



Tikitapu Scenic Reserve Small Bird Monitoring in 2013

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Executive Summary

A small bird monitoring project was initiated in the Tikitapu Scenic Reserve (TSR) in 2010. The purpose of the study is to determine if bird abundance is increasing as a result of the pest management strategy that is carried out in the Reserve. The Department of Conservation (DOC) and the Bay of Plenty Regional Council (BOPRC) assist the Tikitapu Forest & Bird Care Group (TF&BCG) with the pest management programme.

Twenty 5-minute bird count (5-MBC) listening stations are spread across the TSR and are re-measured at the same time (November to December) every year with three counts per station.

Conclusions and recommendations are as follows:

- The total number of birds recorded annually has increased slightly from 2011 to 2013.
- The number of unidentified birds was lowest in 2012.
- Three species, blackbird, bellbird and whitehead, have shown an increase in numbers in each year from 2011 to 2013.
- One species, chaffinch, has shown a decrease in numbers in each year from 2011 to 2013.
- Robin and eastern rosella numbers were highest in 2013.
- Multiple monitoring years are required to accurately assess medium to long term trends, and to separate trends from year to year fluctuations.
- To determine the effect of pest control on bird numbers, the 2002 bird count data should be located and compared to the more recent counts. Also a 5-minute bird count programme should be established in a similar area of bush that has not received pest control, for example the Millar Road end of the Okataina scenic reserve, for comparison.
- An evaluation of the plant composition and the canopy density at each listening station may help to understand variability in bird results.
- Training in bird listening prior to starting fieldwork has been extremely valuable and we recommend that this continue to be undertaken each year.
- To counteract potential observer bias volunteers should undertake different routes during the 3-4 week period rather than visiting the same stations on each occasion.
- Bird monitoring should continue to be conducted annually for at least another three to five years with the same 20 listening stations re-measured a minimum of three times each. Funding for the programme is budgeted until 2017.
- To ensure consistency and allow for comparative analysis the fieldwork for future counts should be conducted at the same time each year (November-December, after pest control programmes are conducted).

Introduction

Tikitapu Scenic Reserve (TSR) is located in the Western Bay of Plenty, southeast of Rotorua, and is situated between Lake Tikitapu (Blue Lake) and Lake Okareka. The land is administered by the Department of Conservation (DOC). The Rotorua Branch of the Royal Forest and Bird Protection Society (F&B) and the Rotorua Botanical Society, supported by DOC, Bay of Plenty Regional Council (BOPRC) and local residents, have been working since 2002 to protect a regionally significant mistletoe population in the Tikitapu Scenic Reserve by controlling plant and animal pest threats (DOC, 2011). DOC and the BOPRC assist the Tikitapu Forest & Bird Care Group (TF&BCG) with pest control programmes.

In 2003, a pest control operation was established over 25 hectares of the eastern side of the TSR primarily using bait stations. The main objectives of the project were to facilitate ecosystem recovery; increase the distribution and numbers of mistletoe and existing native fauna; monitor change in biological communities resulting from enhancement activities and raise awareness and encourage community involvement (as per Cleghorn & Evans, 2003).

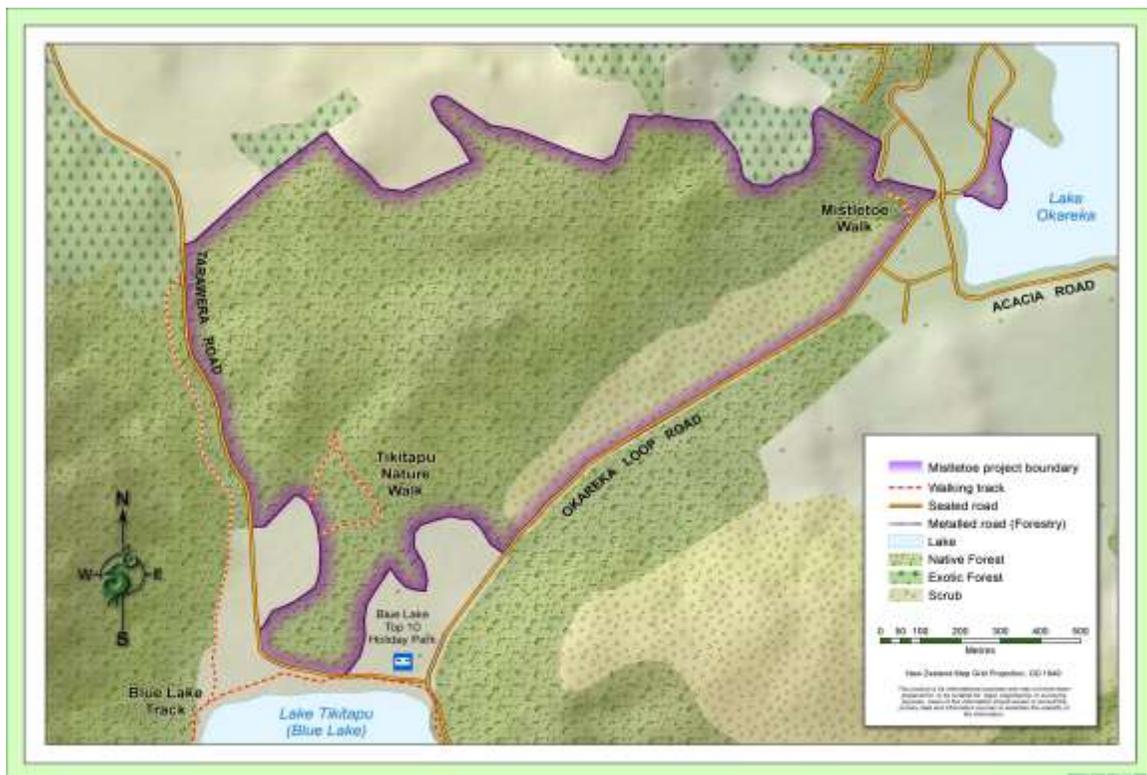


Figure 1. Pest control treatment area in Tikitapu Scenic Reserve

Between November 2002 and December 2006 DOC, assisted by Forest & Bird volunteers, conducted a small scale 5-MBC bird monitoring programme, with a number of bait stations across the TSR used as listening stations. One to two measures were conducted per year at various bait stations. The dates of these 5-MBC were:

- 3 November 2002
- 17 November 2002
- 23 November 2003
- 18 November 2004
- 27 April 2005
- 19 October 2005
- 13 April 2006
- 12 December 2006

In 2010 the consultants First Word in Fauna (FWIF) worked in conjunction with TF&BCG to design a bird monitoring programme to obtain an index of bird abundance in the TSR and allow basic comparison of results over time. Ten 5-MBC stations were established in the north-eastern part of the reserve in 2010; these were increased to 20 stations covering the entire reserve in 2011. Bird counts were carried out during November to early December with dates varying slightly between years (see Appendix C). Fieldwork training days were held for volunteers in 2010, 2011 and 2013.

The main objective for the 2013 re-measure was to compare bird abundance results with those obtained from 2011 and 2012. Data collected in 2010 (from 10 stations), was also used for some comparisons.

Method

Bird count method

The 5-minute bird count (5-MBC) method (Dawson and Bull 1975) was used for bird monitoring in 2013 as for the previous years.

Twenty 5-MBC listening stations are set up in the TSR. Stations were established by Rod Stace of TF&BCG. These have been divided between four 'routes' which provide an efficient way of covering the area. Instructions on how to reach each listening station and the indicative time to travel a route and conduct the counts were prepared by Rod Stace of TF&BCG and can be found in Appendix A.

Volunteers from the TF&BCG conducted the field work. Amanda Hunt and Margaret Dick organised the volunteer group. Volunteer pairs were assigned specific routes (4-6 stations per route) according to their fitness levels and bird monitoring experience, and were paired with an experienced observer, where possible. Ten volunteers took part in the 2013 bird counts. A training session, arranged by Amanda Hunt, was held by Richard Gillies of Wildland Consultants for available volunteers prior to commencement of the counts.

Observers were provided with a basic information sheet about the 5-MBC method (Appendix B). The observer stood at the listening station and, after standing silent for one to two minutes, recorded every bird heard or seen over a 5-minute period. If a bird was seen and heard it was recorded once as seen.

Each of the 20 5-MBC stations was monitored 3 times during the fieldwork. The fieldwork was conducted between 12 and 27 November 2013.

The following map details the location of all 20 listening stations in the TSR and shows the four routes followed.



Figure 2. Tikitapu Scenic Reserve Listening Stations and Routes 2013

Data analysis

The bird count and analysis methods have varied slightly between years (see Appendix C).

The 2013 data have been summarised as average number of birds recorded per 5 minute count for:

- Total number of birds observed in the reserve,
- Number of birds seen in the reserve by species,
- Number of birds seen at each listening station for nine selected species.

The 2013 data were compared with the data from 2010, 2011 and 2012 provided by Connor Quinn of First Words in Fauna.

