Monitoring Birds at Tiromoana Bush Conservation Management Area 2018

Prepared for Transwaste Canterbury by

Jeroen Lurling

Tiromoana Bush Conservation Management Area showing the Kate Valley flats with restoration plantings, and taller kanuka dominated forest patches (left) and broadleaf/scrub regeneration (right) on the hill sides. Mount Cass in the background (Photo: Jeroen Lurling).

Table of Contents

EXECUTIVE SUMMARY

Tiromoana Bush (also known as the Kate Valley Conservation Management Area – CMA) consists of a number of patches of kanuka dominated forest located in the Motunau Ecological District in coastal North Canterbury. Bird monitoring was carried out in October each year during the period 2005–2009 and 2017-2018. The main objectives of the programme are to monitor bird count trends over time as conservation management within the CMA develops and use the monitoring results to inform best management practice to improve avian biodiversity and habitats for birds.

Modified five-minute bird counts (after Dawson & Bull 1975 and Moffat & Minot 1994) were used to monitor forest birds at 39 point locations on 13 transects in regenerating forest. In 2018, acoustic recorders were not used, and waterfowl were surveyed separately, with standardized visual counts at open water areas within the CMA. For the more elusive wetland birds, standardized call playback surveys were conducted. Results were graphed for visual analysis of trends. No comprehensive statistical analyses were carried out this year as this will occur at the end of the second phase of monitoring, after the 2019 survey.

In 2018, 34 bird species (21 indigenous and 13 introduced) were recorded in the CMA. Overall, five-minute bird counts indicated a decline in forest bird numbers by almost a third. Over the 14-year period, there was a decline in exotic bird counts by over 50%, particularly the finches, and also bellbirds. Introduced mammalian predators are the most probable causal agents for this decline. An apparent increase was observed in other common native bird counts, including warbler and silvereye. However, this trend could potentially be influenced by observer differences related to high-frequency hearing ability. Improvements in habitat through understory regeneration may explain the increase in species richness, as well as the rare but regular appearance of tomtits and kereru recent counts.

Waterfowl and wetland bird counts from 2017 and 2018 are the first standardized surveys and provide a baseline for future trend analysis. The most common species were Canada goose, welcome swallow and New Zealand scaup. 38% of the native bird species at Tiromoana CMA were associated with wetlands and waterbodies, as well as all 5 of the threatened species recorded. In wetland bird playback surveys, four spotless crakes were heard, compared to 7 last year. This could reflect a change in response rate, or a decline in numbers most likely due to predation or emigration. A single marsh crake, a threatened and previously undetected species, was heard after call playback. This is a new distribution record for marsh crake, and the most northerly in Canterbury. Another threatened species, pied shag, was also recorded for the first time. Eleven ducks with morphological characteristics of the critically endangered grey duck were recorded, along with four chicks. Genetic analysis is necessary to determine if they are pure grey duck or have some genes of mallard, with which they commonly hybridise.

At least one additional year's data and a full statistical analysis is needed to clarify whether observed trends constitute cyclic fluctuations or long term trends.

Present indications are that habitat improvements may be having some positive effect, but are not likely to fully restore native birds to Tiromoana bush. Predator monitoring and control are strongly recommended to arrest declines of forest bird numbers within the CMA, and to allow more sensitive species to colonise or be reintroduced. Predator control and restoration planting in wetlands should also be prioritized, for the protection of the threatened and at risk species present there, and to offer new colonisation opportunities for endangered species such as bittern.

BACKGROUND

Transwaste Canterbury Ltd have committed to a comprehensive ecological restoration project as part of the mitigation for Canterbury regional landfill at Kate Valley, which has been granted a thirty-five year resource consent. The ecological restoration project is being carried out in the designated Tiromoana Bush Conservation Management Area (CMA), located in the Motunau Ecological District in coastal North Canterbury (Figure 1). Restoration of the CMA is being undertaken to protect and enhance a substantial area of lowland forest, which is a nationally rare and poorly represented vegetation type (Norton 2004).

The main objectives of monitoring birds in the CMA are to evaluate bird count trends over time as conservation management within the CMA develops and use the monitoring results to inform best management practices to improve avian biodiversity and habitats for birds. Conservation management since 2004 has involved removal of domestic stock, baseline monitoring for vegetation and birds, annual restoration planting, weed control, establishment of a deer fence exclusion area (Norton 2012), and more recently pig control and some tracking tunnels to monitor mammalian predators.

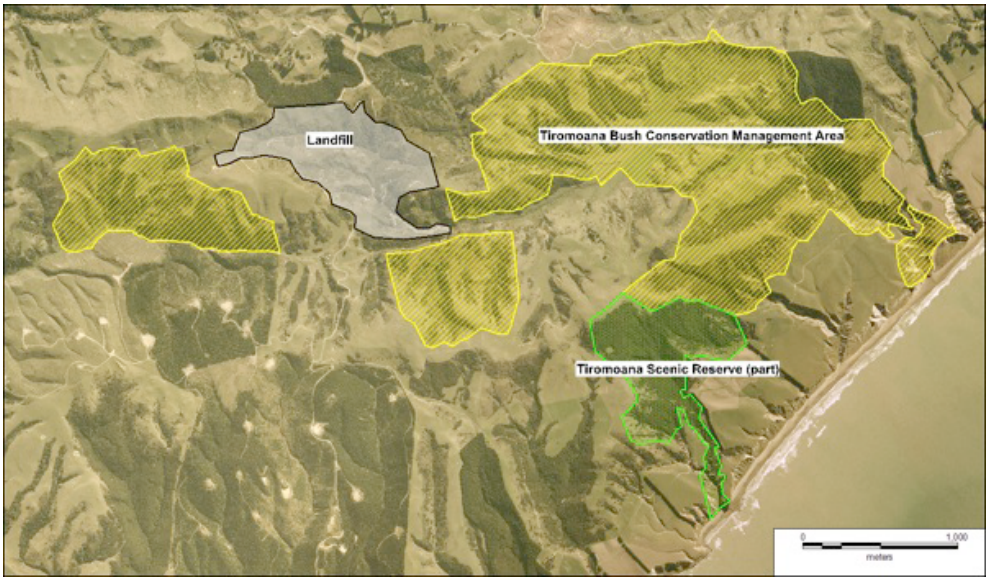

Figure 1. Tiromoana Bush Conservation Area (yellow hatched) in relation to the Canterbury Regional Landfill and adjacent public conservation land (Norton 2012).

Bird monitoring commenced in the CMA during October 2005 and was undertaken each October until 2009, providing five consecutive years of monitoring. This was the commencement of a 'pulsed' monitoring programme designed to be carried out over a 35 year period. Monitoring recommenced in 2017. This report presents the results of the second year of the second set of monitoring, 2018.

METHODS

Field Methods

Five-minute Bird Counts

The survey method, described in Buckingham (2005), entailed a modification of the standard five-minute bird count method for estimating the relative abundance of forest birds (Dawson & Bull 1975). The modification involved using simplified distance sampling techniques (Barraclough 2000; Moffat & Minot 1994). As in previous years, bird species not typically associated with forest or scrub such as welcome swallow and yellowhammer, were not included in the surveys. All individuals of forest bird species seen or heard within 200 m of a counting site were recorded during a formal five-minute counting period. Information recorded included: the individual's species, whether it was first seen or heard, and which of three distance intervals (0–20 m, 20–50 m and 50–200 m) from the counting site the individual was in when it was first seen or heard. Rare species such as kereru and tomtit were noted even if they were not observed on formal counts.

Surveys were undertaken during October in each of the six years 2005–2009 and 2017, with at least three replicate surveys each year. During each survey, counts were undertaken at 39 count sites, with thirteen transects each with three count sites spaced at *c*. 50 m intervals (Figure 2).

