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Bird community composition and relative abundance in production and natural habitats of New Zealand

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Executive Summary

Biodiversity conservation in New Zealand has so far mainly focused on the one-third of the land that lies within public reserves such as national parks. This reflects a preservation rather than conservation orientation that targets mainly indigenous or native species in natural habitats and has no place for extractive use of natural resources. Only 6% of public conservation land lies in the productive and warmer lowland areas (below 500m) where biodiversity naturally flourishes. Conservation management has recently begun to focus on the other two-thirds of New Zealand's land outside public reserves, especially the lowland production landscapes. These lowland areas are highly valued for agricultural production but could also become areas where introduced and native biodiversity could flourish if managed appropriately. Many farmers seek a role as environmental stewards and are searching for ways to sustain a profitable and productive off-take of food and fibre while still maintaining or enhancing biodiversity and ecological processes on their land.

Both introduced and native species play important ecological and social roles in production landscapes. Economic benefits stem from species such as nitrogen fixing plants, insect pollinators, earthworms and other soil invertebrates that increase soil structure and fertility, and insects, spiders and birds that control pasture and crop pests. Many farmers also are very pleased to see tui, wood pigeons, and fantails in farmland, or whitebait and eels in farm streams. Overseas food market chains and their customers are increasingly wishing to be assured that the food and fibre they buy from New Zealand farms has been produced in an ecologically sustainable way that supports other plants and animals in the farm landscape as well as the 'agricultural biodiversity' that directly assists production.

This report on bird abundance and communities composition on farms is an early example of many forthcoming reports by the Agriculture Research Group on Sustainability (ARGOS) that concern farm environment. ARGOS seeks to support farmers, agricultural industry managers, national and regional policy makers, kaitiaki (Māori environmental guardians) and wider New Zealand society to find practical ways of enhancing biodiversity in production landscapes.

We counted birds on three different farming systems: certified organic, Integrated Management (IM), and conventional. The ARGOS project is evaluating these three farming systems as different pathways to improved sustainability. Different management practices have been shown overseas to affect bird abundance and diversity, but this has not been investigated in New Zealand. The sheep/beef farms were arranged in 'clusters' spread from Marlborough to Southland in eastern South Isand. Each cluster had a certified organic farm, an IM farm and a conventional farm. The kiwifruit orchards were also arranged in 12 clusters of three orchards, 10 in the Bay of Plenty, one near Kerikeri and one near Nelson. There are no longer any conventional kiwifruit orchards left for comparison, so we included IM panels of both the common Hayward variety of green kiwifruit (*Actinidia deliciosa*) and the Hort16A 'gold' kiwifruit (*A. chinensis*). Each kiwifruit cluster contained a certified Organic Hayward (termed 'Organic'), a KiwiGreen™ Hayward ('Green') and a KiwiGreen™ Hort16A ('Gold') orchard. KiwiGreen™ is ZESPRI's IM accreditation scheme that closely regulates orchard inputs and management.

Biodiversity on New Zealand's farmed landscapes has received very little study, so we have to start by describing what biodiversity is present on farms now before we can go on to research how it responds to different habitats, landscapes and farming system practices. Here we report the number of all birds seen or heard in 277 five-minute counts on 37 kiwifruit orchards, and on 337 sites from 37 lowland sheep/beef farms.

We surveyed birds because (a) they are good indicators of wider ecosystem health and functioning; (b) they are generally well recognized and familiar to farmers, consumers, politicians and the public; and (c) some species have potential as indicators of good farming system practices for increased farm produce market access.

A first aim of this study was to evaluate the cost-effectiveness and reliability of different methods of monitoring birds on farmland for the next 20 years. We found tentative evidence that the conspicuousness of birds varied (i) between orchards and farms, and (ii) between organic, conventional and integrated sheep/beef farms. We therefore recommend that more sophisticated but expensive bird abundance methods using 'distance sampling' be used for long term monitoring of bird abundance. In the meantime the bird count indices of relative abundance and diversity described in this study must be interpreted cautiously because they only give a broad-brush picture of variation in bird communities.

Secondly we compared the number and type of birds we counted on ARGOS kiwifruit and sheep/beef farms with number counted by other researchers in native forest, scrub and pine forests elsewhere on mainland New Zealand. This showed that ARGOS sheep/beef and kiwifruit orchards had remarkably high bird counts if all species are combined. Our counts on orchards and farms were significantly higher and there were more species present than in native bush, pine plantations and scrub on public land. The majority of the farm and orchard species were introduced finches (passerines) and song birds. A number of native species were seen or heard regularly on the farms and orchards, but in most cases at relatively low abundance. They included pied oystercatcher, southern black-backed gull, harrier hawk on sheep/beef farms, and pūkeko and kingfisher on kiwifruit orchards. Sheep/beef farms mainly supported introduced and native open-habitat species such as skylark, spur-wing plover, redpoll, starling, pied oystercatcher and southern black-backed gull. Kiwifruit orchards supported native and introduced woodland birds, such as blackbird, song thrush, myna, kingfisher and pūkeko. The type of bird community we saw on farms and orchards was most similar to that seen in exotic pine plantations and scrub.

Overall then, our study has showed that (i) the majority of farms do not at present sustain a high diversity of native bird species, but (ii) they generally support a wide range of introduced species and (iii) the abundance of birds in production landscapes is relatively high compared to in native habitats on public reserves.

The third part of our study compared bird counts between the three different farming systems within each of the agricultural sectors. On average we saw and heard more individual birds and more species in five-minute counts on organic Hayward kiwifruit than on both types of IM orchards. However, there was no evidence that the total number of birds counted, or the proportion of them that were native, differed between kiwifruit farming systems. In contrast to kiwifruit, there was no evidence of differences in bird counts or species richness on organic, IM or conventional sheep/beef farms. However the seen/heard ratio of birds was significantly lower in organic than IM sheep/beef farms, so variation in the conspicuousness of birds may have underestimated bird abundance on organic farms and so obscured real differences. Also, the coarseness of the bird count method, or the confounding effect of wider variation in habitat amongst sheep/beef farms than amongst kiwifruit orchards could have further obscured real differences in birds on organic, IM and conventional sheep/beef farms. However the comparative absence of differences in birds between farming systems in sheep/beef compared to kiwifruit is consistent with an ARGOS hypothesis that differences between farming systems will be more extreme for the more intensive agricultural sectors.

The bird communities differed markedly amongst different clusters. This emphasizes the need for our overall matched (clustered) study design and the increased statistcal power that emerges from it. The broad spread of the custers allows the ARGOS team to infer outcomes for a large part of New Zealand and to include regional variation, but the close proximity of the farms within the clusters filters out local and ecological landscape features that would otherwise have obscured the effects of farming system on environmental variables.

Farms and landscapes with more habitat diversity and more native vegetation have more diverse bird communities and have more native species in partcular. For example, ARGOS farms near Owaka (the Catlins region, eastern Southland) and Banks Peninsula had more native species irrespective of their farming system. This indicates the need for better

quantification of habitat diversity, extent and structural complexity on ARGOS farms and their surrounding landscapes.

Studies on European farms have identified widespread declines in birds and consequent triggered rising concern about the impact of agricultural intensification on biodiversity. ARGOS will now monitor trends in birds, hopefully for the next 20 years, to see if similar problems are occurring here and, if so, what can be done about them. If the abundance and diversity of New Zealand farmland birds is stable or increasing, the growing environmental awareness of overseas consumers could create an incentive to buy New Zealand's products.

This study provides important baseline information on the bird communities present on ARGOS farms. It also raises several questions that will be addressed in the coming years of the project, including:

- What is the role of structural complexity, diversity and extent of habitat in determining species presence and abundance?
- how do different farming systems and particular farmer actions affect bird communities?
- what are the beneficial or negative effects of different introduced and native birds in production landscapes?
- what actions are required to increase and sustain native birds on farmland, what might they cost and provide for farmers, and what are the costs and benefits of these actions for wider society?

Our study places the birds found in production landscapes into the wider New Zealand context, and has shown us which species we have to work with on our study farms to answer the above questions. This is a first step in developing healthy, productive and resilient agricultural landscapes.

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1 Introduction

Almost a third of New Zealand falls within the public preservation estate that has been set aside as indigenous forest parks, reserves and other types of protected areas (Craig *et al.*, 2000). Less than a fifth of this land is below an altitude of 500m (Norton, 2001) where the naturally warm and fertile conditions promote maximum biodiversity. On private land outside these protected areas, 52% of New Zealand has been converted from forest into pastoral lands[1]. Most of these lowland areas have high value for economic activities such as agriculture and plantation forestry (Norton, 2001). They are also areas where, with appropriate farm management, indigenous biota could flourish in a greater variety and abundance than in upland national parks (Craig *et al*., 2000; Moller *et al*., 2001; Perley *et al*., 2001). The majority of New Zealand's 88 endemic and 41 introduced non-marine birds tend to be found in these lowland areas (Case, 1996). There is no reason why many rare or even threatened species can not be nurtured on working farms (Moller *et al.*, 2005). Therefore biodiversity conservation effort in New Zealand has recently begun to focus more on the production landscapes and private land. The importance of private land for nature conservation has been recognized in a number of recent government initiatives, including the Resource Management Act 1991, the 'Biowhat' initiative (Kneebone *et al.*, 2000), the New Zealand Biodiversity Strategy (Anon 2000) and the the excellent ongoing work by the Ministry for Environment and Landcare groups. The research described here is by the Agriculture Research Group on Sustainability (ARGOS)[2]. This is a long term collaborative project involving farmers, agricultural industry agencies, iwi, farming system consultants and academic researchers (economists, sociologists and ecologists). ARGOS seeks practical ways to enhance environmental values on New Zealand farms while ensuring that farming families can continue to take a productive and profitable harvest from their land.

The previous preservation rather than conservation emphasis in New Zealand means that biodiversity on New Zealand's farmed landscapes has received very little study so far. The plants and animals living in production landscapes are often divided into two complementary groups: those that immediately support or threaten the production of food and fibre, and those that are present but have little direct ecological link to primary production. The Convention on Biological Diversity calls the first group the 'agricultural biodiversity'[3]. It includes not just the domesticated plants and animals that produce food and fibre, but also the plants, microbes and animals that provide 'ecosystem services' such as nitrogen fixation, decomposition, facilitation of nutrient uptake by plants, pollination, pest control, and ecosystem engineering[4]. Agricultural biodiversity is largely represented by common or abundant species that may be indigenous or introduced (Perley *et al*., 2001). However the plants and animals that are not directly involved in food production are also valued by farmers and wider New Zealand society. While the endemic and/or native organisms that occur in production landscapes are particularly valued for cultural or aesthetic reasons, there is an increasing wish to nurture valued introduced species (Norton 2001).

If we are to sustain agricultural and indigenous biodiversity within production landscapes we need to understand the socio-ecological processes operating in these highly modified private lands (Perley *et al*., 2001; Norton, 2001; Moller *et al*., 2005). There is also a need to monitor

[1] The world average is 23% (Mittermeier *et al.*, 1999).
[2] See www.argos.org.nz for a full description of the project and preliminary results.
[3] Defined as the variability of living organisms associated with production landscapes: United Nations Environment Program/Convention on Biological Diversity/Conference of Parties/3/14, page 2 (Moller *et al.* 2001, Perley *et al*. 2001).
[4] Ecologists recognize ecosystem engineers as those species that help create habitats that support many other species. For example, the deep burrowing earthworms are ecosystem engineers on farms because they physically alter the structure of the soil in ways that promote the abundance and diversity of soil biota.

the abundance and diversity of the plants and animals present so that we can learn about the consequences of current farm practices and identify constructive changes to farming should any problems emerge. The monitoring of birds on farms is one valuable approach to increase our ecological understanding of production landscapes, as they can be excellent indicators of wider environmental health, they are generally more familiar to farmers then many other taxa, and they are good tools to measure the progress of sustainable development (Gregory *et al.*, 2004).