Data for nine species have been analysed in detail. Five of the selected species (bellbird, kereru, silvereye, tomtit and tui) have been considered in previous studies (Quinn and Greaves 2011, 2012, 2013). The four additional species were:

- Grey warbler (as it has one of the highest counts in previous years and has a distinctive song)
- New Zealand robin (as it appears that numbers are increasing (R Stace pers. comm.))
- Whitehead (as it has been observed in gardens within the Okareka village (R Stace pers. comm.))
- Eastern rosella (as it has been seen more often within the Okareka village during the last few years)

A value of 0.33 on the following bar-charts and graphs means that one bird was recorded during one of the three 5-minute counts. A value of one may occur in several ways. For example one bird could have been recorded on each of the 5-minute counts at a particular station, or three birds could have been recorded on one of the 5-minute counts.

Results

The number of birds recorded per count has increased slightly from 2011 to 2013. However the number of birds not positively identified has varied between years (Table 1).

Table 1. Number of birds recorded per 5-minute bird count.

Year	Identified birds	Birds not identified	Total birds
2011	169.67	28.00	197.66
2012	226.67	8.33	235.00
2013	211.33	28.33	239.67

The number of birds recorded in the reserve varied greatly between species. To provide clarity the birds have been split into three groups:

- introduced (Figure 3a)
- native plus endemic, abundant (more frequently recorded species) (Figure 3b)
- native plus endemic, less abundant (Figure 3c).

Many of the introduced species have only been recorded infrequently (less than 6 birds recorded in any one year). Blackbird and chaffinch are the only introduced species where more than 6 birds have been recorded in any one year. Blackbird numbers have increased very slightly over time whilst chaffinch numbers have decreased slightly over time (Figure 3a).

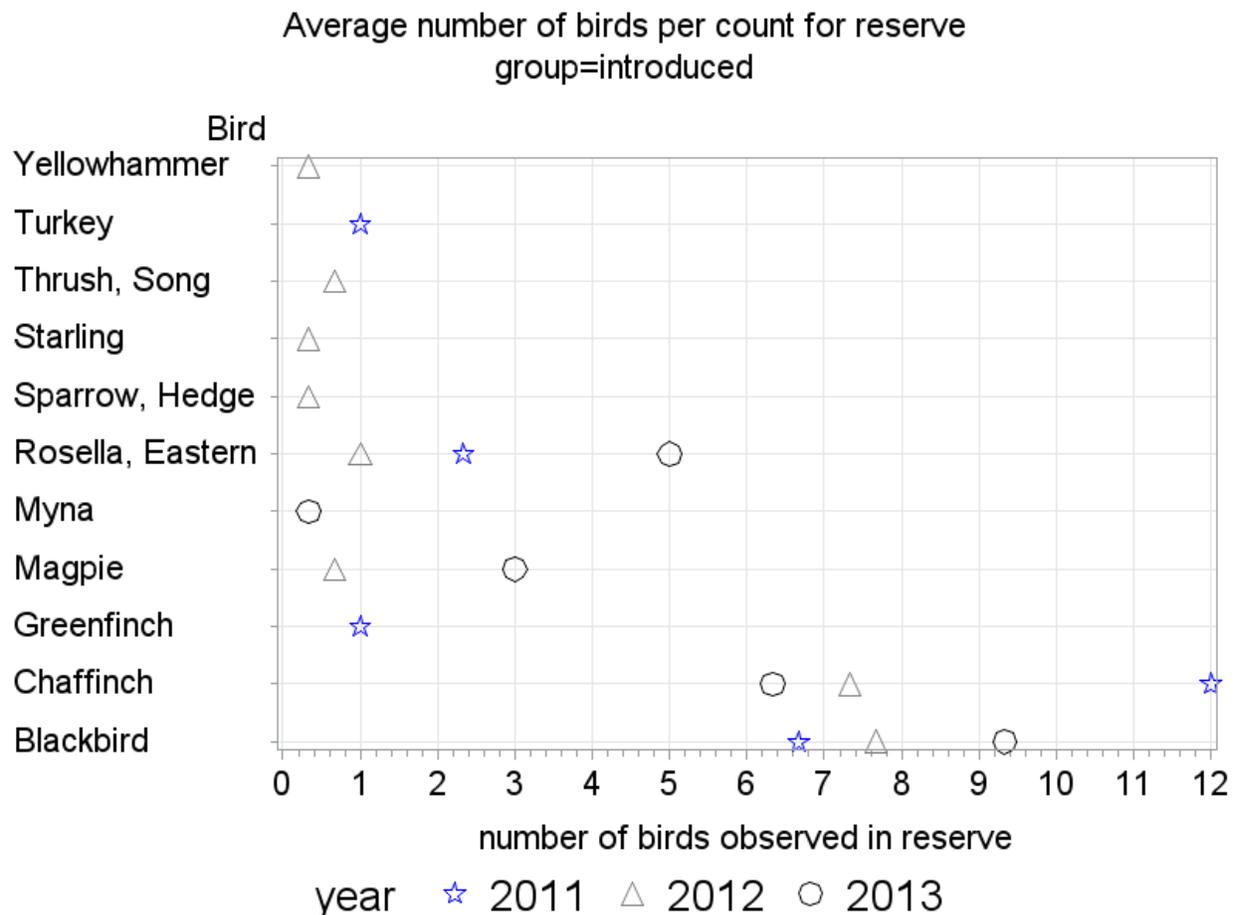


Figure 3a. Number of birds observed per count in TSR (all 20 listening stations) in 2011, 2012 and 2013.

The most abundant endemic bird was tui with over 60 birds recorded in any one year. The next most abundant species was grey warbler. Silvereye was the most abundant native species, and only native species shown in Figure 3b. The highest count over the 3-year period was recorded in 2012 for four of the seven species shown in Figure 3b. This result may be due to better identification in 2012 as there were less unidentified birds in this year. In 2011 and 2013 a similar number of birds were not identified. The 2013 count was approximately the same or higher than the 2011 count for six of the seven species, the exception being tui.

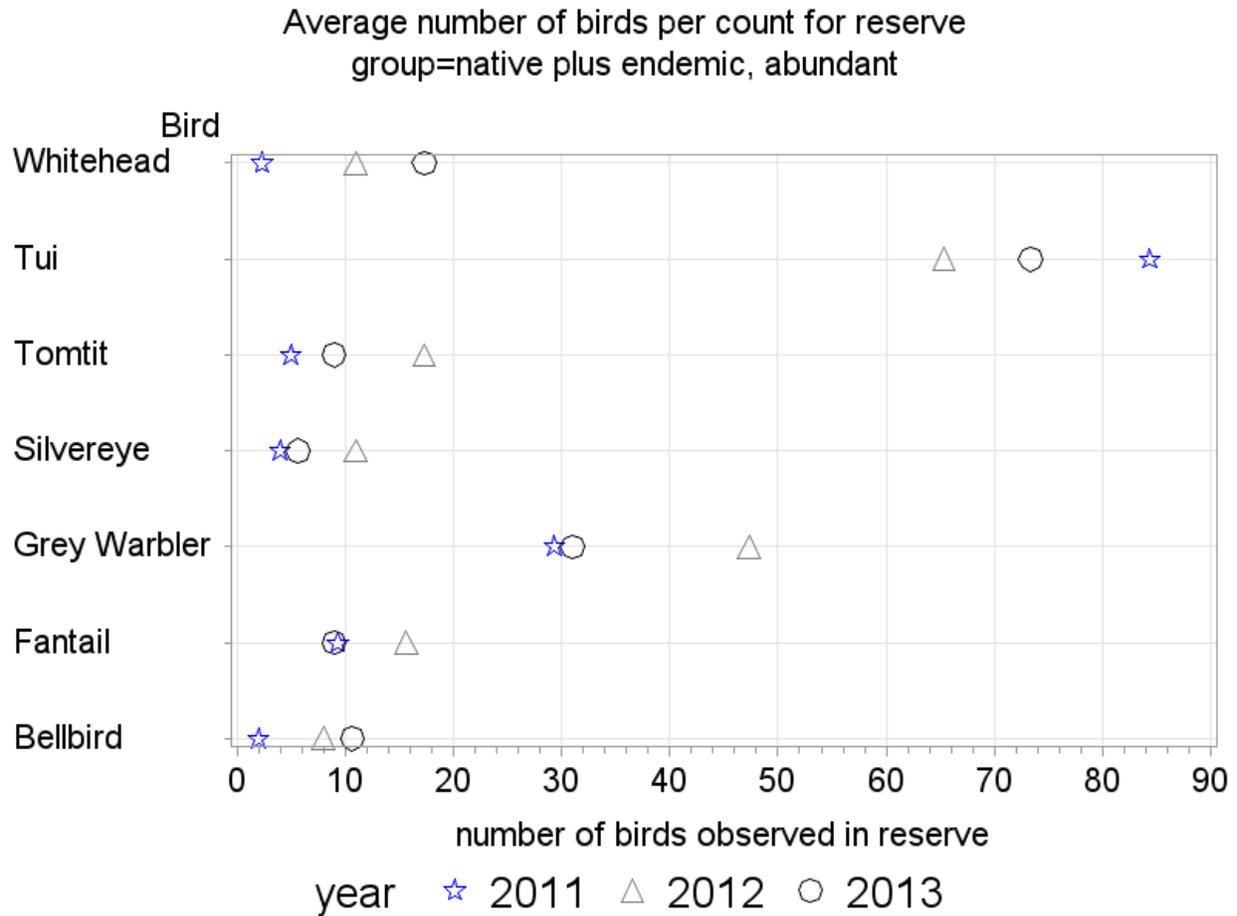


Figure 3b. Number of birds observed per count (all 20 listening stations) in 2011, 2012 and 2013.