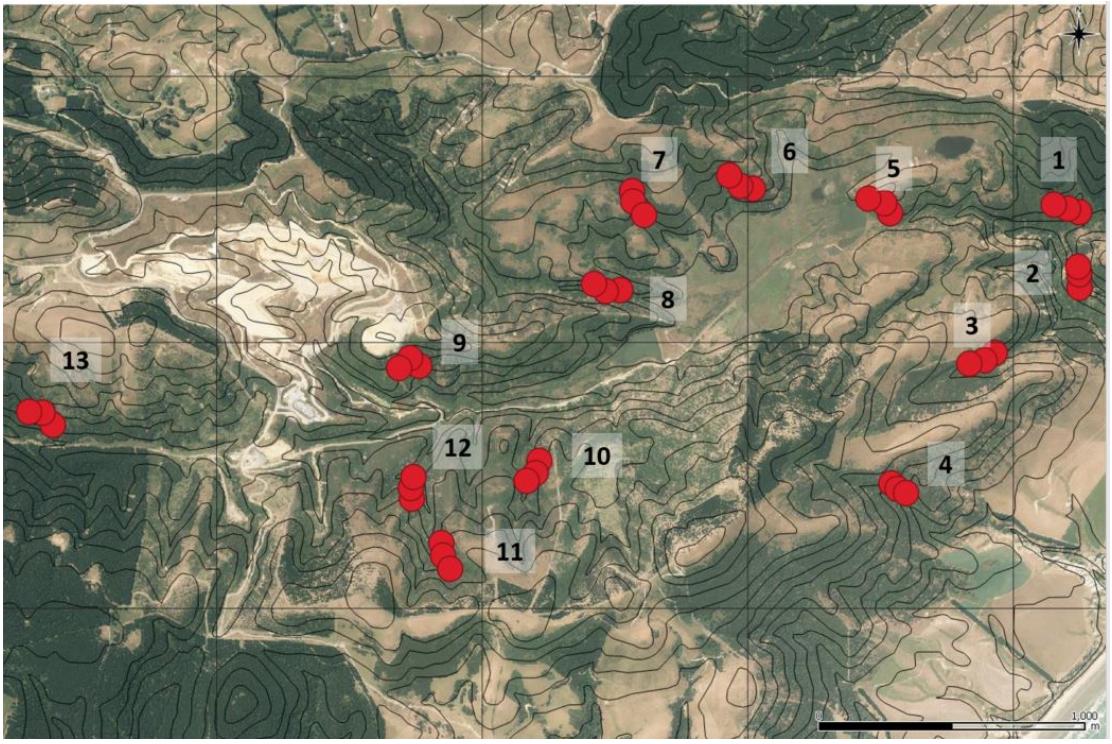

Figure 2. Bird count transects at Tiromoana Bush Conservation Area.

Right truncation at 200 m gives a survey area of 12.6 ha around each count site and, with 39 sites, a total survey area of 490 ha. During the first five years, 2005–2009, distance estimates were only recorded for native species, but in 2017-2018 counts, distance estimates were recorded for all species. Each count was repeated three times, on different days, and at different times of day (morning and afternoon). Counts on the scrub transect were repeated 5 times, to increase sample size, as there is only one transect in this habitat type. A total of 123 five minute bird counts were completed between 8 and 14 October 2018.

Surveys were only undertaken between 08:00 hrs and 17:30 hrs NZDT during suitable weather conditions: without strong wind or heavy rain. Environmental conditions during each survey were described by scoring five variables: *Sun* (0 to 5), *Temperature* (0 to 5), *Wind* (0 to 3), *Rain* (0 to 3) and *Noise* (0 to 3) as per Dawson and Bull (1975).

During the period 2005 to 2009, monitoring was carried out by Rhys Buckingham. The current year's monitoring was carried out by Jeroen Lurling who will continue to carry out future monitoring. To facilitate comparison between the results from monitoring undertaken during the 2005–2009 period and future monitoring, both Rhys and Jeroen surveyed simultaneously but independently in 2017.

Acoustic monitoring

As requested, acoustic monitoring was not carried out with five-minute bird counts or wetland playback surveys in 2018.

Waterfowl

Waterfowl on the open water dams and ponds were surveyed by visual counts with binoculars. In 2018, as in 2017, a methodical approach was used to establish a standard survey method for future comparisons between years. Survey stations were established at high vantage points with good overviews. Counts were repeated at each survey station on three separate days, and at different times of day.

Wetland Birds

The more secretive wetland birds were surveyed using call playback, the standard detection method for these species (O'Donnell, 1994). Bittern, fernbird, spotless crake and marsh crake calls were played at dusk, between the hours of 8 pm and 11:30 pm on three separate evenings. Playback calls were downloaded from the *nzbirdsonline* website and played using a Bluetooth UE WonderBoom speaker and smartphone. One spotless crake call recorded at Kate Valley by Rhys Buckingham in 2017 was also played back. The surveyor stood 10-15m from the speaker, so any call responses during playback could be heard. Approximately one minute of each species' call was played. Calls were played at set survey points to ensure full coverage of all suitable wetland habitat and to standardise effort between years.

Statistical Analysis

Statistical analyses this year were limited to basic summaries and trend comparisons. Full statistical analyses for forest birds were carried out in 2017 and will be carried out again in 2019, at the end of the second period of monitoring. This will enable comparison to the previous period of monitoring (2005-2009). The 2017-2019 surveys will also establish a baseline for wetland and waterfowl species.

RESULTS

General Results

34 bird species (21 indigenous and 13 introduced) were recorded in the CMA during October 2018 (Appendix). As in previous years, the most common native forest birds were bellbird, grey warbler, silvereye and fantail (figure 3). Kereru, tomtit, shining cuckoo, kingfisher and harrier were all recorded in low numbers (figure 4).

Five species found on previous surveys (brown creeper, spur winged plover, black shag, grey teal and pied stilt) were not encountered during 2018, but two additional species (marsh crake and pied shag) were recorded for the first time. Threatened species include pied shag (At Risk: Recovering), spotless crake (At Risk: Declining) and marsh crake (At Risk: Declining). Grey duck (Nationally Critical) were also identified from morphological features, and found breeding, but it is difficult to distinguish purebred grey ducks from grey duck/mallard hybrids without genetic analysis.

Five minute bird counts

Trends in species counts

Full statistical analyses will not be carried out until the 2017-2019 count set is complete. However, a linear trendline fitted to counts from 2005-2009 and 2017-2018 indicates a decline in total bird counts by one third (figure 3). This is explained by a decline in exotic bird counts by over 50%. This decline is consistent with observations in 2017. Total native bird counts showed little change in the long term. For most species there was high variability between years and trends weren't consistent throughout the period (Figure 3).