The distribution and abundance of different bird species tend to be partly determined by the type and extent of habitat that is in an area (Lindsey & Morris, 2002). It is widely hypothesized that native bird abundance in production landscapes is generally limited by lack of suitable habitat (lowered native habitat diversity, reduced area, and reduced structural complexity). An added role of predation by introduced species to exclude native species in production landscapes is potentially also important but has not been studied (Moller *et al.*, 2005). Arable landscapes of Canterbury predominantly support introduced granivorous species such as chaffinch[5], redpoll and starling (Macleod *et al.*, 2004), whereas areas of native forest and scrub are more likely to contain native frugivorous/omnivorous and insectivorous species such as bellbird, fantail and grey warbler (Willams, 1968, 1973; Spurr *et al.*, 1992; Green *et al.*, 1994; Schieck *et al.*, 2000). Use of herbicides and pesticides, cropping, pasture sward management, land drainage and stock management are just some of the farming practices that might also impact on avian species richness and abundance (Sagar *et al*. 2000, 2002; Stephens *et al.*, 2003; Newton, 2004). However, there have been few specific investigations of the birds associated with different New Zealand farming sectors, and we have little baseline information or ongoing monitoring from which we can track changes in bird communities as a whole. A long term study of oystercatchers in Canterbury arable farmlands (Sagar *et al*., 2000, 2002) is a fine single-species exception.

There are three broad types of farming systems used in New Zealand: organic, Integrated Management (IM) and conventional. Organic management strategies claim significant potential to increase broad biodiversity values, including increases in birds (Hole *et al.*, 2005). However, they require high levels of management skill to maintain satisfactory levels of production and financial return. Organic farms are still uncommon and may remain so. IM farms are rapidly becoming more common and offer an intermediate strategy (minimal farm inputs at optimum places and times) between organic and conventional growing. They are a form of market accreditation scheme that incorporates integrated pest management and best professional practice to capture improved economic, social and environmental outcomes (Wharfe & Manhire, 2004). We have called the remaining farms in our study 'conventional'. This is not intended to be a pergorative term. It is merely a short hand way of referring to current practice amongst famers that have not signed up to any of the other accreditation schemes.

New Zealand is unique in the world in relying mainly on market incentive schemes like IM accreditation to 'green' its agriculture (Campbell & Lyons, 2003, Campbell 2004). Overseas countries rely mainly on state-funded subsidies to achieve conservation goals. It is not known whether these different farming systems differ in their support of birds and other biodiversity on farms in New Zealand (Moller *et al.*, 2005). Overseas food market chains and their customers are increasingly wishing to be assured that the food and fibre they buy from New Zealand farms has been produced in an ecologically sustainable way that supports other plants and animals in the farm landscape as well as the 'agricultural biodiversity' that directly assists production. This report on bird abundance and bird communities on farms is an early example of many forthcoming reports from ARGOS to find practical ways of enhancing biodiversity in production landscapes.

Given the expected lifespan of at least 20 years for the ARGOS project, it is vitally important that we establish sound, accurate and repeatable measures of our environmental starting

[5] Scientific names for all bird species are listed in Appendix 1.

point. There are many different methods available to monitor birds, with the commonest being line transects ('distance sampling') and point-counts (Thompson *et al.*, 1998; Buckland *et al.*, 2001). However, distance sampling requires more time to complete than simpler 'point-count' techniques, a higher level of expertise and equipment is required and the techniques are relatively new. Consequently, distance sampling has not been widely employed in New Zealand. One of the aims of this study was to evaluate the utility of point-counts for long term monitoring of birds on ARGOS farms. However, we also wanted to begin investigation of one of the main ARGOS goals – to determine how production areas interact environmentally with the wider New Zealand landscape, including with reserves on public land (Moller *et al*., 2005). This will be researched partly by comparing diversity and abundance of biota on farms to other New Zealand habitats. Therefore this preliminary study set out to compare the species composition and abundance in production habitats (farms, orchards and exotic pine forests) with those in less modified indigenous habitats (native forest and scrub). Comparable survey techniques must be employed in different habitats if results from different studies are to be compared. The most widely used bird survey method in New Zealand is the 'five-minute bird count', where all birds seen or heard in a five minute period from a single spot are recorded (Dawson & Bull, 1975). This technique provides a simple but crude method for obtaining a 'relative abundance' index of bird numbers and detecting major differences in abundance (Freeman, 1999). Here we collate data from five-minute bird counts already available from a wide range of habitats in New Zealand in order to compare with our own counts on 37 kiwifruit orchards and 37 sheep/beef farms in late spring and summer of 2004/05. Preliminary analyses of our distance sampling on the ARGOS sheep/beef farms are reported Green *et al*. (2005) and more complete analysis of all the data will be presented once measures of habitat are available to allow fuller interpretation.

The study had the following specific aims:

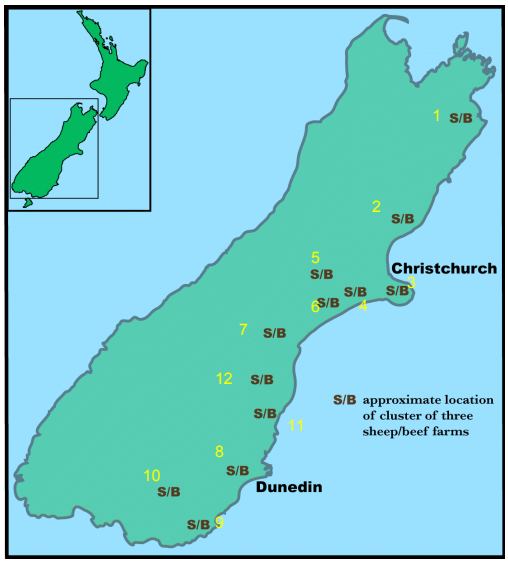
1) Evaluate the five-minute bird count technique for monitoring spatial variation and trends in bird abundance on ARGOS farms,
2) Compare the relative abundance, diversity and composition of bird communities in production and natural habitats in New Zealand,
3) Compare the bird communities present on (i) organic, IM and conventional sheep/beef farms; and (ii) between organic Hayward, IM Hayward and IM Hort16A kiwifruit orchards,
4) Provide baseline measures of bird abundance on ARGOS farms, and
5) Scope potential choices of 'focal species' for the long-term monitoring of biodiversity outside of protected natural areas in New Zealand.

2 Study areas and Methods

2.1 Study Areas

All studies were conducted on lowland sheep/beef farms throughout the eastern South Island of New Zealand (Figure 1a), and on kiwifruit orchards in the Bay of Plenty, Northland and Nelson (Figure 1b).

1a)



1b)

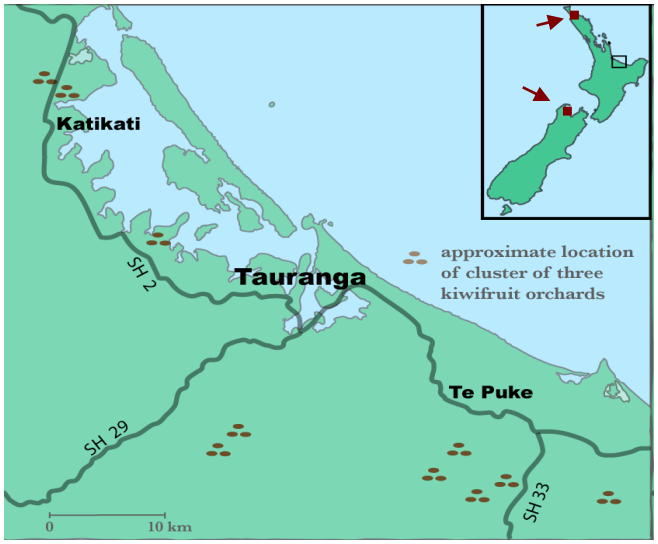


Figure 1a. Map of the South Island, New Zealand, indicating where five-minute bird counts were undertaken on lowland sheep/beef farms. 1 = Blenheim, 2 = Amberley 3 = Banks Peninsula, 4 = Leeston, 5 = Methven, 6 = Ashburton, 7 = Fairlie, 8 = Outram, 9 = Owaka, 10 = Gore, 11 = Oamaru, 12 = Waimate. **1b.** Locations of kiwifruit orchards used in the study. Main figure shows locations of Bay of Plenty orchards, while the Kerikeri (Northland) and Motueka (Nelson) orchards are shown in the inset.

The sheep/beef farms were arranged in 'clusters' of three farms, with one cluster in Marlborough (Blenheim), seven in Canterbury (Fairlie, Leeston, Ashburton, Banks Peninsula, Methven, and Amberley), two in Otago (Waimate and Outram), and two in Southland (Owaka and Gore; Figure 3.1a). Each cluster consisted of an organic, IM and a conventionally managed farm[6]. The farms were predominantly open grass paddocks, but also included patches of grazed native bush sections, manuka (*Leptospermum scoparium*), kanuka (*Kunzea ericoides*) or matagouri (*Discaria toumatou*) scrub, grain crops and exotic shelterbelts and plantations. The Owaka and Banks Peninsula clusters tended to have remnants of native vegetation on the farms, whereas the Canterbury farms tended to be made up of large flat open grass paddocks with exotic trees for shelterbelts. The Gore, Outram and Waimate farms are hillier and contained more scrub. Occasionally farmyards and farm house gardens were included in the surveys.

The kiwifruit orchards were also arranged in twelve clusters, with one cluster in Kerikeri, ten in the Bay of Plenty near Tauranga, Te Puke and Kati Kati, and one cluster in Motueka (Figure 3.1b). Each cluster consisted of a certified organic Hayward orchard, a KiwiGreen™ Hayward and KiwiGreen™ Hort 16A orchard[7]. The Kiwigreen™ is the ZESPRI IM accreditation scheme that imposes strict controls on chemical inputs. Hayward is the most commonly grown variety of green kiwifruit (*Actinidia deliciosa*) and the Hort16A is the relatively newly developed variety of 'gold' kiwifruit (*A. chinensis*). Some of the orchards that we have called KiwiGreen™ Hort16A also had some blocks of KiwiGreen™ Hayward on their property.

Certified organic Hayward, KiwiGreen™ Hayward and KiwiGreen™ Hort 16A will hereafter be refered to as 'Organic', 'Green' and 'Gold' respectively for the sake of brevity.

2.2 Five-minute bird counts on farms and orchards

The five-minute bird count procedure followed that prescribed by Dawson & Bull (1975). All birds seen or heard over a five minute period were counted at all sites. On each farm, sites were chosen by picking random latitudes and longitudes within a farm's boundary. All survey points were at least 300m apart for sheep/beef farms and 200 m apart for the smaller kiwifruit orchards, and were at least 100 m from the property boundary on sheep/beef farms to avoid minimize sampling birds on ajoining properties. Due to the smaller scale of the kiwifruit orchards, some sampling locations were closer than 100 m to the boundary. However, kiwifruit orchards are all bounded by tall linear shelterbelts, which both provide a habitat for many birds as well as a clear demarcation of the orchard boundary; accidental sampling of birds on neighbouring orchards was therefore unlikely.