For the other endemic birds and the one native species (Australasian harrier), less than 10 birds were recorded in the reserve in any one year (Figure 3c). Apart from rifleman, long-tailed cuckoo and NZ falcon, each species was recorded in each of the three years. The year with the highest count varied between species.

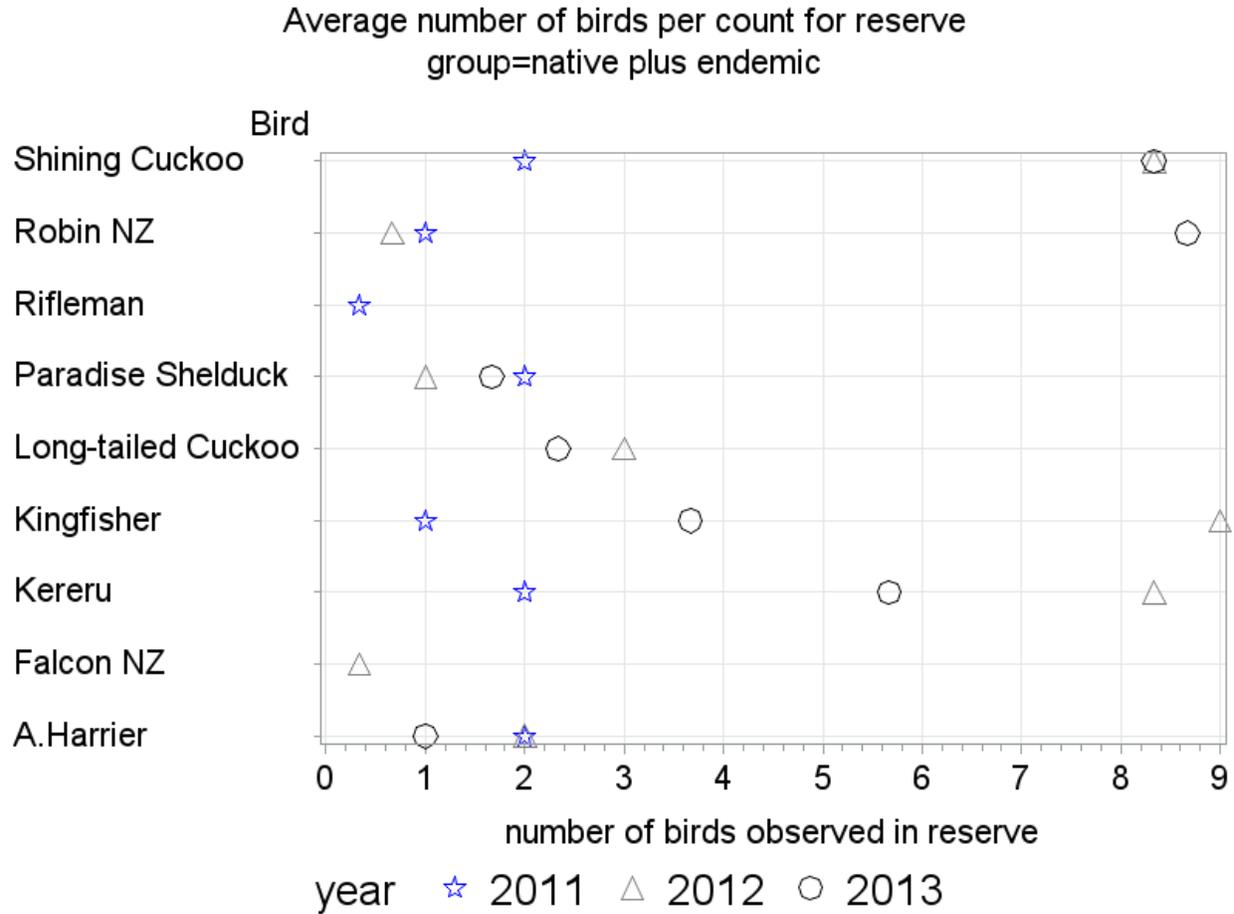


Figure 3c. Number of birds observed in reserve (all 20 listening stations) in 2011, 2012 and 2013.

Bellbird

In 2013, the number of bellbirds recorded was less than one at listening stations 1 to 16, and above one at listening stations 17-20 (Figure 4a).

Over the four years the only counts over one were at listening stations 17-20 in 2013. It is not known whether this is a real increase or an observer bias. In 2013, the counts at listening stations 17-20 were carried out by an experienced observer who had not previously been involved in this project. Another observation from Figure 4b is that the 2010 counts tend to be very slightly higher than those for later years.

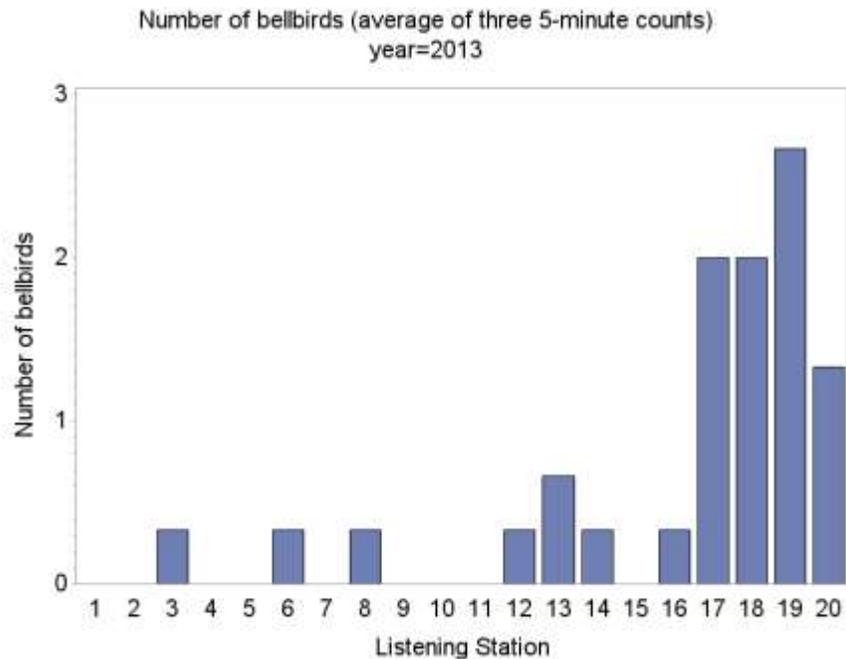


Figure 4a. Number of bellbird recorded at each listening station in 2013.

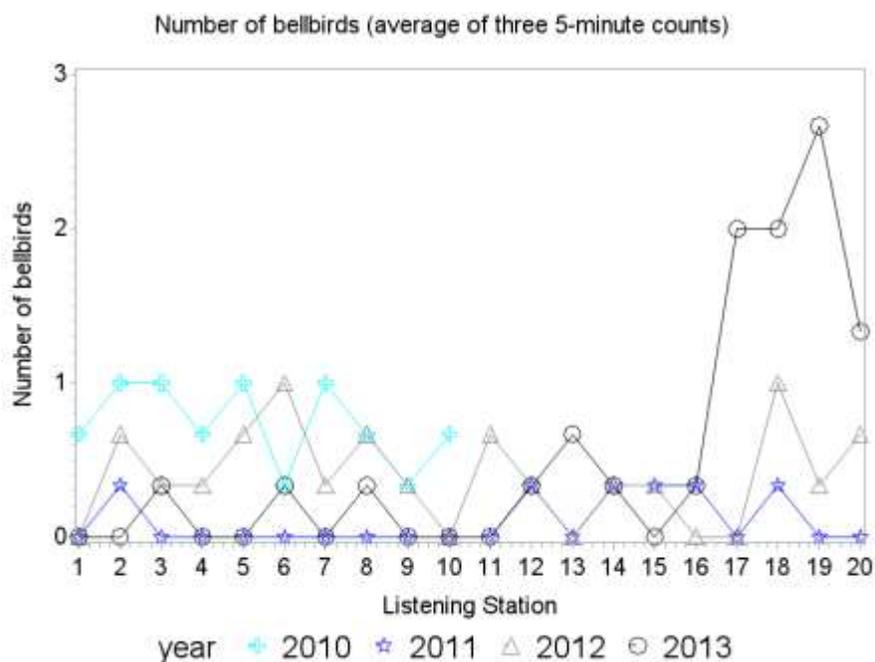


Figure 4b. Number of bellbird recorded at each listening station from 2010 to 2013.

Tui

Tui was the most frequently recorded bird species in 2010, 2011, 2012 and 2013. In 2013, at least two tui were recorded at each listening station, and over four were recorded at some stations. The numbers were lower at the southern end of the reserve (listening stations 18-20) (Figure 5a). Numbers were also low at listening station 13. For the period 2011-2013, the number of tui appears to have decreased at listening stations 18-20 (Figure 5b). In contrast the number of bellbirds appears to have increased in this part of the reserve (Figure 4b). It is not known whether this is a real trend or related to the difficulty in distinguishing the song of the two species.