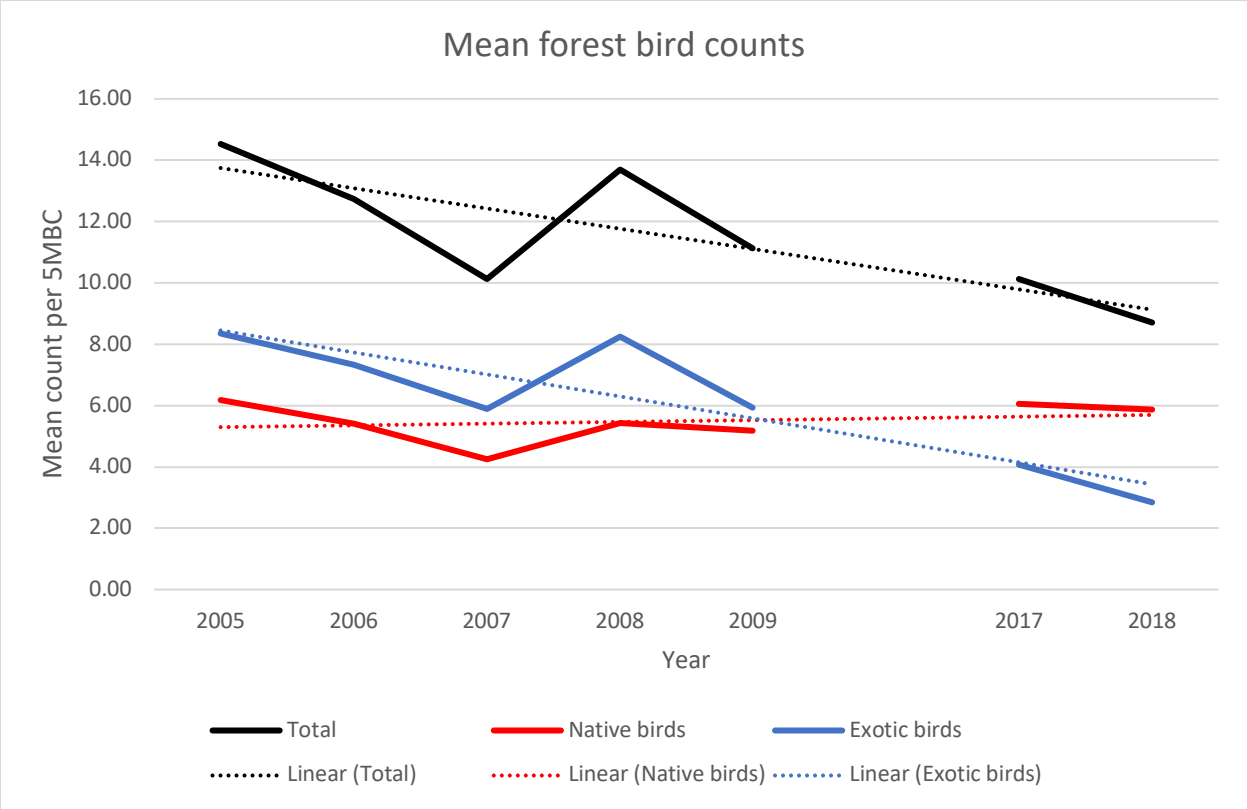

Figure 3: Mean counts of native and exotic forest birds at Tiromoana Bush from 2005 to 2018, with linear trendlines. No counts were conducted during 2010-2016. Slope of linear trendlines is exaggerated as the x axis is discontinuous.

Of the common native birds, bellbirds declined by almost a third, but silvereye increased markedly, and warbler increased slightly (figure 4). Counts of fantail and shining cuckoo varied widely between years, but the long term linear trend is stable (figures 4 and 5).

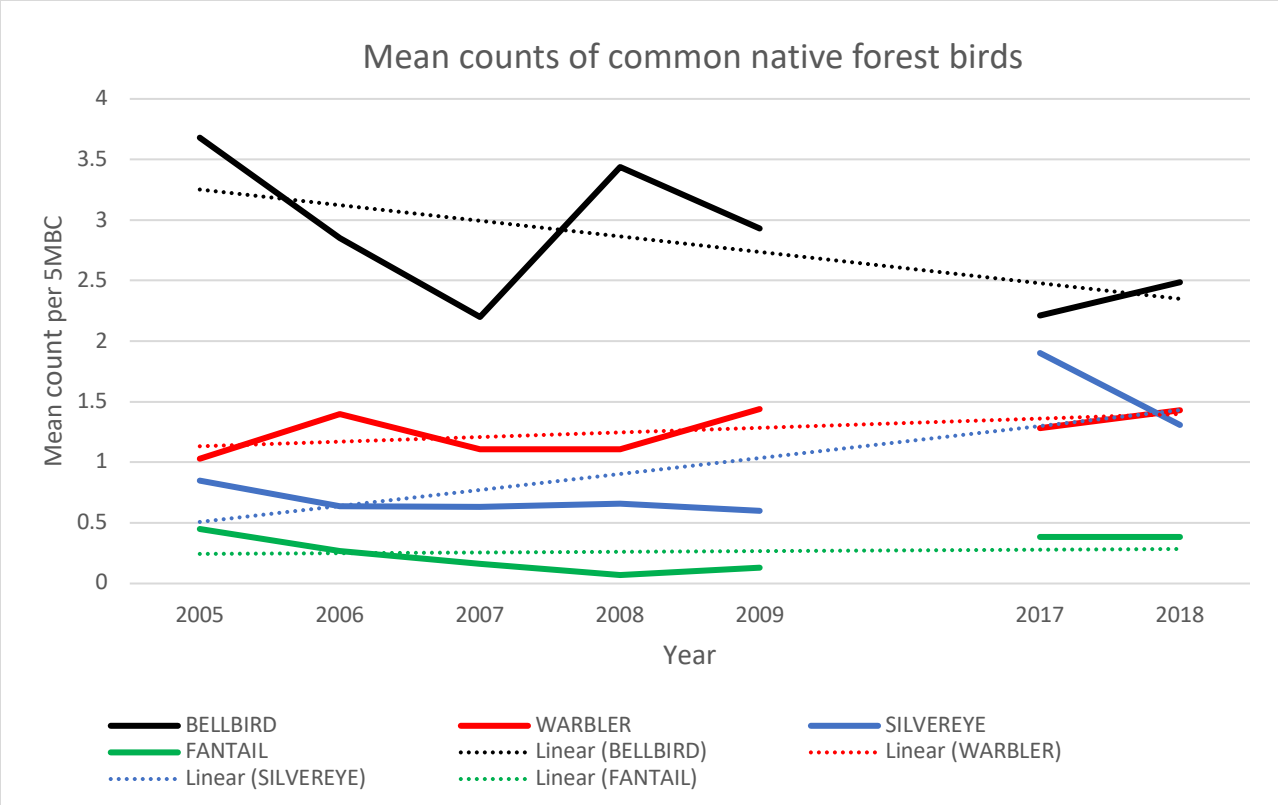

Figure 4: Mean counts of common native forest bird species at Tiromoana Bush from 2005 to 2018, with linear trendlines. Note, no counts were conducted during 2010-2016, and two different observers performed the 2005-2009 and 2017-2018 counts. Slope of trendlines is exaggerated as the x axis is discontinuous.

Variability in counts of the uncommon native species may be too high to detect a significant trend. Counts of tomtit and kingfisher depended on chance observations of single birds or pairs of birds. Kingfishers were present in 2017 and 2018, but not observed in 2017 counts. Kereru and tomtit were recorded in counts in 2007, then in both 2017 and 2018, so may be becoming resident rather than vagrant. It is promising that all forest bird species recorded since 2005 were recorded in 2018, with the exception of brown creeper.

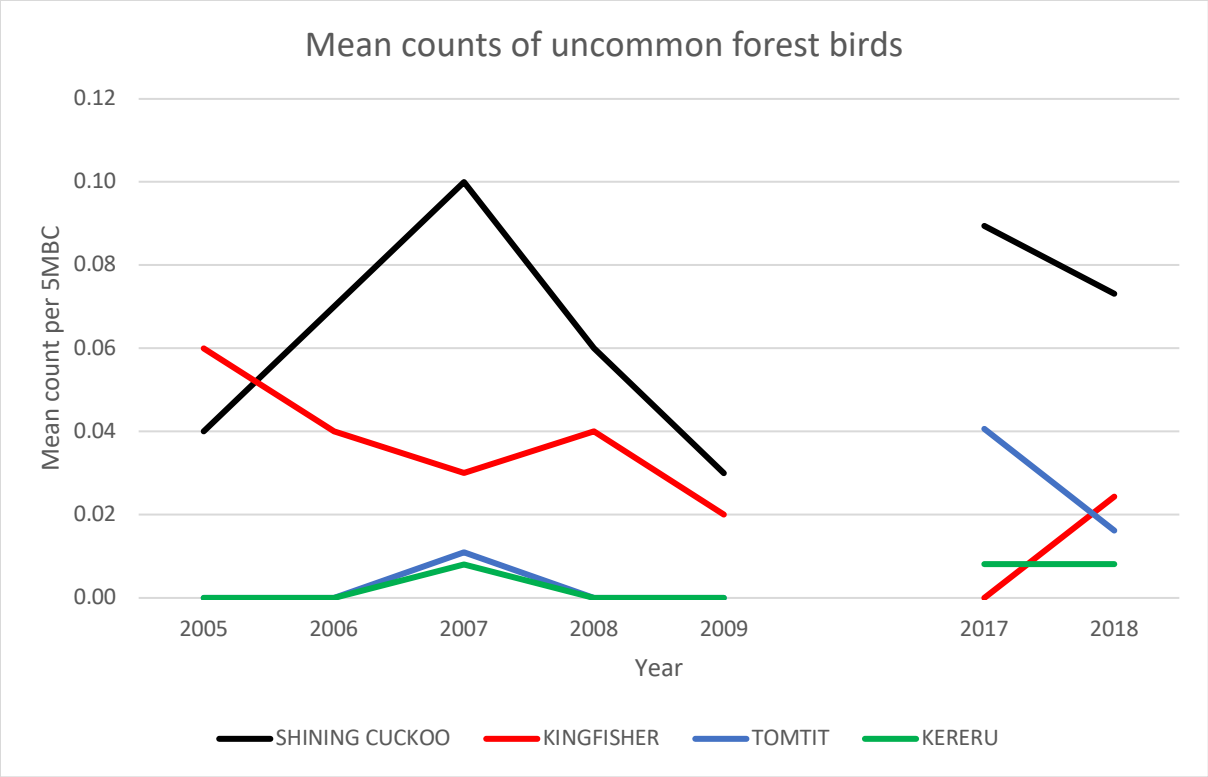

Figure 5: Mean counts of uncommon native forest bird species at Tiromoana Bush from 2005 to 2018, with linear trendlines. Note, no counts were conducted during 2010-2016, and two different observers performed the 2005-2009 and 2017-2018 counts. Slope of trendlines is exaggerated as the x axis is discontinuous.