On the sheep/beef farms, the five-minute bird count sites were placed on the end of each randomly-placed line transects selected for distance sampling methods. In the kiwifruit orchards they were placed every 500 m along the line transects, which ran up and down the vine lines in a regular spacing, but starting on each orchard from a random starting point (more detail on placement of counting sites are described by Blackwell *et al*., 2005). The observers waited for two minutes upon reaching the site before starting the five-minute bird count. This was ensure that any species that may have been disturbed would have returned back to the site or recommenced movement and/or singing. Within each count, no birds were knowingly counted twice (Dawson & Bull, 1975).

[6] Except the Waimate cluster which included a fourth farm that was in the process of converting to organic production. Bird counts from this farm were excluded from the analysis presented in this report.

[7] Except at Kerikeri where a fourth farm in the process of conversion to organic production was also included. Bird counts from this farm were excluded from the analysis presented in this report.

A total of 333 counting sites were spread over the 37 sheep/beef farms (average 9 per farm). There were 277 bird counts on the 37 orchards (7.5 per orchard). Counts were undertaken once at each survey point and each farm was surveyed once between 16th November 2004 and 29th January 2005.

Temperature, wind speed, humidity and cloud cover was recorded for each site. Surveys were not undertaken if it was raining or wind speed was too high (>20km/h^{-1} average) so as to maximize the detection of birds (Dawson & Bull, 1975). All counts were done between 0800 and 1400 hours. Two field teams of four observers were used in the surveys; one was based on the sheep/beef farms and one mainly on the kiwifruit orchards. Sheep/beef clusters 1 and 2 were surveyed by the kiwifruit team directly after they surveyed the Motueka kiwifruit cluster. Otherwise the same four observers conducted all surveys on sheep/beef clusters 3-12, apart from the Owaka cluster where one observer was new.

All observers received the same training in bird identification prior to commencing the surveys. Each observer undertook two to three five-minute bird counts on the same farm on the same day.

Common and full scientific names are listed in Appendix 7.1. A fuller description of the bird counting methodology and habitat features is given by Blackwell *et al*. (2005).

2.3 Five-minute bird counts from other habitats

Thirty-one study sites in areas of natural habitat and pine plantations were obtained from either raw or published data from a variety of people (Appendix 7.2). Comparability was increased by only including studies in which the Dawson & Bull (1975) five-minute bird count technique was used, only if they were undertaken on public forested land, and only where mean values of counts were reported.

We divided the predominating habitats in these studies into 'native forest', 'pine plantations' (exotic conifers) and 'scrub' to compare counts with our 'kiwifruit' and 'sheep/beef' habitats.

2.4 Data analysis

To check for differences in bird conspicuousness and detectability between sheep/beef farms and kiwifruit orchards, we calculated the ratio of birds detected by sight versus heard for each observer on each farm. The ratio is a proxy index for whether different habitat or landscape features altered detectability. It is possible but unlikely that unseen birds would have always have been heard, so rejection of the null hypothesis of equal ratios seen:heard is not categorical evidence that detectability varied between farms. Levene's tests confirmed heterogeneity of variances, so all variables were log+1 transformed prior to analysis. One-way analysis of variance was used to compare seen/heard ratios between sectors. Differences in seen/heard ratios between clusters and farming systems within each sector were compared using nested ANOVA, with management type as the main effect to be compared, and the counts from the observers on each property in each cluster nested within management type (Sokal & Rohlf, 1996). This meant that we could first look for any differences in the seen/heard ratios (and thus differences in habitat that may affect bird detectability) between the different clusters, and then control for any cluster differences to look for any effects of farming system on detectability. We had no information on seen/heard ratios for the studies from other habitats, so could not include them in the analysis.

Average five-minute bird counts were recorded for each species at each site. Species that were recorded in at least one sample from a given habitat (sheep/beef farm, orchard, native forest, scrub, pine forest) were assumed to have potentially occurred in all sites for that habitat. Therefore we included them as a zero count in all sites from that habitat where none were seen or heard. On the other hand, if a species had never been counted in a given habitat, a missing value was substituted in all counts from that habitat. This avoids biasing bird count indices downwards by excluding species whose habitat requirements precluded them from ever being seen in that habitat.

Univariate summary statistics were calculated for each site and habitat type, including the total bird count of all species combined, the species richness (number of species) and the proportion of species recorded that were native. Levene's tests confirmed heterogeneity of variances, so all variables were log+1 transformed prior to analysis. For variables that had homogenous variances following log transformation, univariate differences between habitat types and between management types within sheep/beef farms and kiwifruit orchards were tested using one-way analysis of variance (ANOVA). Tukey's post-hoc honestly significant difference (HSD) test was also run to identify any significant differences between pairs. Only one analysis did not meet the assumption of homogeneity of variances following transformation (the proportion of indigenous species present in the different broad habitat types; $F_{4,97}$ = 2.67, P = 0.037). In this case the Kruskal-Wallis test was used, which compares ranked observations. It is a non-parametric analogue of the analysis of variance (Quinn & Keough, 2002). All univariate analyses were performed with SAS Enterprise Guide 2.1 (SAS Inc., 2004).

For the kiwifruit orchards and sheep/beef farms, differences in the total bird abundance, number of species per farm and the proportion of species that are native between farming systems within each sector were compared using one-way ANOVA.

Principal Components Analysis (PCA) was used to look for overall differences in the bird community found in different sites and habitat types (Quinn & Keough, 2002). The objective of the analysis is to take p variables X_1, X_2, … X_p and find combinations of these to produce indices Z_1, Z_2, … Z_p that are uncorrelated in order of their importance, and that describe the variation in the data. These are called principal components (Manly, 2005). Correlation rather than covariance was used because relative differences rather than actual abundance was measured and because we wished to avoid distortion of pattern by giving undue influence to large feeding flocks on farms. Therefore bird counts were all standardized to have zero means and unit variance so that variation of all species had equal weighting in calculation of the principal components. Individual PCAs were run to compare all sites in the study, and also on the subsets of sheep/beef farms and kiwifruit orchards to look for difference in community composition related to farming system practices. To test for differences in the overall bird communities between sites, habitat types, and farming systems, the axis 1 and axis 2 scores from the PCA's were compared using one-way ANOVA. All PCA analyses were performed using Minitab version 14.1 (2003).

3 Results

3.1 Comparison of bird counts between habitats

3.1.1 Variation in conspicuousness

Log transformed seen/heard ratios for bird detections were significantly different between sheep/beef farms and kiwifruit orchards (average ± SE: sheep/beef = 1.95 ± 0.33, kiwifruit = 0.43 ± 0.10; $F_{1,173}$ = 38.23, P < 0.0001). There were no significant differences in this ratio between kiwifruit clusters, or between farming systems when controlled for cluster.

However, there were significant differences in log transformed seen/heard ratios between sheep/beef clusters ($F_{24, 53}$ = 2.59, P = 0.002), with clusters on the Canterbury Plains and Fairlie having higher seen/heard ratios than those on Banks Peninsula or in Otago. There were also significant differences in log seen/heard ratios between farming systems once cluster had been controlled for (average ± SE: Conventional = 1.24 ± 0.23, Integrated Management = 2.28 ± 0.63, Organic = 0.85 ± 0.12; $F_{2,53}$ = 5.50, P = 0.007), with significant pair-wise differences between Integrated Management (IM) and Organic farms.

3.1.2 Univariate differences between habitats

A one-way ANOVA of log bird count (pooling all species) versus the habitat type showed that a significant difference between habitats was present ($F_{4,97}$ = 13.79, p<0.001; r^2 = 36%). Tukey's test showed that sheep/beef farms had significantly higher total bird count than did kiwifruit orchards, native forest, pine and scrub. Kiwifruit orchard total bird counts were significantly higher than scrub, while native bush, pine and scrub were not significantly different from each other (Figure 2).

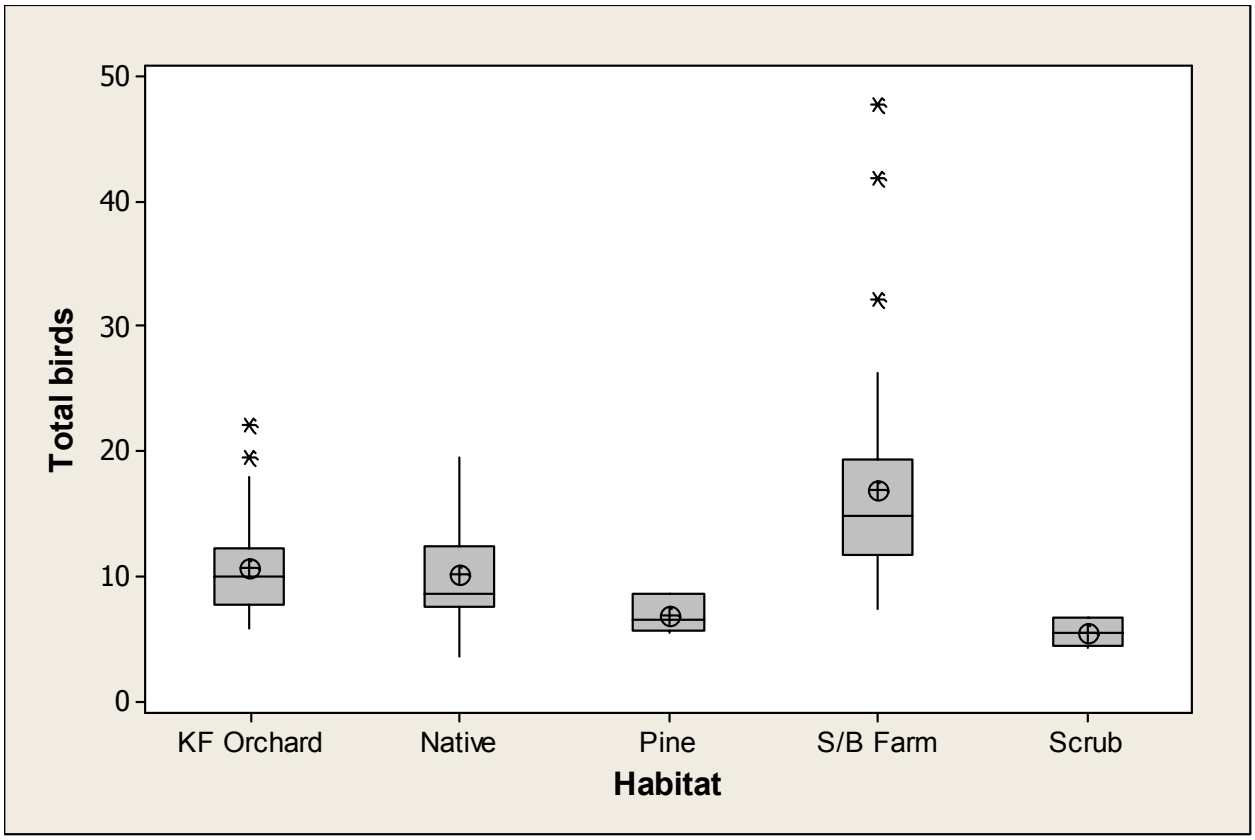


Figure 2. Box and whisker plot of bird counts on kiwifruit orchards, sheep/beef farms and on public native bush, pine and scrub. The log count of all bird species was used in the one-way analysis of variance comparing habitat types. For each habitat type, the mean value is shown by the cross in the circle, while the median value is represented by the horizontal line within the box. The upper and lower margins of the box represent the upper and lower quartiles respectively (the values above and below which 50% of the records lie). The upper whisker indicates the upper quartile plus 1.5 times the inter quartile range, and the lower whisker indicates the lower quartile minus 1.5 times the inter quartile range. The asterisks represent outliers that fall beyond the whiskers. The two outlier values for the kiwifruit orchards occurred on the organic orchards in clusters 10 (19.56 birds/5 mins) and 11 (22.10 birds/5 mins). The outliers for sheep/beef farms occurred on the IM farms in clusters 4 (32.2 birds/5 mins) and 5 (41.9 birds/5 mins) and the organic farm in cluster 2 (47.69 birds/5 mins).