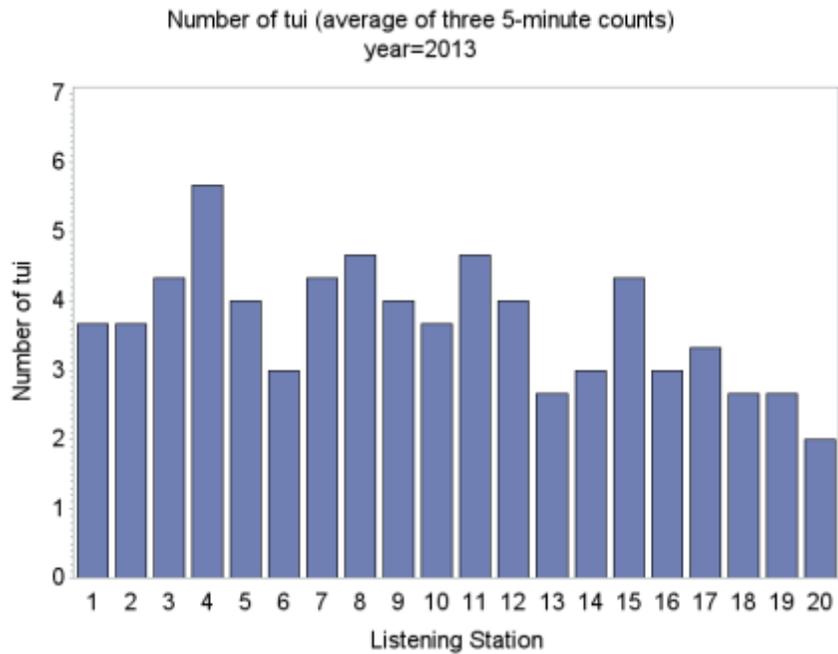


Figure 5a. Number of tui recorded at each listening station in 2013.

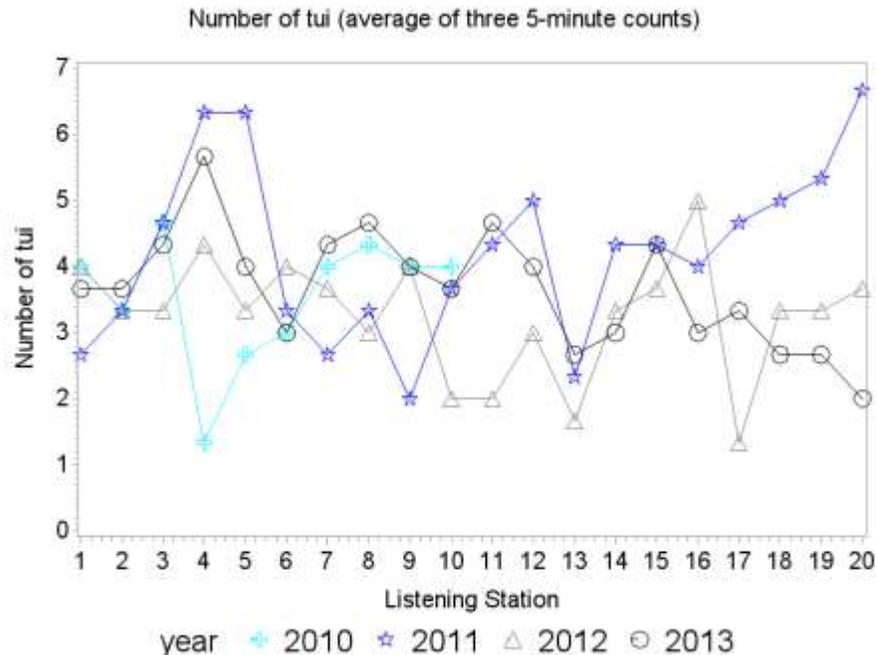


Figure 5b. Number of tui recorded at each listening station from 2010 to 2013.

Kereru

Only low numbers of kereru were recorded in the reserve in 2013 even though they are often seen in the village. This could be because they are not very vocal, and are more likely to be recorded if observed flying or if the wing beat is heard. In 2013, no more than one kereru was recorded at any listening station (Figure 6a). However two or more kereru have been recorded at some listening stations in other years (Figure 6b).

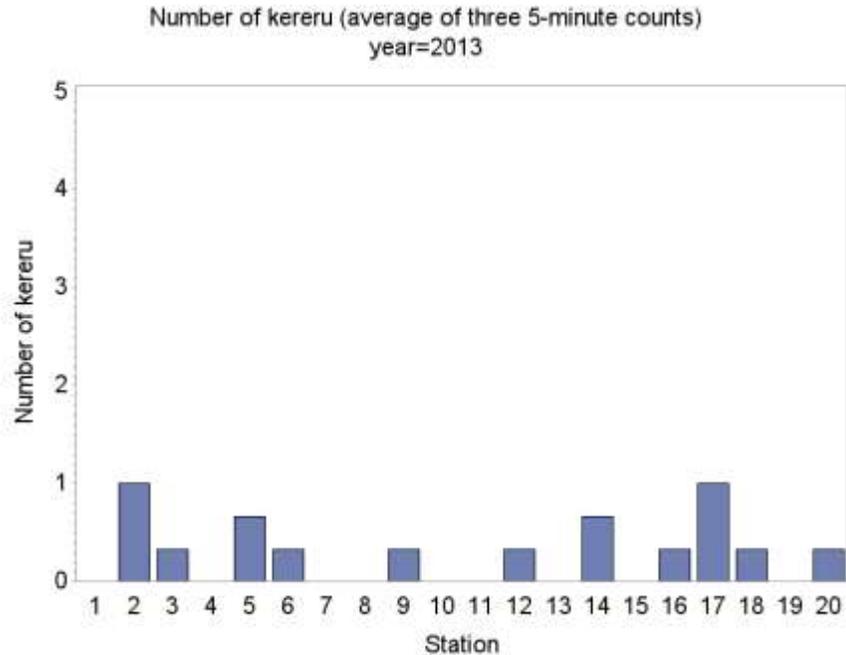


Figure 6a. Number of kereru recorded at each listening station in 2013.

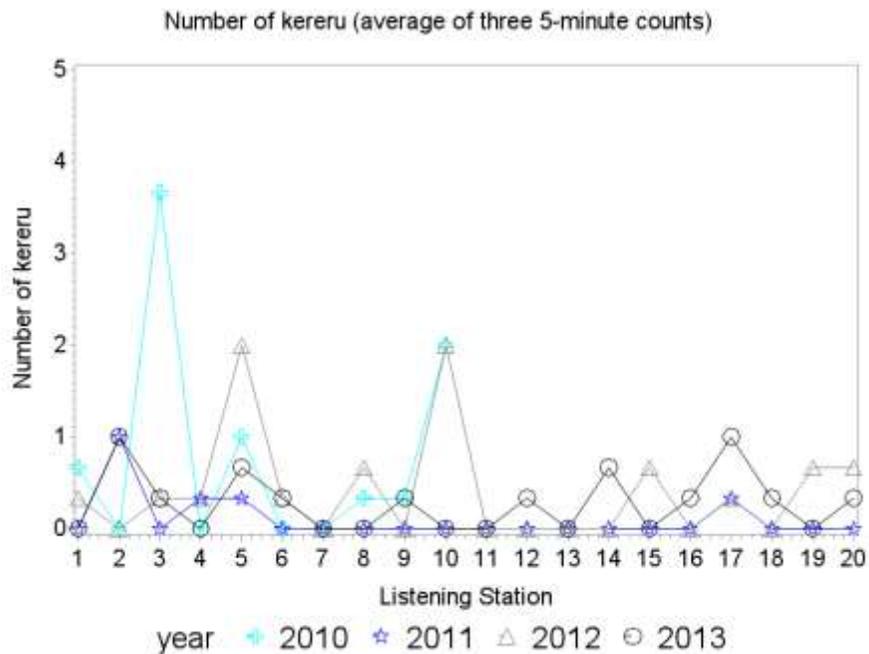


Figure 6b. Number of kereru recorded at each listening station from 2010 to 2013.

Silvereye

Silvereye were only present in very low numbers. One silvereye was recorded at four of the listening stations numbered between 1 and 16. Slightly more silvereye were recorded at listening stations 17-20 (Figure 7a). Examining Figure 7b, similar numbers of silvereye were recorded at this end of the reserve in 2012. Over the four year period it is possible that silvereye numbers may have decreased at listening stations 1 – 10.

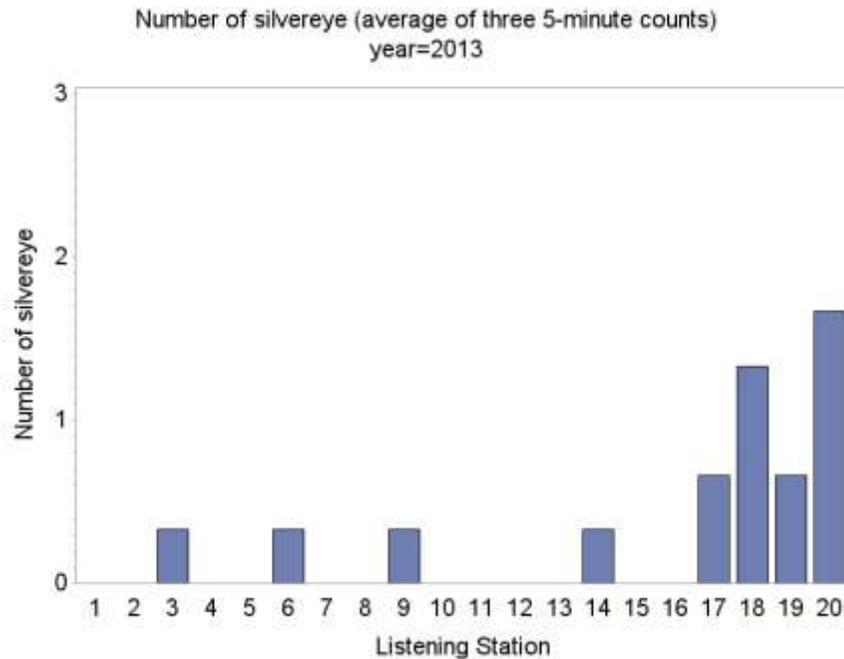


Figure 7a. Number of silvereye recorded at each listening station in 2013.