Of the exotic birds, 5 minute bird counts of all the finches declined over the period 2005-2018, particularly the most common exotic, the chaffinch (figure 6). Redpoll, song thrush, blackbird and dunnock counts fluctuated widely, but also declined slightly overall.

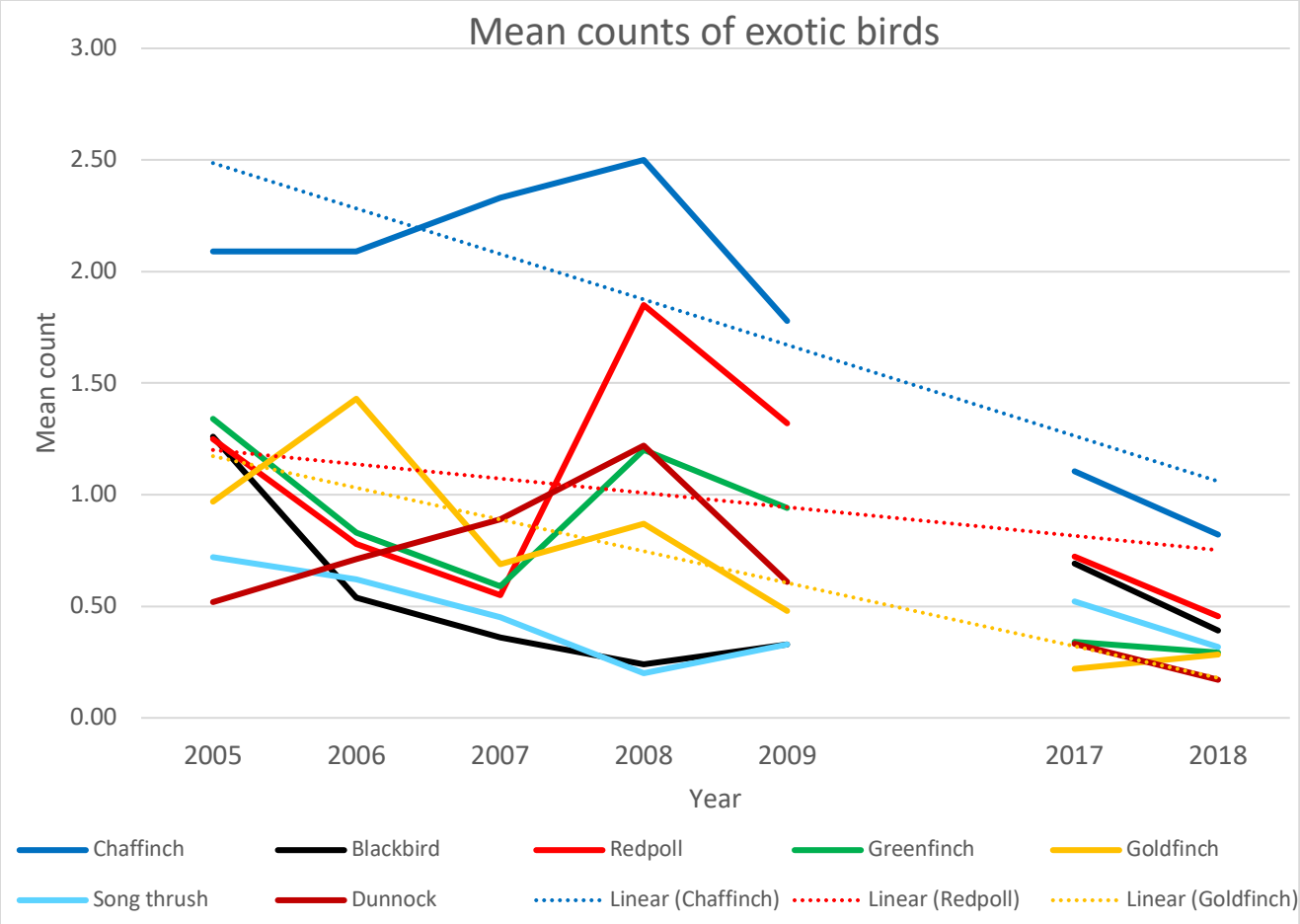

Figure 6: Mean counts of exotic forest bird species at Tiromoana Bush from 2005 to 2018, with linear trendlines for the three most common species. Note, no counts were conducted during 2010-2016. Slope of trendlines is exaggerated as the x axis is discontinuous.

Trends in Species Composition

Species richness of birds counted in 5 minute bird counts in forest patches showed a slight increase during the fourteen-year period, averaging 16.8 the 2005-2009 phase, and 18 during the 2018 survey (figure 7). Harriers were excluded from the analysis as they were initially judged not to be associated with forest habitat, but they were present in all years.

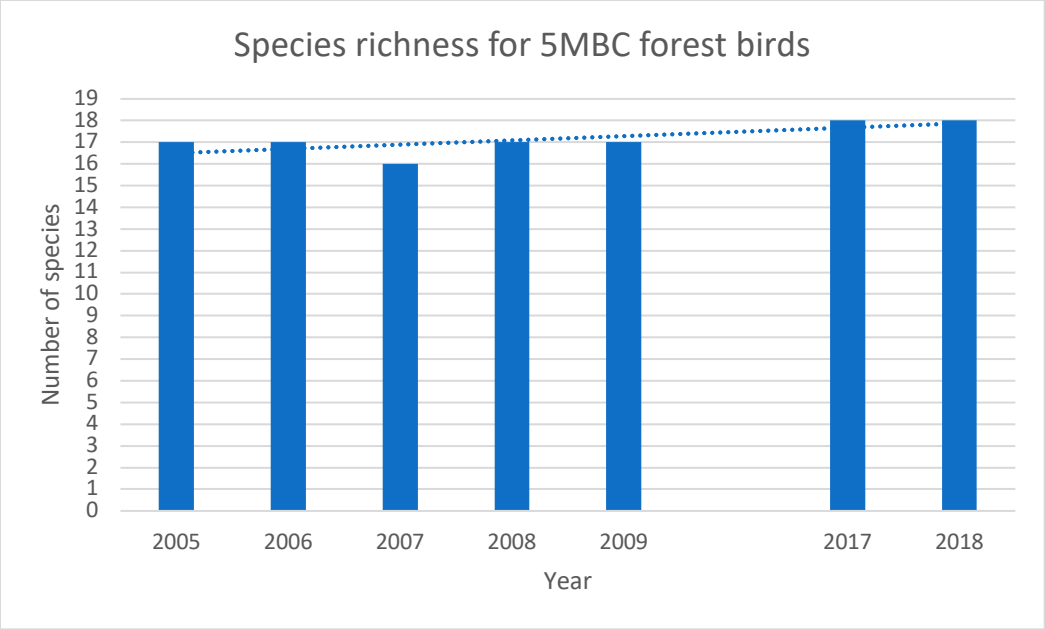

Figure 7: Number of species counted during 5 minute bird counts at Tiromoana Bush from 2005 to 2018. Only birds judged to be associated with forest habitat are included.

