0	0	2	0	7	3	10	4	4.17	**50**
Bellbird	27	9	12	10	8	9	18	6	23	8	8	9	12.25	**147**
Chaffinch	0	0	0	0	0	0	0	5	0	0	28	0	2.75	**33**
Fantail	41	11	20	43	11	21	22	10	23	19	30	16	22.25	**267**
Grey Warbler	11	5	5	4	6	3	6	5	11	3	8	7	6.17	**74**
Sparrow (H)	2	0	0	0	0	0	0	0	0	0	0	0	0.17	**2**
Kereru	1	0	2	4	0	0	0	1	1	0	0	0	0.75	**9**
Kingfisher	5	1	0	0	0	0	0	1	2	0	1	0	0.83	**11**
Magpie	9	4	3	11	2	1	3	0	4	11	11	5	5.33	**69**
Myna	4	0	3	0	0	0	0	1	10	0	2	0	1.67	**22**
Paradise Shel Duck	0	0	0	0	0	0	0	0	0	0	0	0	0.00	**0**
Peacock	0	0	0	0	0	0	0	0	0	8	6	0	1.17	**15**
Pheasant	0	0	0	0	0	0	0	0	0	6	6	6	1.50	**20**
Pukeko	0	0	1	0	0	1	0	3	3	0	0	0	0.67	**8**
Seagull	6	13	6	9	8	0	17	0	0	6	4	5	6.17	**74**
Silvereye	24	4	3	11	0	12	4	11	33	6	14	11	11.08	**133**
Starling	2	0	1	0	0	0	0	0	1	0	4	0	0.67	**8**
Swallow, Welcome	0	0	0	2	0	0	0	0	3	5	6	0	1.33	**16**
Thrush, Song	6	0	0	1	1	0	0	0	1	0	4	1	1.17	**14**
Tui	56	26	35	32	21	22	31	34	54	19	28	20	31.50	**378**
Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0.00	**0**
Tomtit	6	0	2	0	0	0	1	1	0	0	2	0	1.00	**12**
Yellow Hammer	0	0	0	0	0	0	0	0	0	30	0	0	2.50	**30**
Unknown	1	2	0	0	0	0	0	0	0	0	0	0	0.25	**3**
TOTAL	**215**	**80**	**101**	**132**	**59**	**69**	**104**	**78**	**178**	**136**	**173**	**89**	**Avge. 4.71**	**Avge. 56.99**

Transects Species and Totals														
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	Mean	**TOTAL**
Australasian Harrier	2	2	3	7	0	1	0	1	3	8	0	0	2.25	**27**
Blackbird	12	8	19	11	4	4	7	2	3	8	18	9	8.75	**105**
Bellbird	27	29	29	16	12	10	26	13	27	14	27	9	19.92	**239**
Chaffinch	9	0	14	115	0	0	0	0	0	30	8	0	14.67	**176**
Fantail	60	47	62	63	34	29	42	69	39	43	41	26	46.25	**555**
Grey Warbler	28	20	25	2	8	5	19	18	9	10	20	12	14.67	**176**
Sparrow (H)	0	0	3	0	2	1	0	0	0	0	1	0	0.58	**7**
Kereru	9	10	9	6	0	2	10	1	1	1	2	2	4.42	**53**
Kingfisher	4	3	5	4	1	0	0	0	0	0	1	1	1.58	**19**
Magpie	6	5	7	15	3	3	1	1	1	13	7	5	5.58	**67**
Myna	3	2	17	0	0	0	0	2	6	0	1	0	2.58	**31**
Paradise Shelduck	0	0	1	0	0	0	0	0	0	0	0	0	0.08	**1**
Peacock	0	0	0	0	0	0	0	0	0	10	0	0	0.83	**10**
Pheasant	1	1	0	0	0	0	0	0	0	22	0	0	2.00	**24**
Pukeko	0	0	2	0	0	4	0	16	4	0	0	0	2.17	**26**
Seagull	21	8	20	32	1	3	3		4	10	9	7	10.73	**118**
Silvereye	50	41	26	39	15	11	28	67	32	31	47	25	34.33	**412**
Starling	0	0	0	3	0	0	0	0	0	0	0	0	0.25	**3**
Swallow, Welcome	0	6	27	29	0	0	0	4	0	7	0	0	6.08	**73**
Thrush, Song	10	15	8	2	1	2	2	0	1	1	1	1	3.67	**44**
Tui	72	40	55	44	41	40	49	48	70	27	42	31	46.58	**559**
Turkey	0	0	0	5	0	0	0	0	0	6	0	0	0.92	**11**
Tomtit	7	11	7	0	0	4	4	0	3	0	9	0	3.75	**45**
Yellow Hammer	0	0	0	90	0	0	0	0	0	0	0	0	7.50	**90**
Unknown	1	0	2	0	1	0	0	4	4	0	1	1	1.17	**14**
TOTAL	**322**	**248**	**341**	**483**	**123**	**119**	**191**	**246**	**207**	**241**	**235**	**129**	**Avge. 9.65**	**Avge. 115.40**