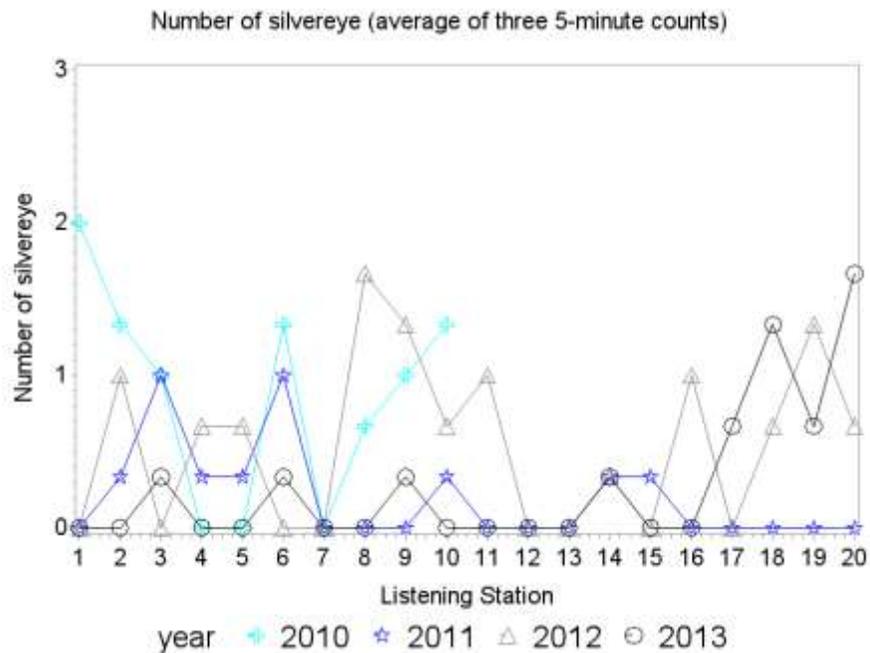


Figure 7b. Number of silvereye recorded at each listening station from 2010 to 2013.

Tomtit

In 2013, more tomtit were recorded at the newer listening stations (11-20) compared to the older listening stations (1-10) (Figure 8a). The 2013 counts for stations 1 to 10 are low compared to 2012 and 2010 counts Figure 8b).

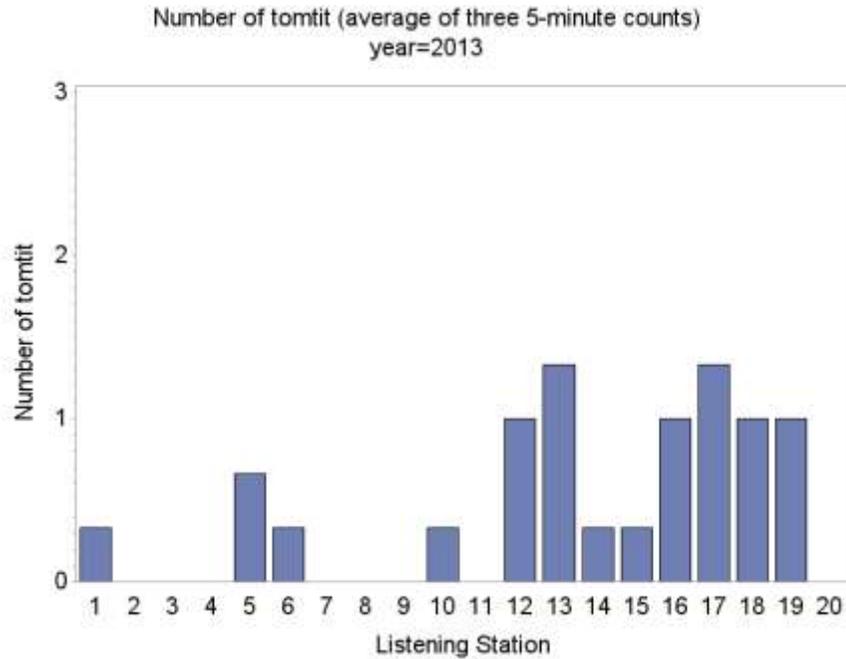


Figure 8a. Number of tomtit recorded at each listening station in 2013.

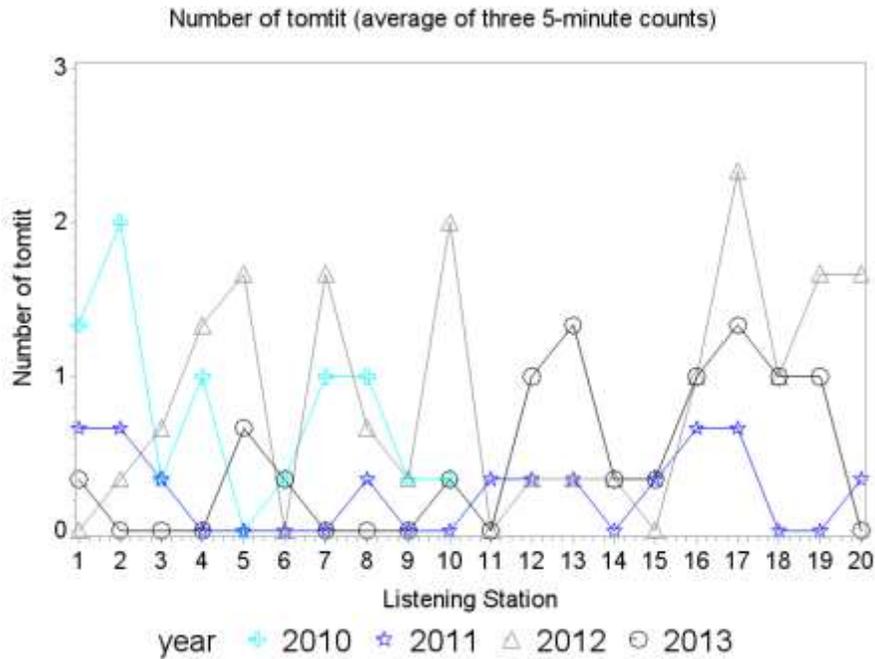


Figure 8b. Number of tomtit recorded at each listening station from 2010 to 2013.

Grey warbler

In 2013, grey warbler were recorded at all listening stations but in low numbers. More than two birds were recorded at only four listening stations, 14, 17, 18, and 19 (Figure 9a). These four listening stations are contiguous (Figure 2). For stations 1-10, the counts in 2011 and 2013 tend to be lower than those in 2010 and 2012.

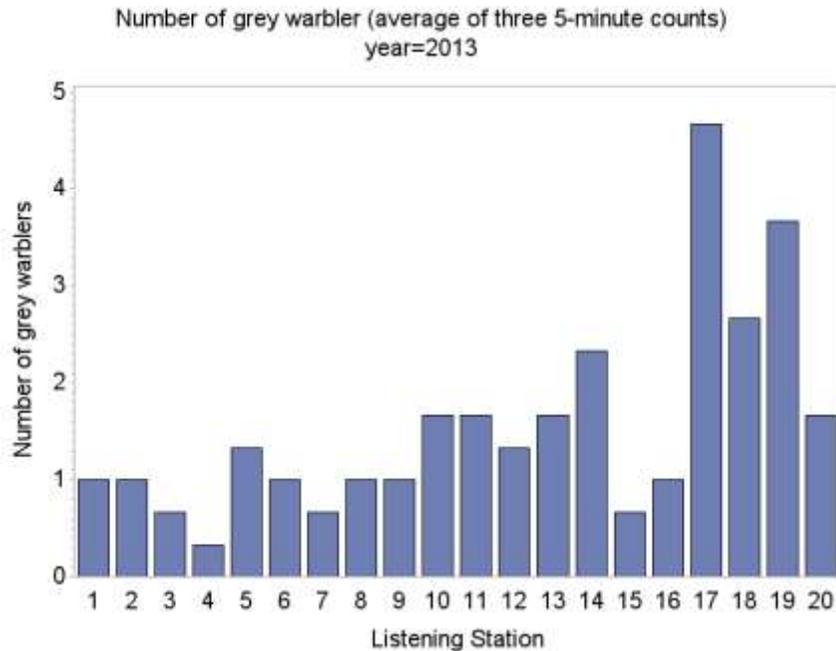


Figure 9a. Number of grey warbler recorded at each listening station in 2013.