Waterfowl and Wetland Birds

Waterfowl

16 species recorded in 2018 are associated with wetlands and waterbodies (appendix), comprising 38% of the total species richness of the Tiromoana CMA, and 52% of the indigenous species. A total of 281 waterfowl and species associated with water were counted on the three water bodies over three standardized counts, similar to the 2017 count of 275.

A similar assemblage of waterfowl to previous years was observed. The most common waterfowl and birds associated with waterbodies were Canada goose and welcome swallow, with counts of 9.2 and 7.5 averaged over the last two years of standardized monitoring (figures 8 and 9), followed by scaup (5.2), shoveler (3.9), mallard (3.7), black swan (2.2) and grey duck/hybrid (1.9). Ella tarn had the greatest numbers of waterfowl, particularly natives, closely followed by kate pond.

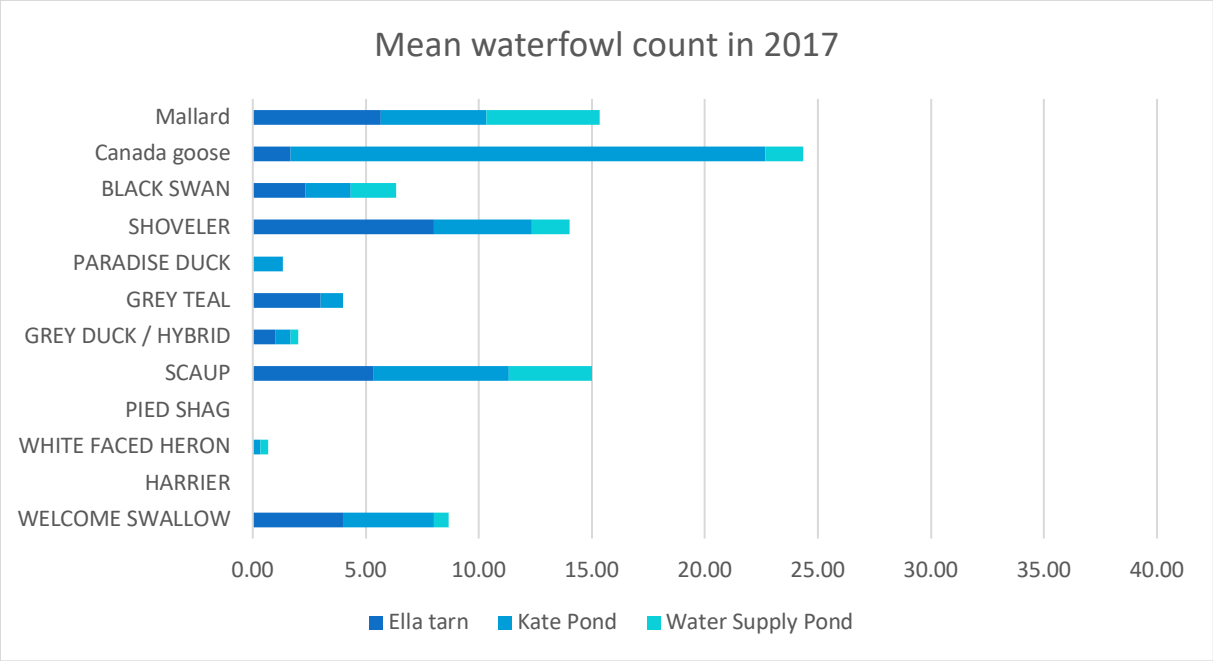

Figure 8: Mean waterfowl counts at three waterbodies in Kate Valley CMA in 2017

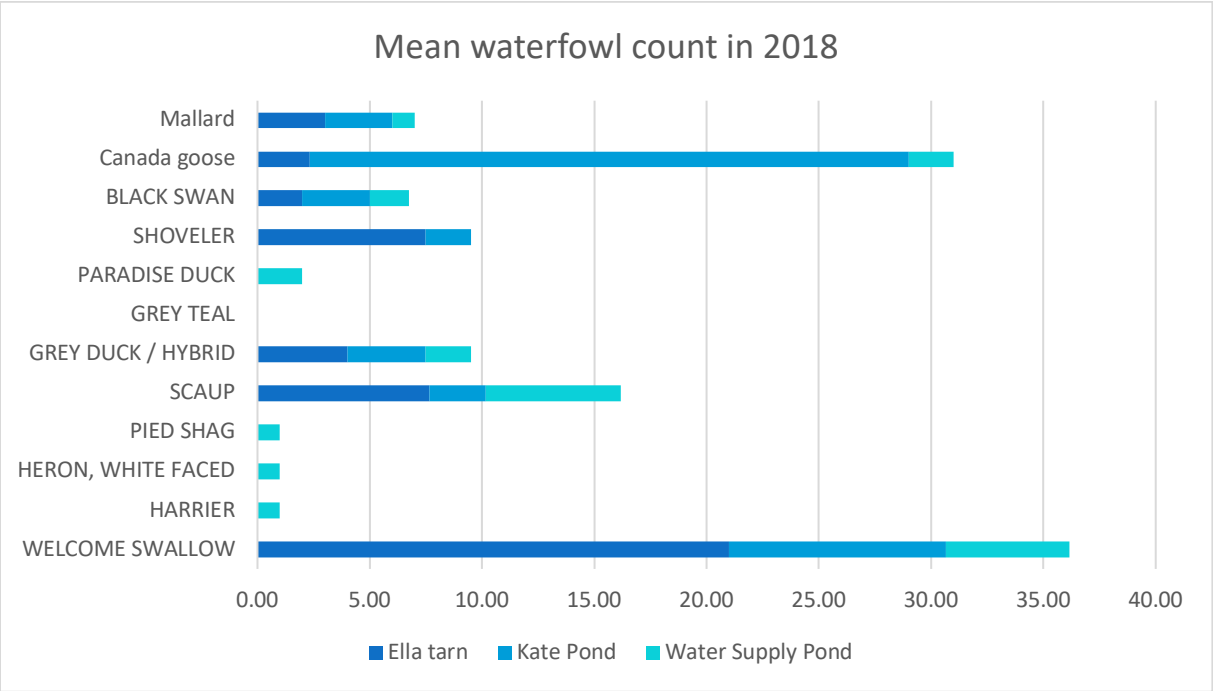

Figure 9: Mean waterfowl counts at three waterbodies in Kate Valley CMA in 2018

Most species were relatively stable in numbers between 2017 and 2018. However, there was an increase in counts of grey duck/hybrid, welcome swallow and Canada goose, and a decline in counts of mallard. Gregarious species such as welcome swallows, Canada geese and the six duck species did seem to move between the three waterbodies, as counts on any one waterbody varied markedly between days, but averages were fairly constant. In 2018 there was also a pied shag observed at the water supply pond, a threatened species and a first for the Tiromoana counts. Grey teal and stilt may be more mobile, as they were not recorded in 2018, only occasionally in previous years.

Seven ducks seen at Ella tarn, and four at kate pond, were either nationally critical grey ducks or hybrids with some mallard genetics. They were breeding, with 1 duckling seen in tow at Ella tarn, and three at kate pond. This compares to six adults observed in 2017, with no sign of breeding. All of these ducks had clear facial stripes and grey beaks, and the three which were observed while preening had green speculums. These morphological characteristics are typical of the pure grey duck phenotype, but genetic analysis may be needed for accurate identification (Williams 2013).

Wetland birds

As in 2017, no bittern or fernbird were detected during playback surveys. Only four spotless crake were recorded this year (figure 10), as opposed to seven in 2017. Calls were detected at kate pond and the water supply pond, as well as one new site, a large area of raupo surrounded by redwood forest between the water supply dam and kate pond. As in 2017, no crake were observed at Ella tarn, most likely due to a lack of raupo habitat.