A one-way ANOVA showed a significant difference between log species richness in the habitat types surveyed ($F_{4,97}$ = 15.84, $p < 0.001$; r^2 = 39 %). On average we counted 13.2 bird species per five-minute count at each site in Kiwifruit orchards, and 15.3 on sheep/beef farms. Species richness was especially low in scrub habitats (8.2). Log species richness was significantly higher on sheep/beef farms than on kiwifruit orchards and scrub. Log species richness was not significantly different between kiwifruit orchards, native forests and pine forest, but was significantly higher in these three habitat types than in scrub (Figure 3).

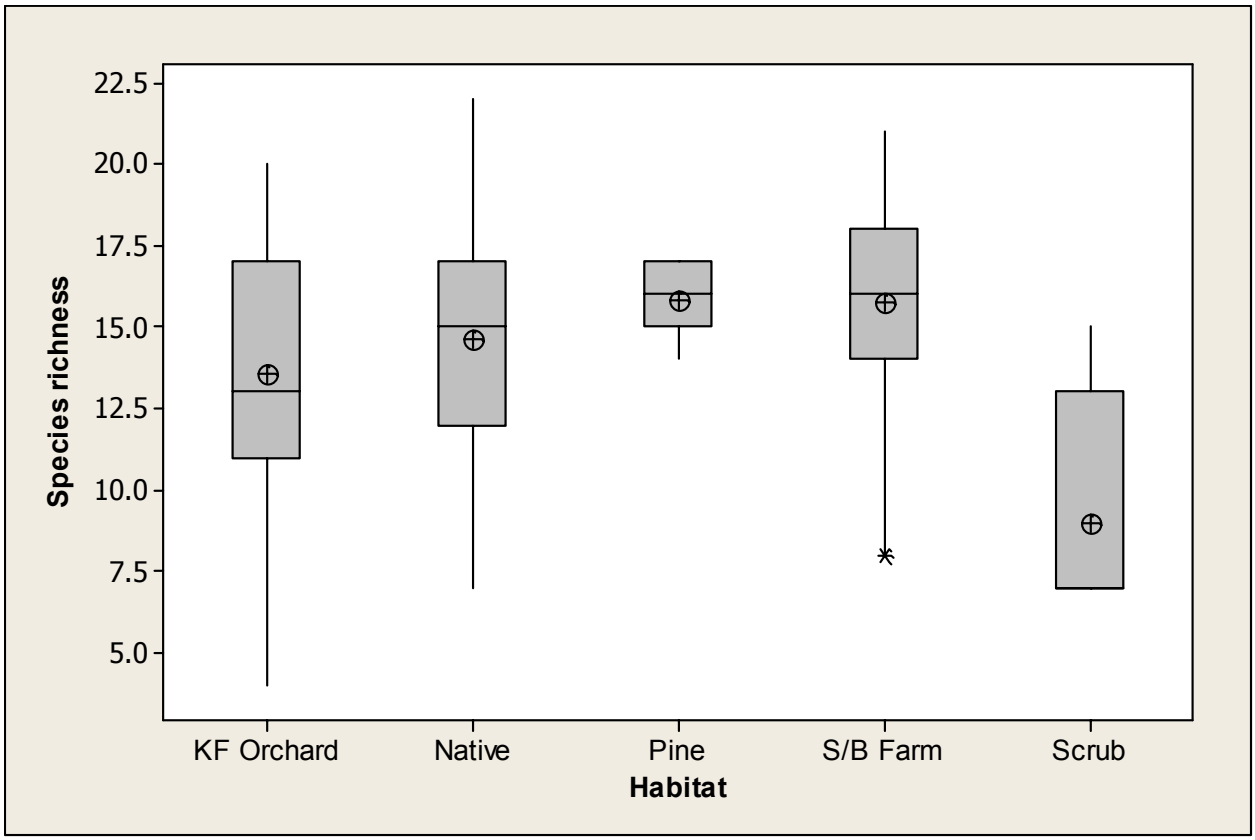


Figure 3. Bird species richness in different habitats, with sheep/beef farms and kiwifruit orchards on private land and native bush, pine and scrub on public land. Log species richness was used in the one-way analysis of variance. See Figure 2 for a description of the key for the graph. The outlier value for sheep/beef farms was on the organic farm in cluster 1 (8 species/5 mins).

A non-parametric Kruskal-Wallis test showed that the proportions of all birds that were native rather than introduced were significantly different between habitat types (χ^2 = 63.29, d.f. = 4, $p < 0.001$). Tukey's test showed that native forest habitats had significantly higher proportions of native species than kiwifruit orchards, sheep/beef farms and pine plantations, but were not significantly different from scrub. Pine plantations had significantly greater proportions of native species than either of the farming habitat types, but were not significantly higher than scrub. Both kiwifruit orchards and sheep/beef farms had significantly lower proportions of native species than the three native habitats, but were not significantly different from each other (Figure 4).

Although the average proportion of native species was 2 to 3 times lower in the farm and orchard sites compared to the pine forests and native habitats, it is noteworthy that both introduced and native birds occurred in both groups of habitats. The shift in make-up of the bird communities is therefore one of predominance, not total exclusion of introduced or native birds from modified or unmodified habitats.

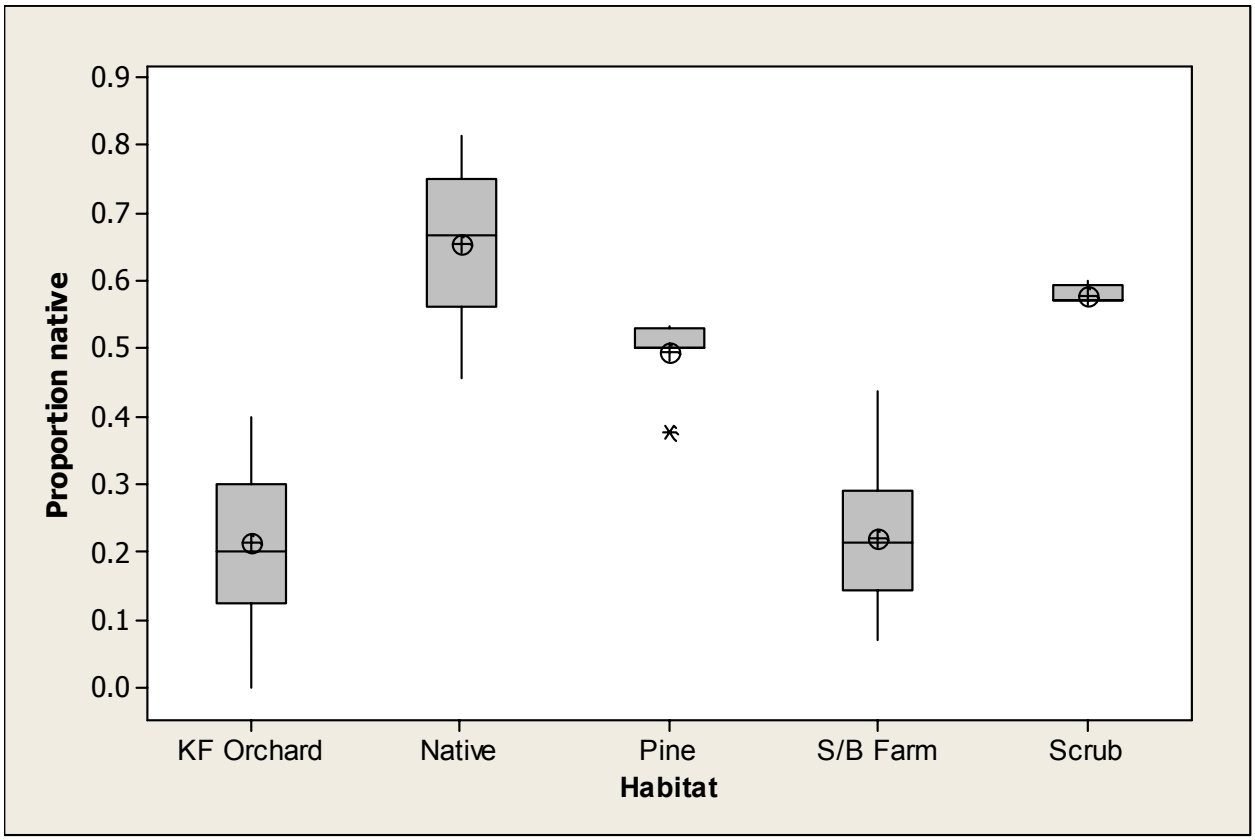


Figure 4. Proportion of bird species recorded in each habitat type that were native to New Zealand compared to introduced species. The proportion of native species was used in the Kruskal-Wallis non-parametric test comparing habitat types. For a description of the graph, see Figure 21. The outlier in the Pine habitat occurred in the Inglewoods Pine site (proportion native = 0.38).

3.1.3 Multivariate differences in bird counts between habitats

A principal component analysis was run in order to try to boil the large number of data from 54 species into a few summary descriptors of community make-up. However the first four principal components explained 33 % of the variation, while the first seven components cumulatively explain only 46 % of the variation (Table 1).

Table 1. Eigenanalysis of the principal components analysis using a correlation matrix to compare the bird communities found in the kiwifruit orchards, sheep/beef farms, native forest, pine forest and scrub landscapes used in the current study. The table only shows the values for the first seven principal components.

	1	2	3	4	5	6	7
Eignevalue	7.69	5.26	2.88	2.65	2.19	2.15	1.95
Proportion	0.14	0.10	0.05	0.05	0.04	0.04	0.04
Cumulative	0.14	0.24	0.29	0.34	0.38	0.42	0.46

A score plot (Figure 5) of the first two principal components depicts the similarities in bird communities for each site in the study. The co-ordinates summarise the 'multivariate

distance' between the bird communities in the different studies so that two points close to each other have more similar bird counts than ones separated by a large distance. The PCA axis 1 (PC1) scores were significantly different between the habitat types ($F_{4,97}$= 49.09, p < 0.001; r^2 = 66.93 %). A Tukey's test showed that the native forest habitat had significantly different overall bird community composition than all other habitat types, while scrub and pine forest communities were also significantly different to sheep/beef farms. Overall bird communities on kiwifruit orchards were significantly different to those in native and pine forests, but were not significantly different to those found in scrub or sheep/beef farms. There were significant differences between PCA axis 2 (PC2) scores and habitat types ($F_{4,97}$ = 71.83, p < 0.001; r^2 = 74.76 %), with kiwifruit orchards significantly different from the other habitats, and sheep/beef farms significantly different from all habitats except scrub. The PC2 scores for the overall bird communities were not significantly different between native forests, pine forests and scrub.