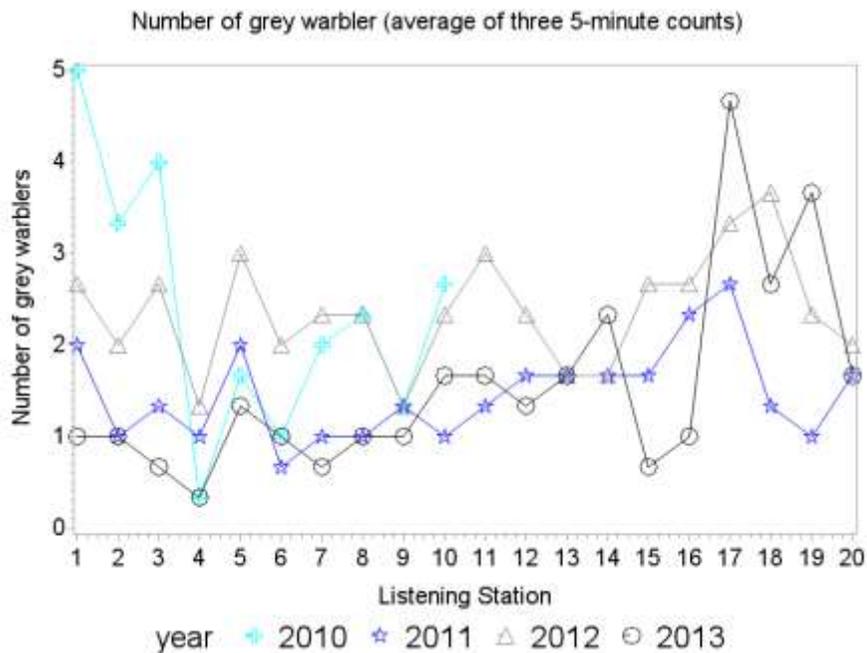


Figure 9b. Number of grey warbler recorded at each listening station from 2010 to 2013.

New Zealand Robin

In 2013, robin were recorded at 12 of the 20 listening stations. Slightly higher counts were recorded at listening stations 17-20 (Figure 10a). Over the four-year period the number of robin recorded has been increasing (Figure 10b and Figure 3c) from none in 2010 to just under nine in 2013. It will be interesting to determine if robin numbers continue to increase in future years.

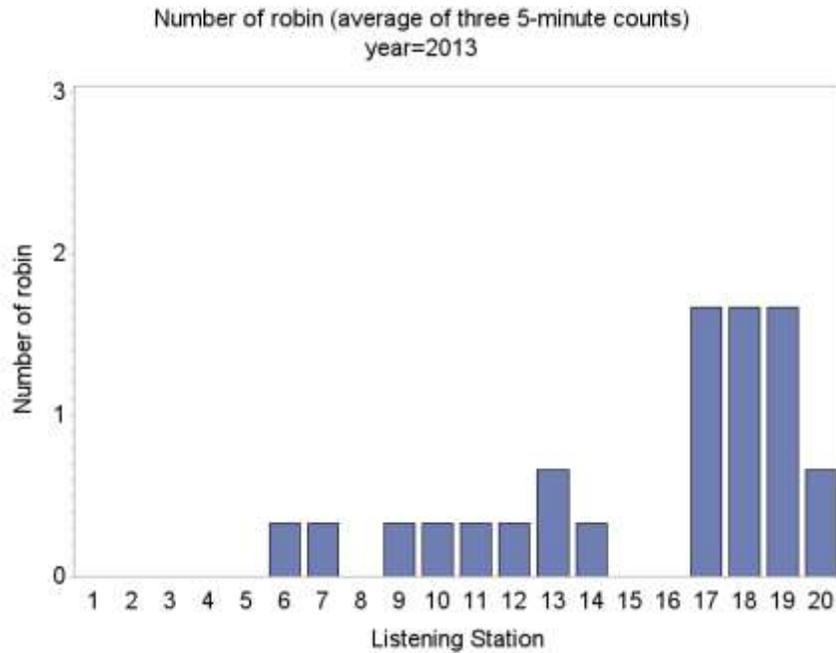


Figure 10a. Number of robin recorded at each listening station in 2013.

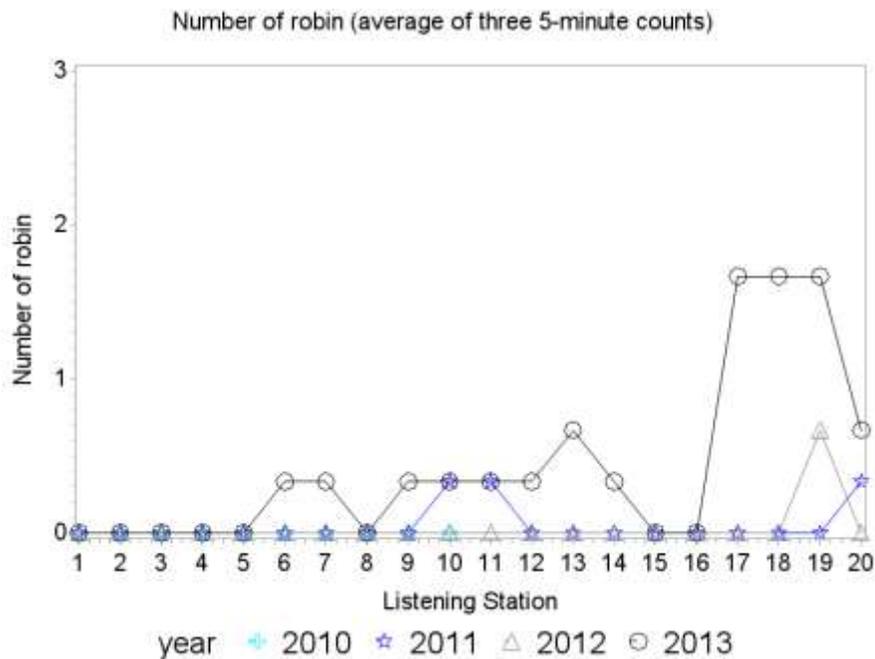


Figure 10b. Number of robin recorded at each listening station from 2010 to 2013.

Whitehead

In 2013, whitehead were recorded at two of listening stations 1-10 and eight of listening stations 11-20. The highest numbers were recorded at stations 18 and 19 (Figure 11a). Whitehead have been recorded in the reserve in each of the four years, however it appears that numbers may be increasing (Figure 11b).

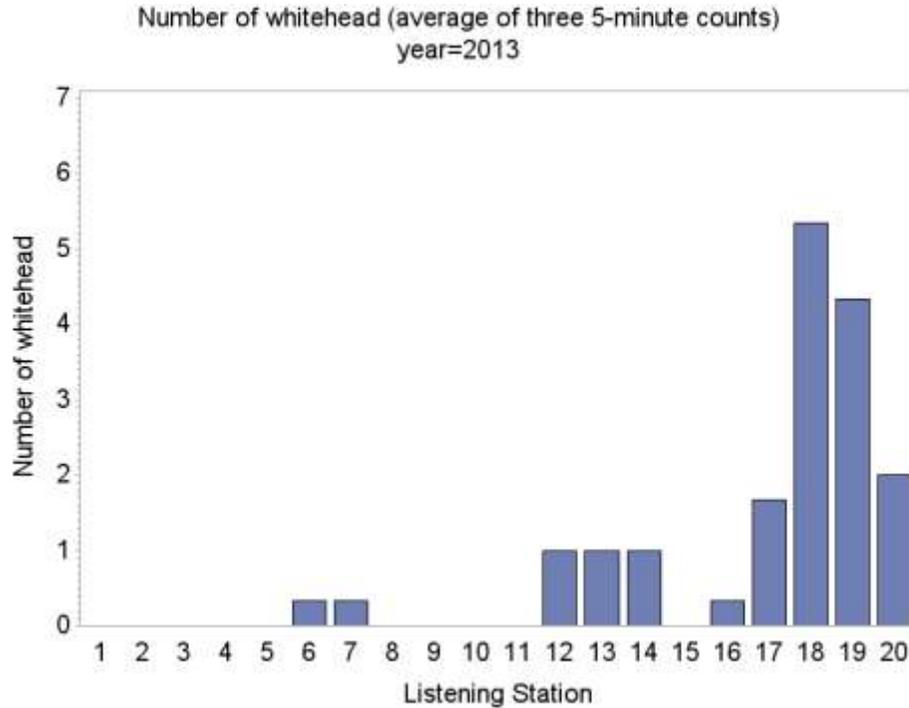


Figure 11a. Number of whitehead recorded at each listening station in 2013.