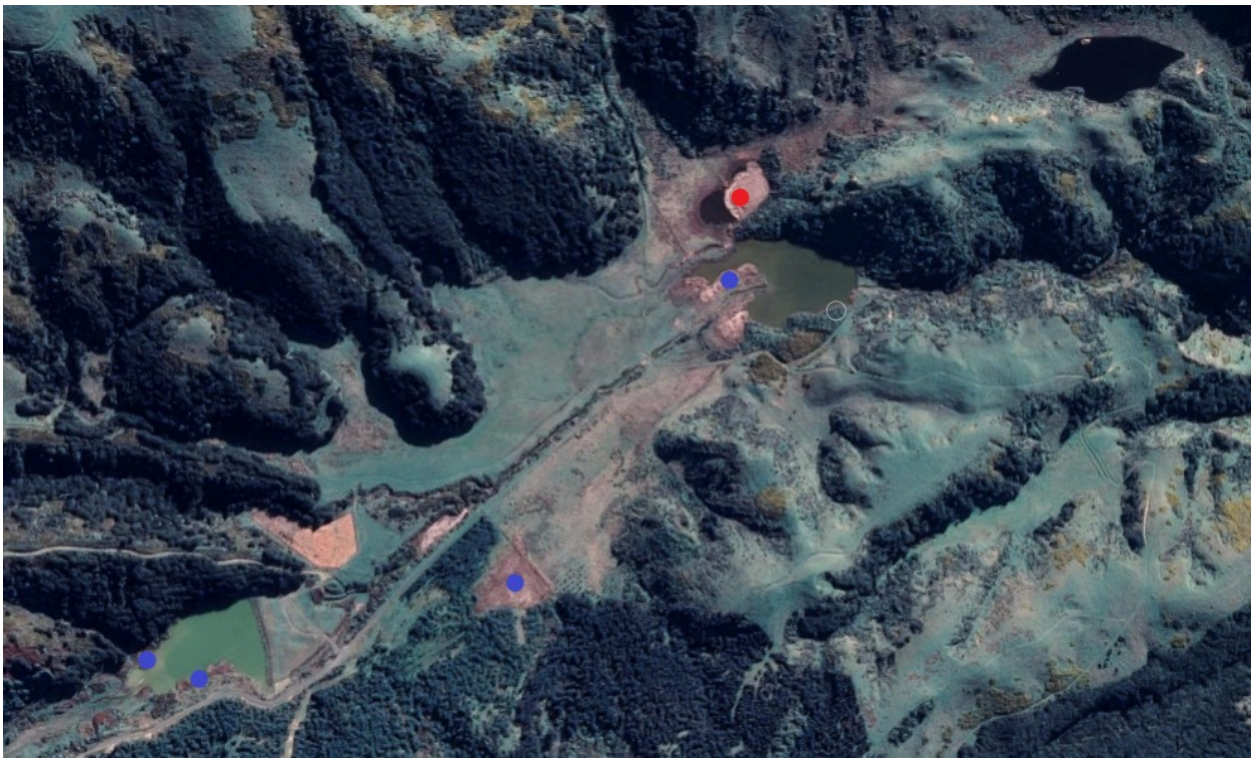

Figure 10: Spotless crake observations (blue dots) and marsh crake calls (red dot).

A marsh crake call was heard twice at Kate pond, at the same site where two unknown crake calls were heard last year. It was extremely elusive and never ventured outside the raupo. No visual observation was made, but the call closely resembled a marsh crake call on the nzbirdsonline website, so is thought to be a marsh crake. All crakes were observed in dense raupo, which was either growing out of shallow water, or on swampy ground.

Pest mammal observations

A cat was heard near 5MBC station 9a, just below the landfill. The landfill is likely to provide food for rodents, which would could bolster wild cat numbers.

While surveying after dark, pigs were heard at the water supply dam, Ella tarn, and on the hills north of Kate pond, indicating there were significant numbers present. This was after pig control had been carried out. Rooting damage is extensive in parts of the CMA, and is no doubt influencing bush and wetland regeneration and water quality in streams and Ella pond. In some gullies more than half the ground surface has been uprooted over considerable areas.

A number of restoration plantings were found dead, ring barked by deer or goats. These were primarily totara, between 1 and 2 metres high.

DISCUSSION

Five minute bird counts

Composition

The scarcity or absence of many indigenous forest bird species in the Tiromoana Bush Reserve, and the very low diversity for indigenous birds compared to larger forest areas, may reflect small patch size and fragmentation of forest (resulting in lowering of genetic diversity, etc.), modification of this forest by browsing mammals etc., and possibly relatively high numbers of mammalian predators brought about by these conditions (Buckingham & Holster 2010).

However, with good conservation management as is currently being carried out in the area, Tiromoana Bush has the potential to restore and increase biodiversity values for birds and other fauna in the future. The fact that bush bird species richness has steadily increased, and that birds such as kereru and tomtit have been counted in both of the last two years suggests the quality and extent of forest and scrub habitat in the area may be improving to a level that allows new species to colonize successfully.

Trends in numbers

The observed decline in bellbird and finch counts between 2005 and 2018 is consistent with last year's finding of a significant decline. It is concerning, as bellbirds are the most common native bird recorded during 5 minute bird counts at Tiromoana. Bellbird counts in 2018 were, however, slightly higher than in 2017. 2019 counts and density estimates will help determine if numbers are recovering or if 2018 was an anomaly in an ongoing decline. Finches have continued to decline, and the reason is not immediately apparent. If the declines in counts (Figures 4 and 6) reflect an actual decline in population densities, the results of studies elsewhere indicate that mammalian predators are the most probable causal agents for the declines (Elliott et al. 2010; Elliott & Suggate 2007; Innes et al. 2010; O'Donnell 1996; O'Donnell & Hoare 2012). However, it is unclear as to why finches and bellbirds would be more affected by predation than the other common native birds. Observer differences may play a part.

The increase in grey warbler, silvereye and fantail counts over 2005-2018 is inconsistent with 2017 findings of a significant decline in these species. The inconsistency appears most likely to be due to hearing loss in observer A (Rhys) resulting in underestimation of birds with high frequency calls, especially warblers, silvereyes and fantails. This applies in 2017, and potentially also from 2005 to 2009. During simultaneous counts in 2017, observer B (Jeroen) generally counted higher numbers of grey warbler, silvereye fantail than observer A , and attributed calls to closer distance bands (Buckingham et al. 2018). Observer A's (lower) 2017 count was used for trend analysis in the 2017 report, but replaced with observer B's counts for this (2018) trend analysis. If observer A had good hearing in 2005-2009, the observed increase in grey warbler, silvereye and fantail counts (and total native birds) could reflect an actual increase in numbers. If observer A had already experienced loss of high frequency hearing in 2005-2009, the observed increase may be an artefact attributable to observer differences in hearing ability. The major inconsistencies in density estimates versus 5 minute counts in 2005, 2007 and 2017 suggest that even in 2005-2007, observer A's warbler and silvereye calls were likely allocated to closer distances than they are actually in (Buckingham et al. 2018). This is indicative of some hearing loss over the 2005-2009 period. In the absence of data on observer hearing ability over this period, observer A's data for warblers, silvereyes and fantails cannot be reliably used in analyses. Therefore, there is some doubt about the apparent increase in these native species.

It is recommended the observer (and any future observers) conduct regular hearing tests, so any decline can be quantified and factored into the analysis of bird trends. When the technology is available, automated analysis of acoustic recordings could cancel out the influence of differences in observer hearing ability over time, and between observers.

For bellbirds, blackbirds, thrushes and finches, which generally have lower frequency calls, both observers counted comparable numbers in 2017. This suggests observer A had good low-mid frequency hearing, and the observed decline is not an artifact of observer differences in hearing ability.

Other possible explanations for the observed increase in these common native birds are changes in predation and improvements in habitat. A reduction in predation seems unlikely, as bellbird and finch counts declined over the same period. Habitat has improved, with notable understory regrowth within the kanuka forest patches since the removal of stock and exclusion of deer. Even since 2017, vigorous growth of Mahoe (*Melicytus ramiflorus)* and *Coprosma* shrubs was apparent. Composition and extent of forest patches has not changed dramatically (Buckingham et al 2018), but the coverage and height of understory species appears to be increasing. The effects of habitat change on bird populations at the CMA have not been analysed, but regeneration and restoration could be providing additional insect food sources for fantails and grey warblers, and insects and berries for silvereyes. These species are associated with native forest while the exotic finches are associated with open areas, and feed largely on grassland seeds (Heather and

Robertson 1996). However, forest habitat regeneration does not explain the decline in counts of bellbirds, which also eat insects and fruits, as well as nectar.