The first principal component neatly separates the highly modified production landscapes (low PC1) from the more unmodified native habitats (high PC1), with scrub and pine forests being in the middle (Figure 5). The second principal component completely partitions the kiwifruit orchards (high PC2) from sheep/beef farm bird communities (low PC2). Therefore we hypothesise that PC1 represents some aggregated measure of the degree of modification or proportion of native vegetation remaining. PC2 appears to represent some other aspect of the quality and complexity of the vegetation that each species was found in. More detailed measures of habitat characterstics within each study area would be needed to test these over-arching hypotheses and pinpoint more detailed predictors of bird counts.

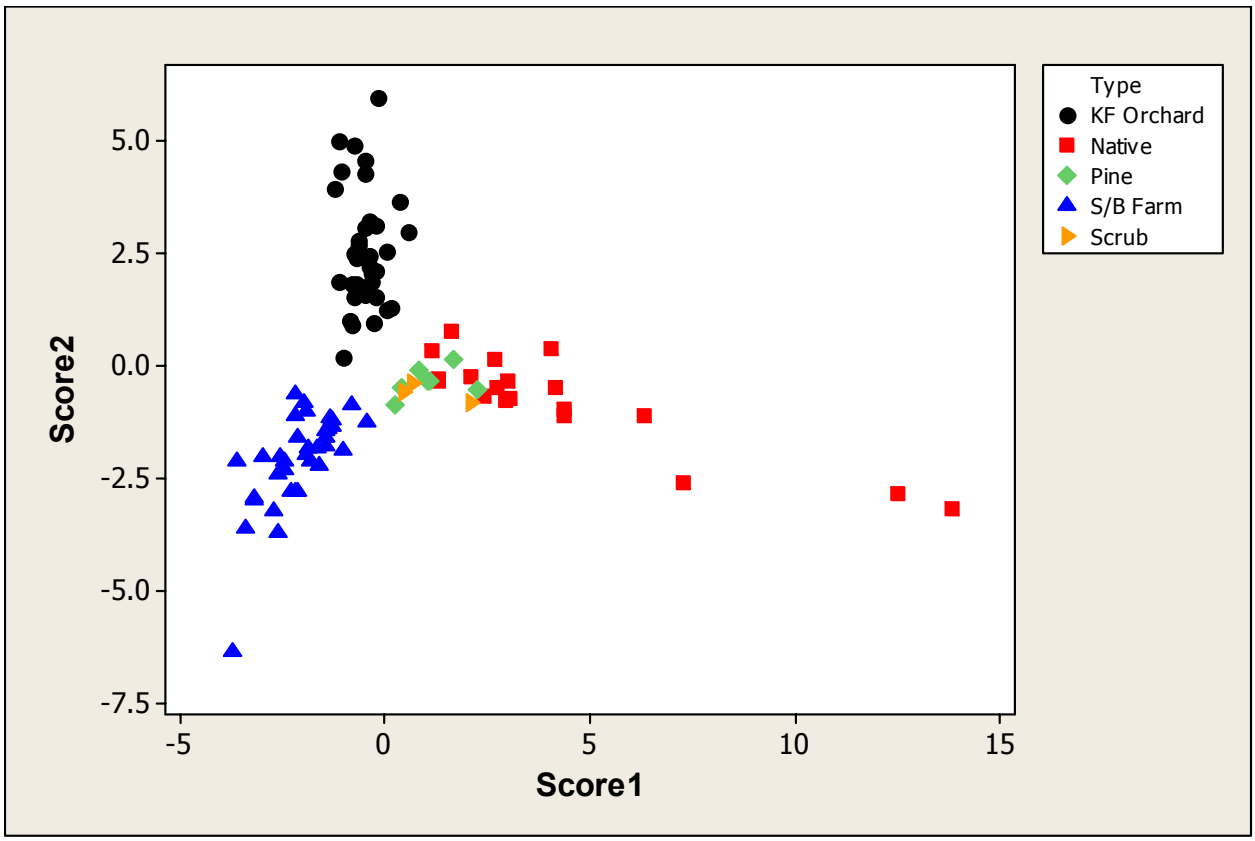


Figure 5. Score plot representing the variation in bird communities found at all survey sites. PCA axis Score1 separates the two production landscapes from the three other habitat types (native forest, pine forest and scrub), while PCA axis Score2 separates kiwifruit orchards from sheep/beef farms.

A loading plot (Figure 6) of avifaunal community composition was produced in for the PCA to illustrate which species were most important in driving the analysis. The direction of the lines in Figure 6 indicates which axis (or component) each species is most closely associated with. For example, abundance of grey warblers and tomtits are strongly positively associated with Axis 1, and greenfinches are negatively associated with PC1, while blackbirds are strongly positively associated with PC2. The length of the line indicates how quickly abundance of each species changes along the axis. Thus, grey warbler abundance changes gradually along PC1, from low numbers on farmland (on the left of the graph), to higher numbers to the far right of the graph. In comparison, South Island pied oystercatchers change rapidly in abundance, from very few (or none) on kiwifruit orchards and the natural habitats, to relatively high numbers on the sheep/beef farms. Species such as robin and parakeet are associated with bush sites, while introduced species such as skylark, yellowhammer and greenfinch are strongly associated with farmland. Some native species such as the paradise shelduck and southern black backed gull are found to be strongly associated with sheep beef farms, while pūkeko were strongly associated with kiwifruit orchards in the study. The analysis also found strong species associations with the different production systems, with skylark, spur winged plover, magpie and redpoll associated with sheep/beef farms and song thrush and blackbird associated with kiwifruit orchards.

3.2 Variation in bird counts amongst farms and orchards

3.2.1 Univariate differences between farming systems: sheep/beef farms

There was no evidence that log total bird count varied between sheep/beef farming systems ($F_{2,33} = 1.55$, $p > 0.05$; $r^2 = 8.59$ %: Figure 7). Similarly, there were no significant differences between farming systems for log species richness ($F_{2,33} = 0.67$, $p > 0.05$; $r^2 = 3.90$ %: Figure 8) or for the log transformed proportion of native species present ($F_{2,33} = 0.47$, $p > 0.05$; $r^2 = 2.74$ %: Figure 9).

3.2.2 Univariate differences between farming systems: kiwifruit orchards

Log total bird count was higher on organic orchards than on either Green or Gold orchards, and this difference approached significance ($F_{2,33} = 2.72$, $p = 0.08$; $r^2 = 14.14$ %, Figure 10). Log species richness was significantly higher on organic than on both Green and Gold orchards ($F_{2,33} = 4.18$, $p = 0.02$; $r^2 = 20.22$ %, Figure 11). There is no evidence that log species richness differed between Green and Gold orchards.

The transformed proportion of species that were native was not significantly different between the three farming systems types ($F_{2,33} = 2.18$, $p > 0.05$; $r^2 = 11.65$ %, Figure 12).

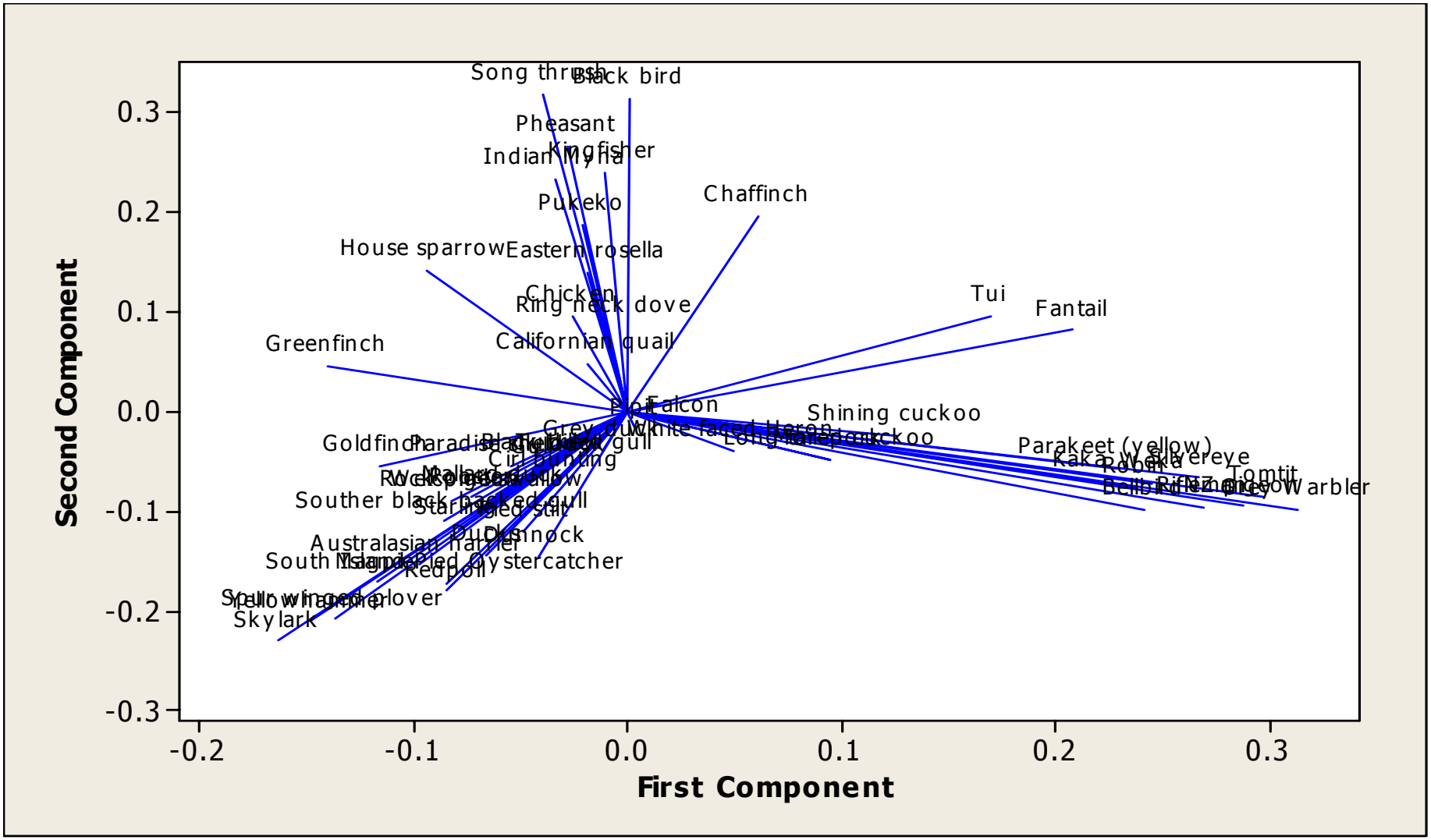


Figure 6. Loading plot of avifauna found in production and indigenous landscapes used in the current study. This plot can be used in relation to Figure 5 to show habitat and species association. The direction of the line shows which axis (component) the species is most strongly associated with, while the length of the line illustrates how rapidly abundance of the species changes between different sites.