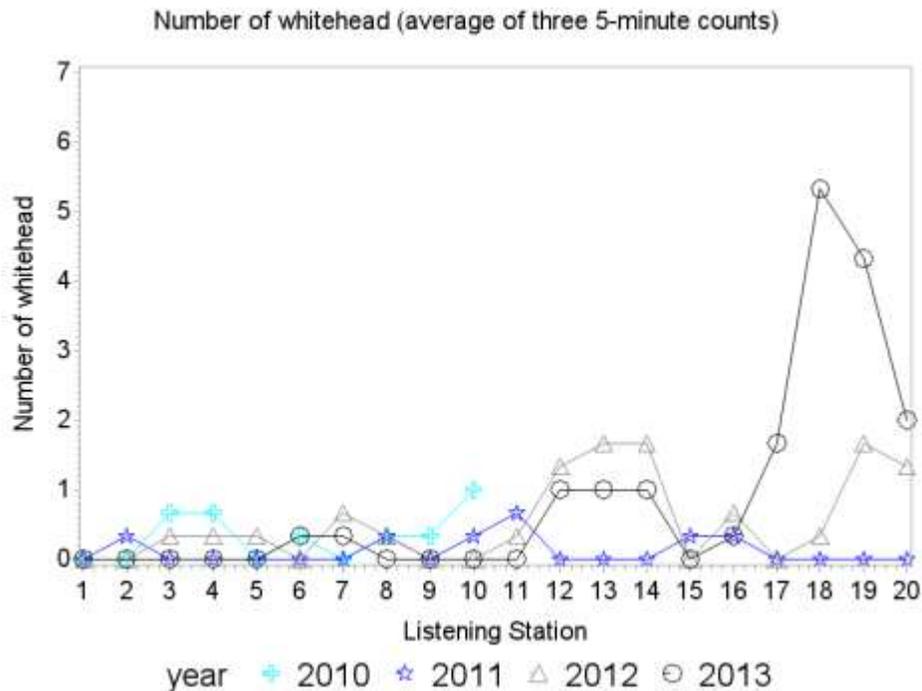


Figure 11b. Number of whitehead recorded at each listening station from 2010 to 2013.

Eastern rosella

Eastern rosella is an introduced species that has been seen more frequently around the Okareka village in recent years. In 2013, it was recorded at 10 of the 20 listening stations (Figure 12a). According to Reader's Digest (1985) eastern rosella prefer lightly timbered and open habitats. This is supported by the fact that seven of the stations where it was recorded were classified as edge stations by Quinn and Greaves (2012). Considering Figure 12b, it appears that eastern rosella have been recorded at more listening stations in 2013, however the numbers remain low with generally less than one bird being recorded at any one listening station.

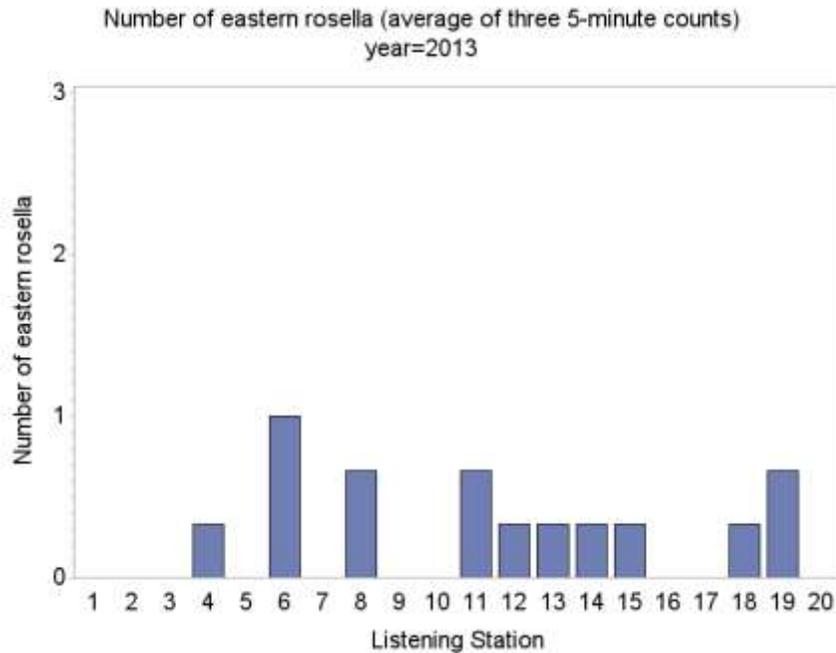


Figure 12a. Number of eastern rosella recorded at each listening station in 2013.

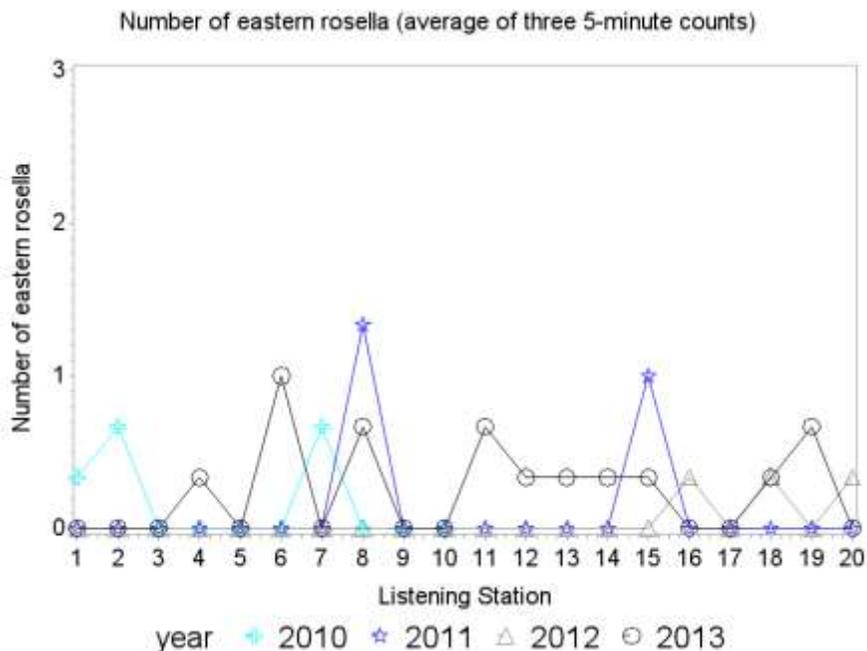


Figure 12b. Number of eastern rosella recorded at each listening station from 2010 to 2013.

Discussion

Pest control commenced in 2003 and has been carried out annually since then with the exception of 2012. The number of birds recorded in the reserve per 5-minute bird count increased slightly from 197.67 in 2011 to 235 in 2012, and then to 239.67 in 2013. Continued monitoring is needed to determine if bird numbers have been affected by no bait being laid in 2012.

It is possible that numbers recorded are only changing slightly as it is at least eight years since the commencement of the bait-laying programme and it is possible that an equilibrium of numbers that the TSR can sustain has been reached. Anecdotal reports from Lake Okareka residents indicate that birdsong in the area, and the numbers of birds sighted, has been much greater in the past three or so years than previously (prior to the increased baiting programme).

It would be valuable to compare the more recent data with the data collected in 2002 if these data can be located to determine if numbers have increased since commencement of pest control. In addition, it is suggested that a 5-minute bird count programme be set up in the Millar Road end of the Okataina scenic reserve. This reserve has similar vegetation to Tikitapu reserve and to our knowledge has not received intensive pest-control in recent years. This would provide an estimate of the effect of pest control on bird numbers.

For the five species (bellbird, kereru, silvereye, tomtit and tui) examined individually in the previous reports (Quinn and Greaves 2011, 2012, 2013), only bellbird have shown a slight increase in numbers from 2011 to 2013. For the other four species (grey warbler, New Zealand robin, whitehead and eastern rosella), the 2013 count was the middle value. The highest count occurred in 2012 for tomtit, silvereye and kereru.

Four the four additional species (grey warbler, New Zealand robin, whitehead and eastern rosella) examined individually, only whitehead showed an increase in numbers from 2011 to 2013. The highest count occurred in 2013 for robin and eastern rosella and in 2012 for grey warbler.

Blackbird is the only other species where there has been an increase in numbers from 2011 to 2013. Chaffinch is the only species where numbers have declined from 2011 to 2013.

There are a number of reasons for variation in comparative numbers of different species from year to year. Bird populations tend to fluctuate due to natural variation in breeding success as a result of environmental influences directly on the birds, and on productivity and location of food sources. Also, in a programme of this nature variations may be due to the differing levels of observer experience. For example the number of 'unknown' birds was much lower in 2012 compared to 2011 and 2013. This may be a reason for higher counts for some species in 2012. Another possible explanation for higher counts in 2012 compared to 2013 is the lack of pest control in 2012. It is essential that monitoring is continued to gain a better understanding of bird populations in Tikitapu Scenic reserve.

For the 2011 and 2012 counts the 20 listening stations were grouped as either interior stations or edge stations. Edge stations were located within 150 m of a reserve edge where the 'Reserve Edge' is defined as a change from indigenous vegetation to pasture, exotic forest, road or housing (Quinn and Greaves 2012, 2013). It was hypothesised (Quinn and Greaves 2012) that interior stations should have higher bird counts than edge stations as those located closer to a reserve edge are likely to have habitats that have less canopy cover and be drier

than those located further inside the reserve. In both years there was very little difference in the number of birds observed at edge and interior stations, so this particular analysis was not carried out using the 2013 data. It is recommended that the canopy composition and structure at each listening station be recorded and then analyses be carried out to determine if there is any relationship between vegetation and species observed.