At least one additional year's data is needed for a more comprehensive and conclusive trend analysis on basic and distance 5-minute bird counts. Inconsistencies and complexities in trends over time and between species indicate there may be a combination of factors interacting.

As predation by introduced rodents, mustelids and possums is known to heavily impact bird populations in New Zealand, monitoring and control of these predators is a logical first step to restoring birds to Tiromoana bush CMA. Stoat control has been effective in increasing numbers of bellbirds (Kelly et al. 2005; Masuda et al. 2014) and rodent control has benefited populations of rodent sensitive birds such as tomtit, robin and mohua (Elliott & Suggate 2007; O'Donnell & Hoare 2012). One study found that control of ship rats and possums was sufficient to enhance nesting success of small forest birds in North Island remnant forest fragments (Innes et al. 2015).

Serious consideration should be given to (a) focusing initial predator monitoring and control on wetlands and waterbodies where the greatest density of threatened species occurs and (b) running the predator control as a before-after-control-impact (BACI) study where a discreet part of the valley has predator control and a similar but separate part receives none. This would enable the effect of predator control to be determined without the confounding factors of year and weather during counts. The study can be used to fine tune predator control techniques (trap type, density, poison use etc.) for this environment, and then extended to the rest of the valley.

Waterfowl and Wetland birds

The presence of a breeding population of grey duck (potentially hybrids with some mallard genetics) at Kate Valley wetlands is notable, as grey duck is currently listed as Nationally Critical due to hybridization with mallards (Robertson et al. 2017). Grey duck/mallard hybrids are variable and difficult to distinguish morphologically from purebred grey ducks. This may not be possible without genetic sampling (Williams 2013, Williams & Basse 2006). Future surveys should allocate time to assess morphological features, and investigate the option of genetic sampling of feathers.

The presence of marsh crake adds to the significance of Tiromoana Bush's wetland and pond areas, as it is classed as 'at risk, declining' and extends the species known distribution. Marsh crake have been recorded around Amberly, but Kate Valley is the most northerly record in Canterbury (Robertson et al. 2007). It also adds to the list of threatened waterfowl and wetland birds in the CMA and to the already high species diversity of these habitats.

The ongoing observations of spotless crakes confirm the presence of a resident population. The 43% decline in spotless crake counts since last year could reflect a decline in numbers due to

mortality or emigration, or a decline in response to playback. Next year's monitoring may clarify trends and causes.

Predator monitoring and control should be prioritized. Tracking tunnels are recommended around the water supply dam, kate pond and the redwoods raupo swamp, if not already present. The initial stages of mustelid, rat and cat control could also focus around these areas, as they are home to the greatest concentration of threatened birds in the CMA, and are very easy to access.

Increasing the area of wetland habitat in the CMA is important for populations of species currently occupying them, and to provide colonisation opportunities for other species such as bittern. Wetland habitat has been reduced by over 90% nationwide and most wetland bird species are listed as threatened or at-risk. Bittern and grey duck are listed as Nationally Critical. Kate Valley forms a key component of a network of wetlands along the north Canterbury coast, and if restored further, has potential as a hotspot for threatened and at-risk wetland birds. Restoration would bolster its value as a key stepping stone between the coastal dune swale and estuary wetlands to the south, and Mata Kopae/St Anne's Lagoon and the Kaikoura wetlands to the north. In the CMA, crakes only occur in raupo stands. Planting of raupo at the margins of Ella pond would be the most effective and affordable way to increase habitat for spotless and marsh crakes, as well as creating habitat for bitterns. Additional pig control may be needed, as extensive pugging of the lake margin was observed in October 2018 (figure 11).

RECOMMENDATIONS

- Resumption of acoustic recording should be considered to monitor long-term trends in forest bird counts when suitable software is available to accurately recognise species calls. This could avoid observer differences in hearing ability and is likely to become a standard method to monitor NZ's forest birds in the future.
- In the meantime, regular hearing tests for observer/s could be used to account for observer differences and age-related declines in observer hearing ability.
- Playback surveys for at risk and threatened wetland birds including spotless crake, marsh crake, bittern and fernbird should be continued. The playback points and methods established this year should be used for consistency, although additional points could be established if the habitat expands.
- A search for grey duck feathers should be carried out for genetic analysis to determine whether endangered purebred grey ducks are present.
- Five-minute bird counts should continue for at least one more year in this phase of monitoring, to determine whether observed trends are ongoing or simply cyclic or annual fluctuations.
- Full statistical analysis should be carried out after next year's bird survey, including trend analysis and measures of species diversity and composition for forest, wetland and waterfowl birds. Density estimates obtained from distance sampling analyses should be

scrutinized to improve the quality of the data collected and ensure that the method is effective.

- Multi-species predator control should be implemented, including mustelids, rats and cats. Regular monitoring of mammalian predator and browser numbers should also be carried out. Consideration should be given to beginning control at the wetland and pond areas, and to running predator control as a before-after-control-impact study.
- Increasing the area of wetland habitat in the CMA is important for populations of species currently occupying them, such as crakes and to provide colonisation opportunities for other species such as bittern. Planting raupo and *Carex secta* at the margins of Ella pond would be the most cost effective way to do this. Restoration of much of the valley floor wetlands could be a long term goal to create a wetland area of national significance.

CONCLUSION

In summary, five-minute bird counts showed an overall decline in forest bird numbers. Over the 14-year period, there was a decline in exotic bird counts, particularly finches, as well as bellbirds. An apparent increase was observed in other common native bird counts, such as warbler and silvereye. However, some of these findings could potentially be influenced by observer differences related to high-frequency hearing ability.

The effect of habitat change on species trends has not been analysed, but understory regeneration was observed and potentially related to the slight increase in species richness. More regular counts of kereru and tomtit suggest that these species may be becoming resident.

Waterfowl and wetland bird counts in 2017 and 2018 are the first standardized surveys and provide a baseline for future trend analysis. Thirty eight percent of Tiromoana CMA native bird species were associated with wetlands and waterbodies, as well as all five of the threatened species recorded, making them regionally significant.

The significant decline in bird counts is of concern, especially bellbird and potentially spotless crake. Further monitoring will be required to see whether the observed trends are part of a continuing decline or merely cyclic fluctuations in numbers. If the declines in counts reflect actual declines in population densities, introduced mammalian predators are likely to be the primary cause. Predator abundance should be monitored, so that it can be included as a variable in the statistical analysis of bird trends. Predator control is likely necessary for native bird numbers and diversity to recover, and essential before considering relocations of birds such as tomtit, robin, or fernbird to the CMA. Due to their high indigenous biodiversity and threatened species, it is strongly advised to focus a large component of predator monitoring and control, and ongoing restoration efforts, around the wetlands and waterbodies.

ACKNOWLEDGEMENTS

The author thanks Professor David Norton for helpful advice and the access gate key. I also thank staff of Transwaste Canterbury Ltd for their assistance.

REFERENCES

Barraclough, R.K. 2000. Distance sampling: a discussion document produced for the Department of Conservation. *Science & Research Internal Report 175*. Department of Conservation, Wellington. 26 pp.

Buckingham, R.P. 2005. Monitoring birds at the Kate Valley Conservation Management Area, Canterbury. Interim contract report for Transwaste Canterbury. Prepared by Wildlife Surveys Unlimited. 18 pp.

Buckingham, R.P., & Holster, A. 2010. Monitoring birds at the Kate Valley Conservation Management Area, Canterbury, Fifth pre-treatment monitor - 2009. 48pp.

Buckingham, R.P., Lloyd, B., Lurling, J.J.F. 2018. Monitoring birds at the Kate Valley Conservation Management Area, Canterbury, 2017. report for Transwaste Canterbury.

Dawson, D.G.; Bull, P.C. 1975. Counting birds in New Zealand forests. *Notornis 22:* 101–109.

Elliott, G.P.; Wilson, P.R.; Taylor, R.H.; Beggs, J.R. 2010. Declines in common, widespread native birds in a mature temperate forest. Biological Conservation 143: 2119–2126.

Elliott, G.; Suggate, R. 2007. Operation Ark: Three year progress report. Department of Conservation, Christchurch. 83 pp.