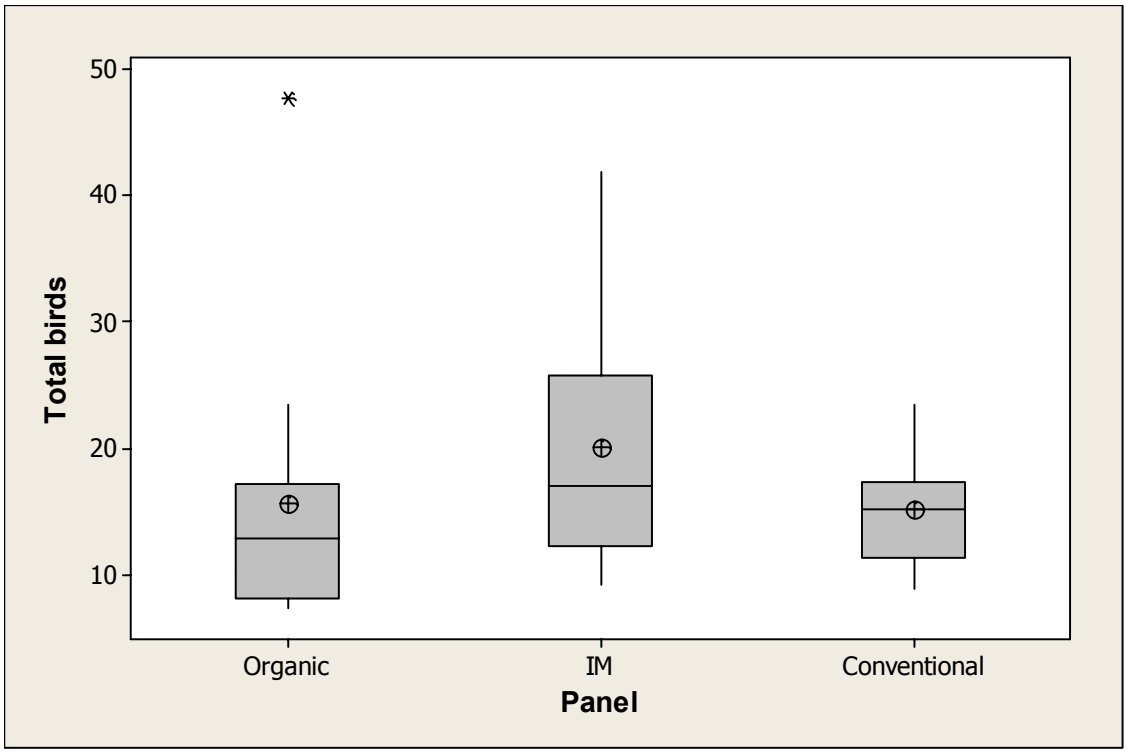


Figure 7. Box plot of total bird count of birds recorded on each sheep/beef farm operating under an organic, integrated management (IM) or conventional farming systems. For a full explanation of the graph, see Figure 2. The outlier in the organic panel was in cluster 2 (47.69 birds/5 mins).

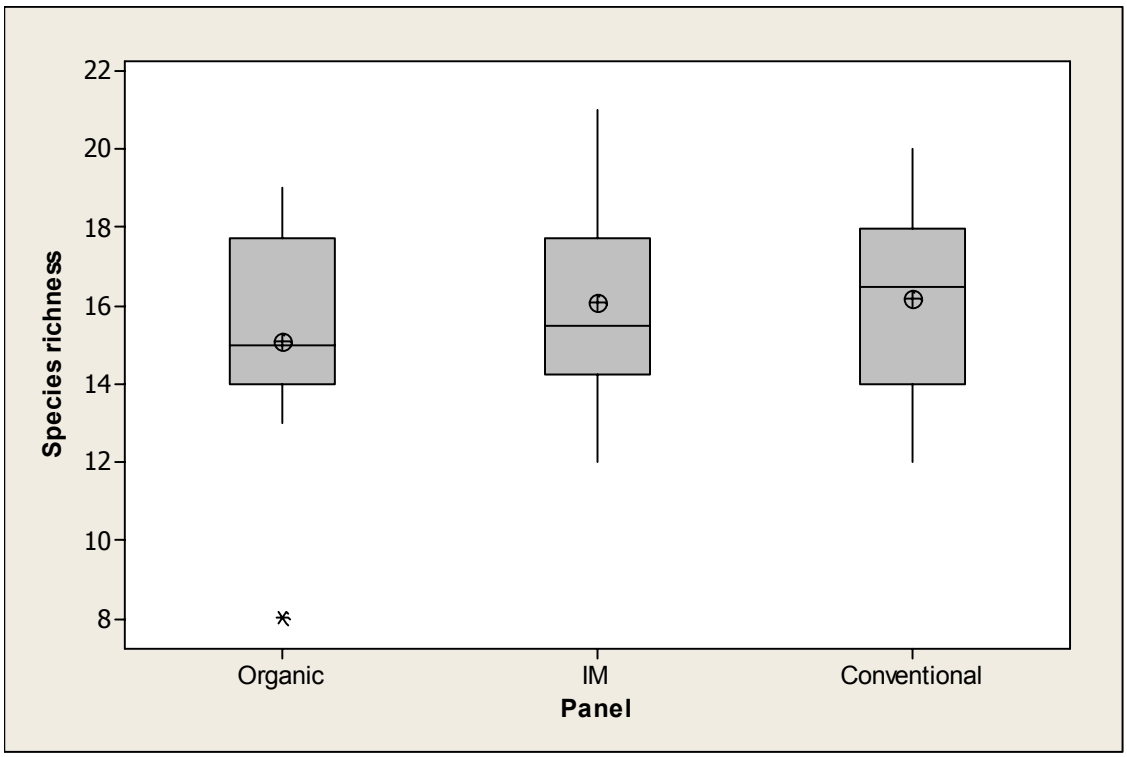


Figure 8. Box plot of species richness of birds recorded on each sheep/beef farm operating under an organic, integrated management (IM) or conventional farming systems. For a full explanation of the graph, see Figure 2. The outlier in the organic panel was in cluster 1 (2.20 species/5 mins).

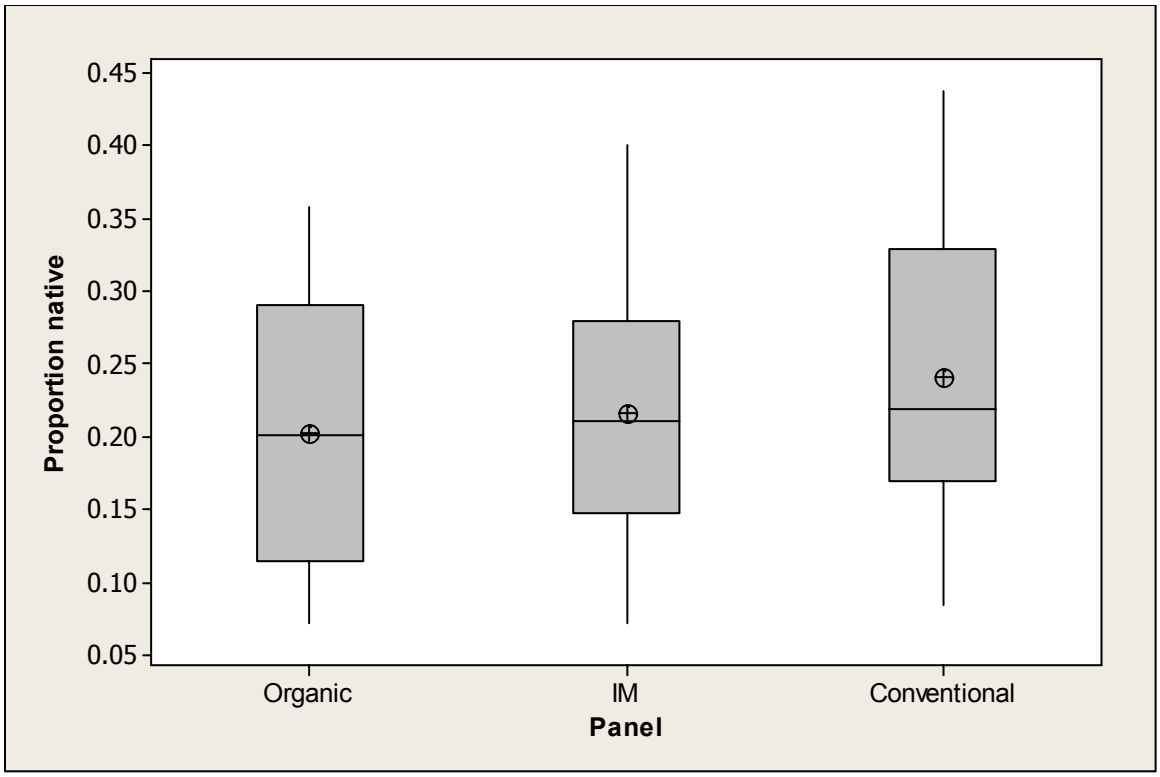


Figure 9. Box plot of the proportion of birds recorded that were native species on each sheep/beef farm operating under an organic, integrated management (IM) or conventional farming systems. For a full explanation of the graph, see Figure 2.

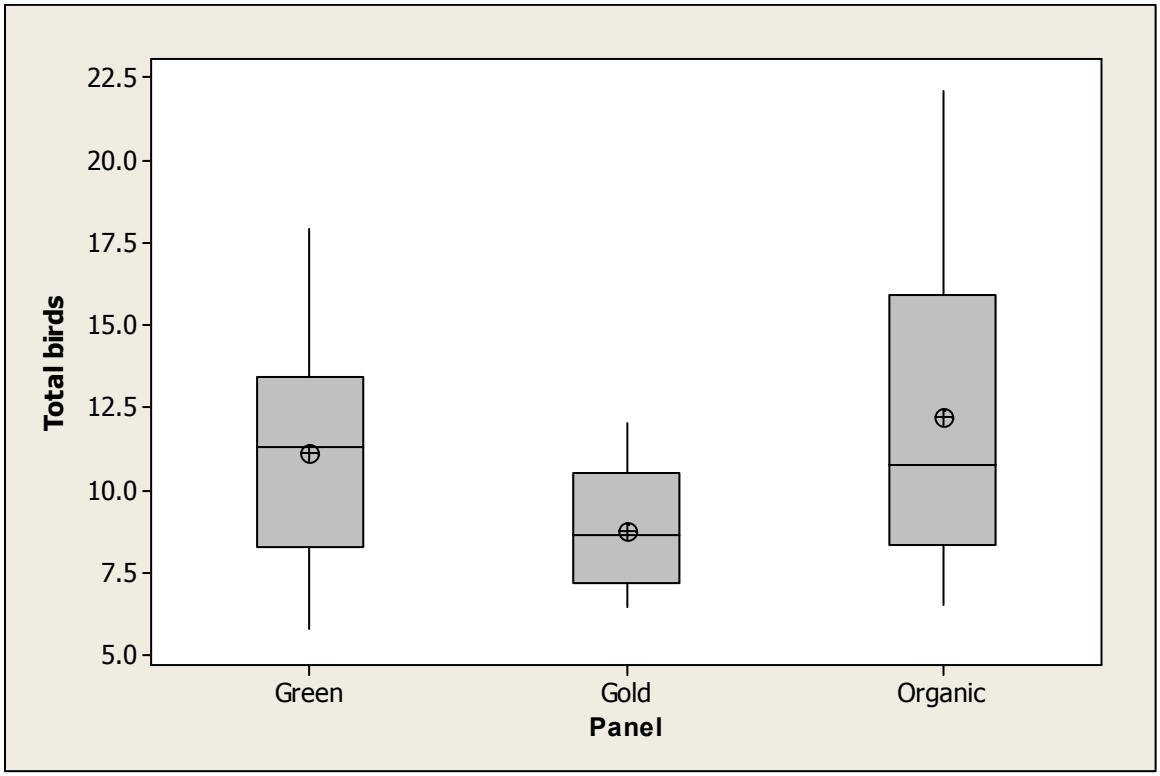


Figure 10. Box plot of total bird count of birds recorded on each kiwifruit orchard operating under different farming systems. For a full explanation of the graph, see Figure 2.