Conclusions and Recommendations

- The total number of birds recorded annually has increased slightly from 2011 to 2013.
- The number of unidentified birds was lowest in 2012.
- Three species, blackbird, bellbird and whitehead, have shown an increase in numbers in each year from numbers from 2011 to 2013.
- One species, chaffinch, has shown a decrease in numbers in each year from 2011 to 2013.
- Robin and eastern rosella numbers were highest in 2013.
- Multiple monitoring years are required to accurately assess medium to long term trends, and to separate trends from year to year fluctuations.
- To determine the effects of pest control on bird numbers, the 2002 bird count data should be located and compared to the more recent counts. Also a 5-minute bird count programme should be established in a similar area of bush that has not received pest control, for example the Millar Road end of the Okataina scenic reserve.
- An evaluation of the plant composition and the canopy density at each listening station may help to understand variability in bird results.
- Training in bird listening prior to starting fieldwork has been extremely valuable and we recommend that this continue to be undertaken each year.
- To counteract potential observer bias volunteers should undertake different routes during the 3-4 week period rather than visiting the same stations on each occasion.
- Bird monitoring should continue to be conducted annually for at least another three to five years. Funding for the programme is budgeted until 2017.
- To ensure consistency and allow for comparative analysis the fieldwork for future counts should be conducted at the same time each year (November-December, after pest control programmes are conducted).
- Re-measuring should be is conducted over 2-3 weeks with the same 20 listening stations re-measured a minimum of three times each to maintain a consistent sample of 60 re-measures.

Acknowledgements

We thank all the volunteers who carried out the field work and who made managing this project such an enjoyable experience. In no particular order: Pete Goodwin, Judy Gardner, Jody Richardson, Geoffrey Cox, Margaret Dick, Johlene Kelly, Amanda Hunt, Sandra Goodwin, Neil McCready, Lou Sherman.

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We thank Scion for making the statistical package available for data analysis.

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Appendices

Appendix A details directions for locations to each of the twenty 5-MBC listening stations established for the project.

Appendix B is the instruction sheet for the 5-minute bird count method

Appendix C details the bird count and analysis methods used in different years since the inception of the programme.

Appendix A

ROTORUA FOREST & BIRD TIKITAPU PEST CONTROL PROJECT

BIRD MONITORING: ROUTE INSTRUCTIONS FOR FIVE- MINUTE BIRD COUNT STATIONS

GENERAL

Stations (identified below as 5MBC + number) are all located on pest control bait station (BS) lines. Most are beside numbered bait stations (identified as BS + line/station numbers), but some are at former locations of bait stations no longer used (described as 50m past a numbered station). BS lines and numbered stations are all approx. 100m apart. BS lines numbered 1, 3, 5, and 7 no longer exist.

Note: the location of the 5MBC sites has not changed since 2010, but the number of the nearest bait station changed when bait the bait stations were renumbered.

5MBC stations are marked with pink on white plastic triangles and pink plastic tape. Bait station lines and links between them are marked with pink plastic triangles, except where the ridge or saddle tracks are used as links - these are marked with white metal rectangles.

The bait station lines and links are rough unformed routes with many obstructions. They are very steep in places and may be slippery especially after rain. They require reasonable fitness, and care in walking along them. Walking times given are approximate – they average about 4 minutes (up to 6 minutes if steep) per 100 metres.

ROUTE A: STATIONS 1- 5

Start at bottom of ridge track on Loop Road opposite Benn Road. At the junction after 2 minutes go left on the baseline a few metres to **5MBC 1** at BS 4/1. Go up BS line 4 for 6 minutes to **5MBC 2** 50m past BS 4/2. Go up a further 6 minutes to link track on left 50m past BS 4/3 and follow it (on ridge track at end) to BS line 6. Go down this line 4 minutes to **5MBC 3** 50m past BS 6/4. Go back up to ridge track and follow it to left 8 minutes to BS line 8. Go down this line to right 3 minutes to **5MBC 5** at BS 8/6. Go back up to ridge and down BS line 8 for 12 minutes to **5MBC 4** 50m past BS 8/3. Continue down line to road. Total time about 1 ½ hours.

ROUTE B: STATIONS 6-11

Start at bottom of BS line 10 on Loop Road (room to park by BS line 12) and go up 4 minutes to **5MBC 6** 50m past BS 10/1. Continue up line 10 minutes to **5MBC 7** 50m past BS 10/3. Continue 12 minutes further to **5MBC 8** at BS 10/6 (1 minute past ridge track). Return to ridge track and follow it to right 6 minutes to BS line 12. Go along this line to right 8 minutes to **5MBC 11** at BS 12/8. Return to ridge track and down BS line

12 1 minute to **5MBC 10** at BS 12/5. Continue down 14 minutes to **5MBC 9** 50m past BS 12/2. Exit down line to road. Total time about 1 3/4 hours

ROUTE C: STATIONS 12-16

This is a through route requiring a drop-off or car left at top corner of reserve on Tarawera Road, and a pick-up or car left near bottom of BS line 16 on Loop Road (room to park at top of hill by BS line 17). Go through planted area to start of saddle track and turn right to pick up markers to BS line 19. Go up this line to left 8 minutes to **5MBC 16** at BS 19/3. Return to saddle track and go along it 4 minutes, continuing straight ahead where it veers right, to BS line 18. Follow marked link track from BS 18/12 6 minutes to BS line 17 and **5MBC 15** at BS 17/1. Continue on link track 12 minutes to BS line 15 and along it to right 8 minutes to **5MBC 12** at BS 15/3. Continue down BS line 15 20 minutes to **5MBC 13** at BS 15/8, and 8 minutes further down this line to track with yellow markers just before BS 15/10. Follow this 4 minutes to right to BS line 16 and go down it 1 minute to **5MBC 14** at BS 16/2. Continue down this line to road. Total time about 2 hours.

ROUTE D: STATIONS 17-20

From grassed area beside Tarawera Road north of Blue Lake pick up markers to BS line 22 towards lake and follow them to BS 22/6. Go to right along line 4 minutes to **5MBC 20** at BS 22/5. Return to grassed area and go along Nature Walk (by sign, orange markers). Where it curves to left up a gully after 4 minutes go straight ahead along track with yellow markers 2 minutes to BS line 19. Go up it to left 3 minutes to **5MBC 18** at BS 19/9. Return to Nature Walk and follow it to right to saddle track junction by hollow pukatea. Go up saddle track 8 minutes, past seat at saddle and straight ahead 2 minutes down BS line 17 to **5MBC 17** at BS 17/6. Return to saddle track and back down it, turning right onto Nature Walk at junction. Go down 3 minutes to markers for BS line 20 and up line to right 2 minutes to **5MBC 19** at BS 20/4. Return down this line to Nature Walk and go right to exit to grassed area. Total time about 1 1/2 hours.

EQUIPMENT FOR BIRD MONITORING

Recording sheets, pen
Watch
Binoculars
Boots
Warm/waterproof clothing
Drink
Bird field guide (optional)
Small backpack

Appendix B

THE 5 MINUTE BIRD COUNT (5MBC) METHOD

The 5MBC method, developed in the early 1970s by Dawson and Bull, is still regarded as the standard protocol for measuring and comparing bird populations.

Summary

An observer stands at a count station, in this case situated in the Tikitapu Scenic Reserve. Stations are generally a minimum of 200m apart.

1. The observer records the number and species of all birds seen and heard.
2. The original method recommended a 200m cut-off, but many observers have found it difficult to estimate 200m. As a consequence many studies have stipulated there is no cut-off but recommend observers do not record birds that are clearly a long way away. For the purposes of this study all birds heard or seen will be recorded on the field sheet.
3. On the field sheet the observer records:
 - their own name
 - the number of birds seen and heard of each species
 - the location of the station (i.e. station or i/d number)
 - the date
 - the start time
 - the weather variables; temperature, wind, other noise, sun, precipitation type and precipitation value
4. No bird is knowingly counted twice within a five-minute interval.
5. If a bird is heard at two separate stations, but the observer believes it is the same bird, it should still be recorded at both locations.
6. No birds should be assumed to be present unless they are seen or heard e.g. observers should record the number of silvereyes heard calling, not the size of the flock they think this amount of calling represents.
7. For consistency counts should be undertaken prior to 11 am.

When to use this method

It is important to remember that, like other index counts, this method does not result in an accurate count of all the birds present. The numbers recorded are used to indicate the number of birds present, but many factors introduce variability into the results including:

- Range of observer skill levels for bird identification and bird-call recognition.
- Range of hearing abilities among observers.
- Range of habits and different levels of conspicuousness between species.
- Range of environmental and behavioural factors that change how visible birds are during the course of a day and from day to day.

The relationship between the number of birds seen and the real number of birds out there is unknown and will almost certainly vary from species to species.

For this study it is assumed there will be varying degrees of ability between observers, but one of the objectives of the study is to increase the skill level of volunteers so this is as much about the learning process as accurate measures.

Appendix C

DATA COLLECTION AND ANALYSIS FROM 2010 to 2013

In 2010 there were 10 listening stations. Each station was monitored 5 times between 12th and 17th December (Quinn and Greaves 2011). Data were reported as total number of birds observed.

In 2011 an additional 10 listening stations were established giving 20 in total. Each station was monitored 3 times between 6th and 19th November (Quinn and Greaves 2012). Data were reported as total number of birds observed (seen). To enable the 2010 and 2011 data to be compared three random measures were selected for each listening station from the 2010 data collected (Quinn and Greaves 2012).

In 2012 the same 20 listening stations were used. Each station was monitored 3 times between 14th November and 12th December (Quinn and Greaves 2013). Data were reported as average number of birds.

In 2013 the same 20 listening stations were used. Each station was monitored 3 times between 12 and 27 November 2013. The data are reported below as average number of birds observed per count.