Heather, B. & Robertson, C.J.R. 1996. The field guide to the birds of New Zealand. Viking. Auckland. 432pp.

Innes, J.; Kelly, D.; Overton, J. M.; Gillies, C. 2010. Predation and other factors currently limiting New Zealand forest birds. *New Zealand Journal of Ecology 34 (1):* 86–114.

Innes, J.; King, C.; Bartlam, S.; Forrester, G.; Howitt, R. 2015. Predator control improves nesting success in Waikato forest fragments. *New Zealand Journal of Ecology 39 (2):* 245–253.

Kelly, D.; Brindle, C.; Ladley, J.L.; Robertson, A.W.; Maddigan, F.W.; Butler, J.; Ward-Smith, T.; Murphy, D.J.; Sessions, L.A. 2005. Can stoat (*Mustela erminea*) trapping increase bellbird (*Anthornis melanura*) populations and benefit mistletoe (*Peraxilla tetrapetala*) pollination? *New Zealand Journal of Ecology 29 (1):* 69–82.

Masuda,B.M.; McLean, M.; Gaze, P. 2014. Changes in passerine populations during ongoing predator control at a community-based conservation project: a case study to evaluate presence-absence surveys. *Notornis 61:* 75-83.

Moffat, M.; Minot, E.O. 1994. Distribution and abundance of forest birds in the Ruamahanga Ecological Area, North Island, New Zealand. *New Zealand Journal of Zoology 21:*135–150.

Norton, D. A. 2004. Transwaste Canterbury Ltd: Kate valley Conservation Management Area (CMA): Tiromoana Bush restoration project management plan. Report prepared for Transwaste Canterbury Ltd by Dr David A. Norton, Biodiversity Solutions Ltd, Christchurch. 45 pp.

Norton, D. A. 2012. Tiromoana Bush Restoration Management Plan July 2012 – June 2017 (Version 2.0). Report prepared for Transwaste Canterbury Ltd by Professor David A. Norton. School of Forestry, University of Canterbury, Christchurch. 27 pp.

O'Donnell, C.F.J. 1994. Distribution and habitats of spotless crakes in Canterbury. *Notornis* 41: 211–213

O'Donnell, C.F.J. 1996. Predators and the decline of New Zealand forest birds: an introduction to the hole-nesting bird and predator programme. *New Zealand Journal of Zoology 23:* 213–219.

O'Donnell, C.F.J.; Hoare, J. M. 2012. Quantifying the benefits of long-term integrated pest control for forest bird populations in a New Zealand temperate rainforest. *New Zealand Journal of Ecology 36 (2):*131–140.

Robertson, H.A.; Baird, K.; Dowding, J.E.; Elliott, G.P.; Hitchmough, R.A.; Miskelly, C.M.; McArthur, N.; O'Donnell, C.F.J.; Sagar, P.M.; Scofield, P.; Taylor, G.A. 2017. Conservation status of New Zealand birds, 2016. *New Zealand Threat Classification Series 19*. Department of Conservation, Wellington. 23 pp.

Robertson, C.J.R.; Hyvönen, P.; Fraser, M.J.; Pickard, C.R. 2007. "Atlas of bird distribution in New Zealand: 1999–2004". The Ornithological Society of New Zealand, INC. 533 pp.

Williams, M.J. 2013. Grey duck in Miskelly, C.M (ed) New Zealand birds online. www.nzbirdsonline.org.nz

Williams, M.; Basse, B. 2006. Indigenous gray ducks, *Anas superciliosa*, and introduced mallards, *A. platyrhynchos*, in New Zealand: processes and outcome of a deliberate encounter. *Acta Zoologica Sinica 52 (supplement):* 579–582.

APPENDIX

Annotated bird list grouped according to habitat (2005-2018)

Table A1. Forest and scrub birds, including some species that are also found in open habitat. (NT= Not Threatened)

Common Name	Latin Name	Gen. Status	Threat status	Abundance
Kereru	*Hemiphaga novaeseelandiae*	Endemic	NT	Rare in 2017-18. one record previous monitors
Shining cuckoo	*Chrysococcyx lucidus lucidus*	Native	NT	Occasional all years
Kingfisher	*Todiramphus sanctus vagans*	Native	NT	Occasional 2005-2018
Grey warbler	*Gerygone igata*	Endemic	NT	Common all years
Brown creeper	*Mohoua novaeseelandiae*	Endemic	NT	one record in 2009
South Island fantail	*Rhipidura fuliginosa fuliginosa*	Native	NT	Frequent all years
South Island tomtit	*Petroica macrocephala macrocephala*	Endemic	NT	Rare records (one individual in 2007, 2017 and 2018 only)
Silvereye	*Zosterops lateralis lateralis*	Native	NT	Common all years
Bellbird	*Anthornis melanura melanura*	Endemic	NT	Common all years

Table A2. Birds found mainly in open or partly scrubby areas.

Common Name	Latin Name	Gen. Status	Threat status	Abundance
Australasian harrier	*Circus approximans*	Native	NT	Frequent
Skylark	*Alauda arvensis*	Introduced	NT	Common
Blackbird	*Turdus merula*	Introduced	NT	Common
Song thrush	*Turdus philomelos*	Introduced	NT	Common
Yellowhammer	*Emberiza citrinella*	Introduced	NT	Common
Goldfinch	*Carduelis carduelis*	Introduced	NT	Common
Redpoll	*Carduelis flammea*	Introduced	NT	Common
Starling	*Sturnus vulgaris*	Introduced	NT	Local, infrequent
Australian magpie	*Gymnorhina tibicen*	Introduced	NT	Frequent
Spur-winged plover	*Vanellus miles navaehollandiae*	Native	NT	Occasional, not in 2018
California quail	*Callipepla californica*	Introduced	NT	Occasional - locally frequent
Dunnock	*Prunella modularis*	Introduced	NT	Common all years
Chaffinch	*Fringilla coelebs*	Introduced	NT	Common all years

Table A3. Indigenous birds found in open valley near creeks and ponds.

Common Name	Latin Name	Gen. Status	Threat status	Abundance
Black shag	*Phalacrocorax carbo navaehollandiae*	Native	At risk: Naturally Uncommon	One record, 2007
Pied shag	*Phalacrocorax varius*	Native	At risk: recovering	One record, 2018
White-faced heron	*Ardea novaehollandiae*	Native	NT	Occasional, including 2018
Southern black-backed gull	*Larus dominicanus*	Native	NT	Occasional, including 2018
Welcome swallow	*Hirundo tahitica neoxena*	Native	NT	Frequent

Table A4. Waterfowl and wetland species

Common Name	Latin Name	Gen. Status	Threat status	Abundance, notes
Black swan	*Cygnus atratus*	Introduced/self-introduced	NT	Breeding
Canada goose	*Branta canadensis*	Introduced	NT	Common, breeding
Paradise shelduck	*Tadorna variegata*	Endemic	NT	Common, breeding
Mallard	*Anas platyrhynchos*	Introduced	NT	Common, breeding
Grey duck (likely with some mallard hybridization)	*Anas superciliosa (x Anas platyrhynchos)*	Endemic x Introduced		Occasional in 2017 and 2018, breeding
Grey teal	*Anas gracilis*	Native	NT	Variably frequent. None in 2018
New Zealand scaup	*Aythya novaeseelandiae*	Endemic	NT	Common each year
Australasian Shoveler	*Anas rhynchotis*	Native	NT	Common
Pied stilt	*Himantopus himantopus leucocephalus*	Native	NT	A few each year. None in 2018
Spotless crake	*Porzana t. tabuensis*	Native	At risk: declining	Eight responded to playback in 2017, four in 2018
Marsh crake	*Porzana pusilla affinis*	Native	At risk: declining	One heard in 2018, and possibly one or two in 2017

Table A5. Unconfirmed species.

Common Name	Latin Name	Gen. Status	Threat status	Abundance, notes
Grey duck	*Anas superciliosa*	Endemic	Nationally Critical	Possibly some pure grey duck, but genetics required to confirm
Tui	*Prosthemadera n.novaeseelandiae*	Endemic	NT	One presumed heard at Transect 8, in 2005