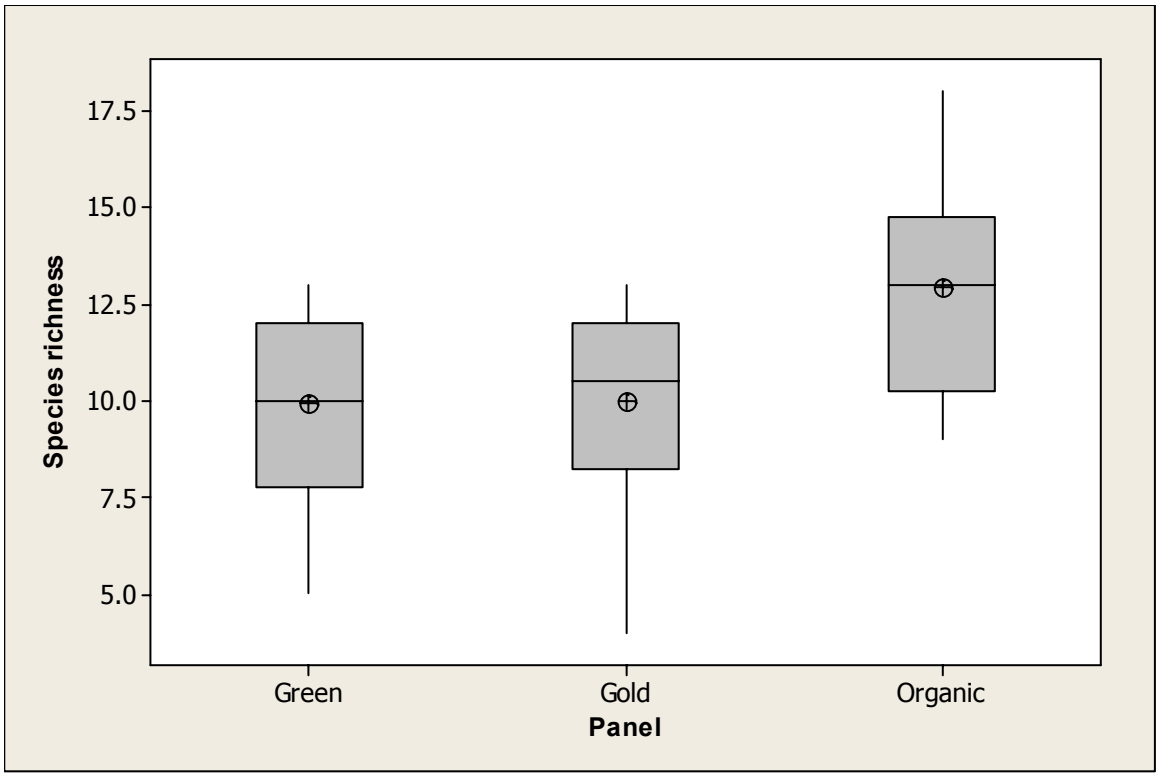


Figure 11. Box plot of species richness of birds recorded on each kiwifruit orchard operating under different farming systems. For a full explanation of the graph, see Figure 2.

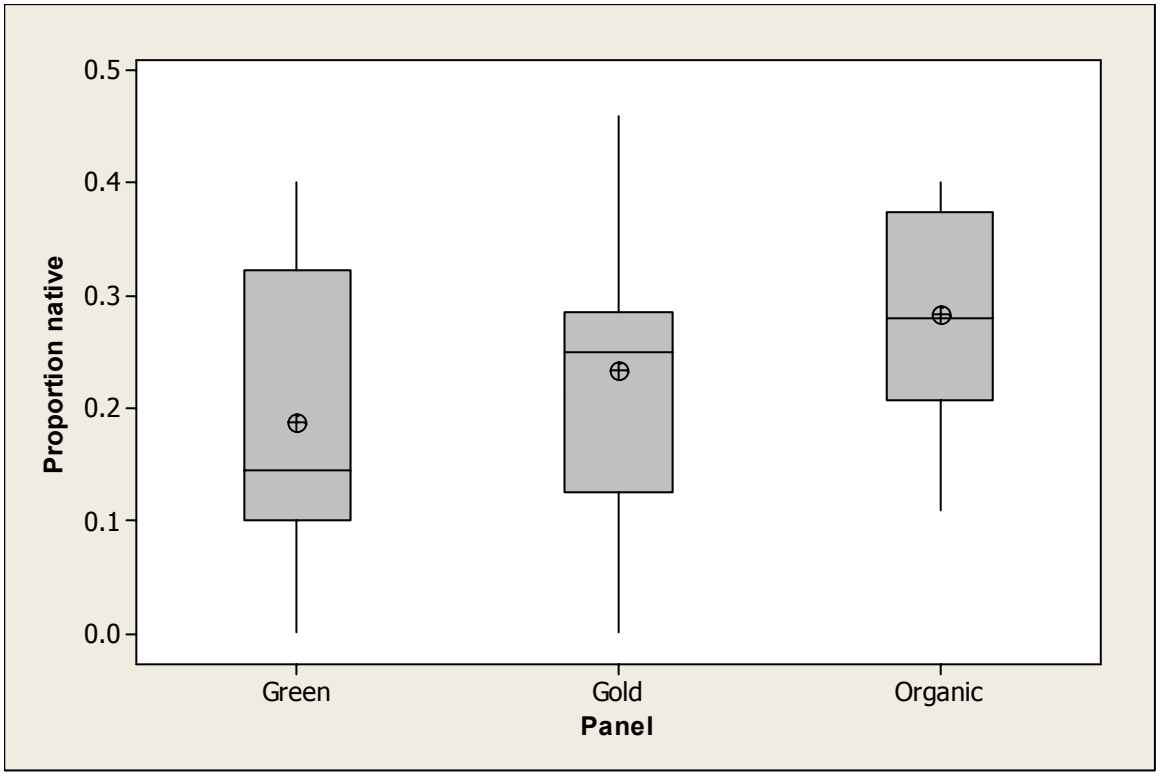


Figure 12. Box plot of the proportion of birds recorded that were native species on each kiwifruit orchard operating under dfferent farming systems. For a full explanation of the graph, see Figure 2.

3.2.3 Multivariate differences between farming systems: sheep/beef farms

A Principal Component Analysis compared bird communities between the different farming systems within the twelve clusters of sheep/beef farms. Table 2 shows the eigenanalysis of the first seven principal components for the correlation matrix for farms. As with the overall PCA for all habitat types, the analysis shows that bird distributions within the sheep/beef farms were not being strongly driven by any clearly identified single factors, although the analysis did explain slightly more of the variation in the data (Compare Tables 1 and 2).

Table 2. Eigenanalysis of the principal components analysis using a correlation matrix to compare the bird communities found in sheep/beef farms. The table only shows the values for the first seven principal components.

	1	2	3	4	5	6	7
Eigenvalue	5.20	3.89	3.63	2.93	2.71	2.52	2.17
Proportion	0.13	0.10	0.09	0.07	0.07	0.06	0.05
Cumulative	0.13	0.23	0.30	0.37	0.44	0.50	0.55

The score plot (Figure 13) shows the distribution of farms within the twelve clusters surveyed based on their bird communities. PC1 scores differed significatly between clusters ($F_{11,24}$ = 6.03, $p < 0.001$; r^2 = 73.44 %). Cluster 9 (Owaka) was significantly different to all other clusters with the exception of cluster 3 (Banks Peninsula), and cluster 3 was significantly different to cluster 7 (Fairlie). There were no other significant pair-wise differences between clusters in PC1 scores.

PC2 also differed significantly between clusters ($F_{11,24}$ = 3.44, $p < 0.01$; r^2 = 61.19 %).Therewere significant differences between cluster 2 (Amberley) and clusters 7 (Fairlie), 8 (Outram) and 10 (Gore). No other pair-wise comparisons between clusters were significant.

These comparisons suggest that two general groups of farms are distinguished when considering bird counts: 1) Banks Peninsula and Owaka; and 2) Outram, Gore and Waimate, and all the Canterbury Plain farms. Nevertheless there was sometimes wide variation in the bird counts between farms within the same cluster (e.g. cluster 7). The score plot suggests no consistent orientation of differences in bird counts between organic, IM and conventional sheep/beef farms within each cluster. There were no overall significant differences between farming systems for either PC1 ($F_{2,33}$ = 0.19, p = 0.83; r^2 = 1.16 %) or PC2 ($F_{2,33}$ = 0.88, p = 0.43; r^2 = 5.06 %).

A loading plot (Figure 14) suggests the following groups of species:

1. Generalist species that appear in most farms: Magpies, southern black backed gulls, mallards, and yellowhammers.
2. Species that are strongly and negatively associated with PC1, including: tomtits, bellbirds, grey warblers, blackbirds, song thrushes, and redpolls.
3. Skyarks: strongly and positively associated with PC1.
4. Species that are strongly and positively associated with PC2: South Island Pied Oystercatchers, pied stilts, white faced herons, ducks and dunnocks.
5. Species strongly and negatively associated with PC2: goldfinches, house sparrows, and to a lesser extent paradise ducks and greenfinches.

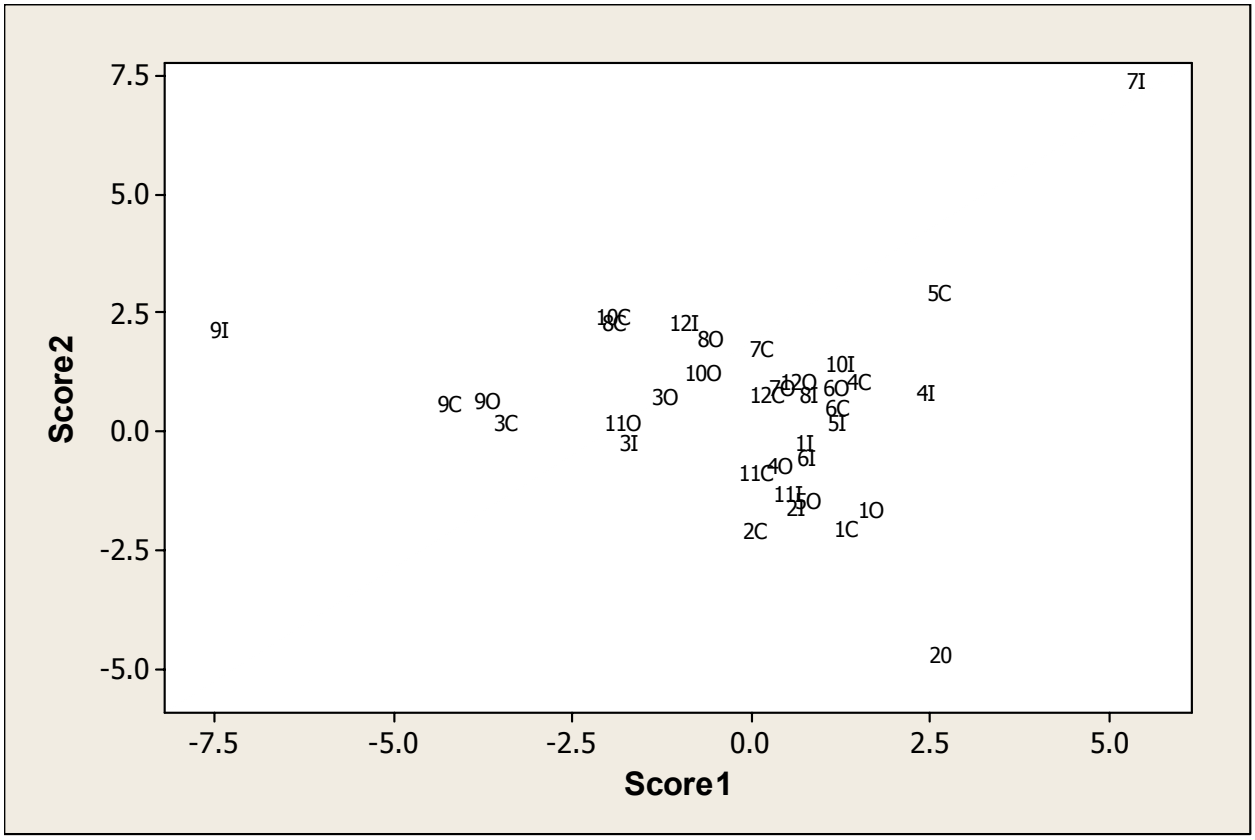


Figure 13. Score plot for the PCA analysis showing the distribution of farm clusters based on the overall bird communities found at each site. Numbers represent the 12 clusters: 1 = Blenheim, 2 = Amberley, 3 = Banks Peninsula, 4 = Leeston, 5 = Methven, 6 = Ashburton, 7 = Fairlie, 8 = Outram, 9 = Owaka, 10 = Gore, 11 = Oamaru, 12 = Waimate. The letters after each number represent the three farming systems: O = organic, I = integrated management, and C = conventional.

3.2.4 Multivariate differences between farming systems: kiwifruit orchards

A principal component analysis comparing bird counts between the different farming systems types within the twelve kiwifruit clusters explained relatively little of the variation (Table 3).

Score plots reveal little evidence of grouping of orchards within cluster (Fig 15) or for farming systems. There were no significant differences in bird communities between clusters or farming systems system based on either PCA axis 1 or 2 scores.

Table 3. Eigenanalysis of the principal components analysis using a correlation matrix to compare the bird communities found in kiwifruit orchards used in the current study. The table only shows the values for the first seven principal components.

	1	2	3	4	5	6	7
Eigenvalue	3.28	3.16	2.86	2.55	2.32	1.92	1.78
Proportion	0.11	0.10	0.09	0.08	0.08	0.06	0.06
Cumulative	0.11	0.21	0.30	0.38	0.46	0.52	0.58

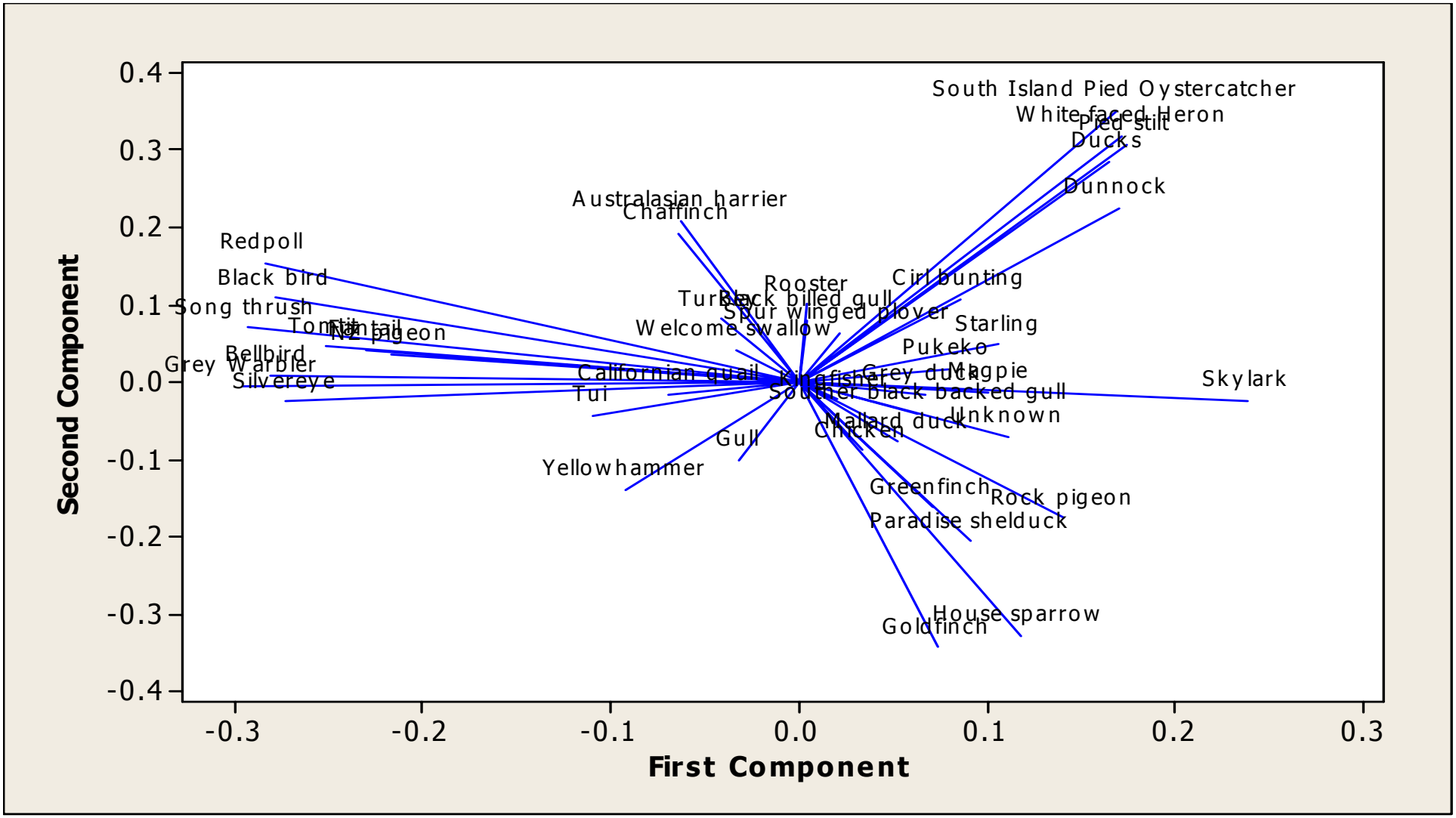


Figure 14. Loading plot of avifauna found in relation to farm clusters and farming systems type derived from a Principal Components Analysis using a correlation matrix.

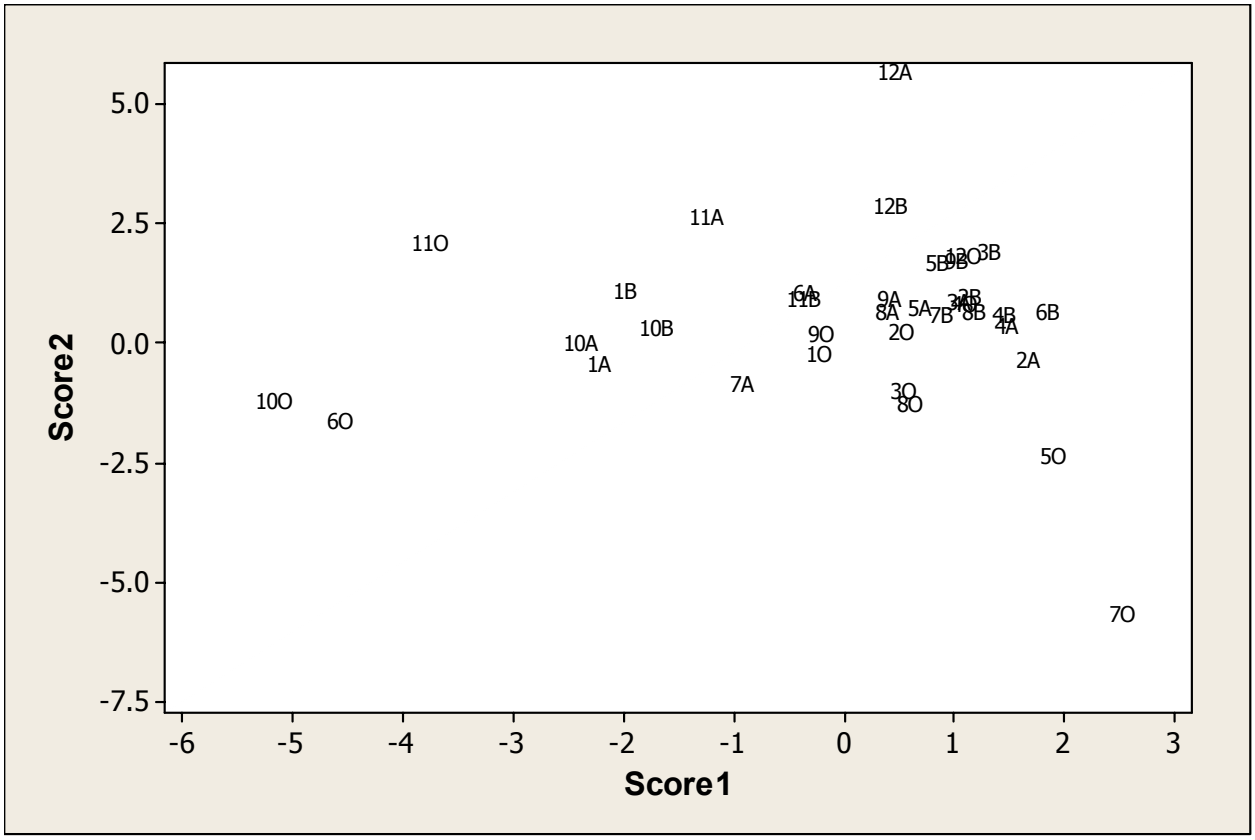


Figure 15. Score plot for the PCA analysis showing the distribution of orchard clusters based on the overall bird communities found at each site. Numbers represent the 12 clusters: 1 = Kerikeri, 2-11 = Bay of Plenty, 12 = Motueka, while letters represent the three farming systems: O = organic, A = KiwiGreen™ Hayward (Green), and B = KiwiGreen™ Hort 16A (Gold).

A loading plot (Figure 16) was produced showing the avifaunal community composition in relation to each cluster and farming systems. There were no strong consistent trends in the data, although there is a suggestion that native species are more strongly associated with the Bay of Plenty orchards (clusters 2-11) than with either the Kerikeri or Motueka clusters.

The loading plot (Figure 16) suggests three main groups of species on the kiwifruit orchards:

1. Generalist species found across most orchards: magpies, chaffinches, song thrushes and blackbirds.
2. Species strongly and negatively associated with PC1: house sparrows, silvereyes, fantails, greenfinches, Indian mynas, eastern rosellas and Australasian harriers.
3. Species strongly and positively associated with PC2: skylarks, goldfinches, dunnocks and starlings.
4. Species strongly and negatively associated with PC2: pūkekos, kingfishers and kererū (New Zealand pigeons).

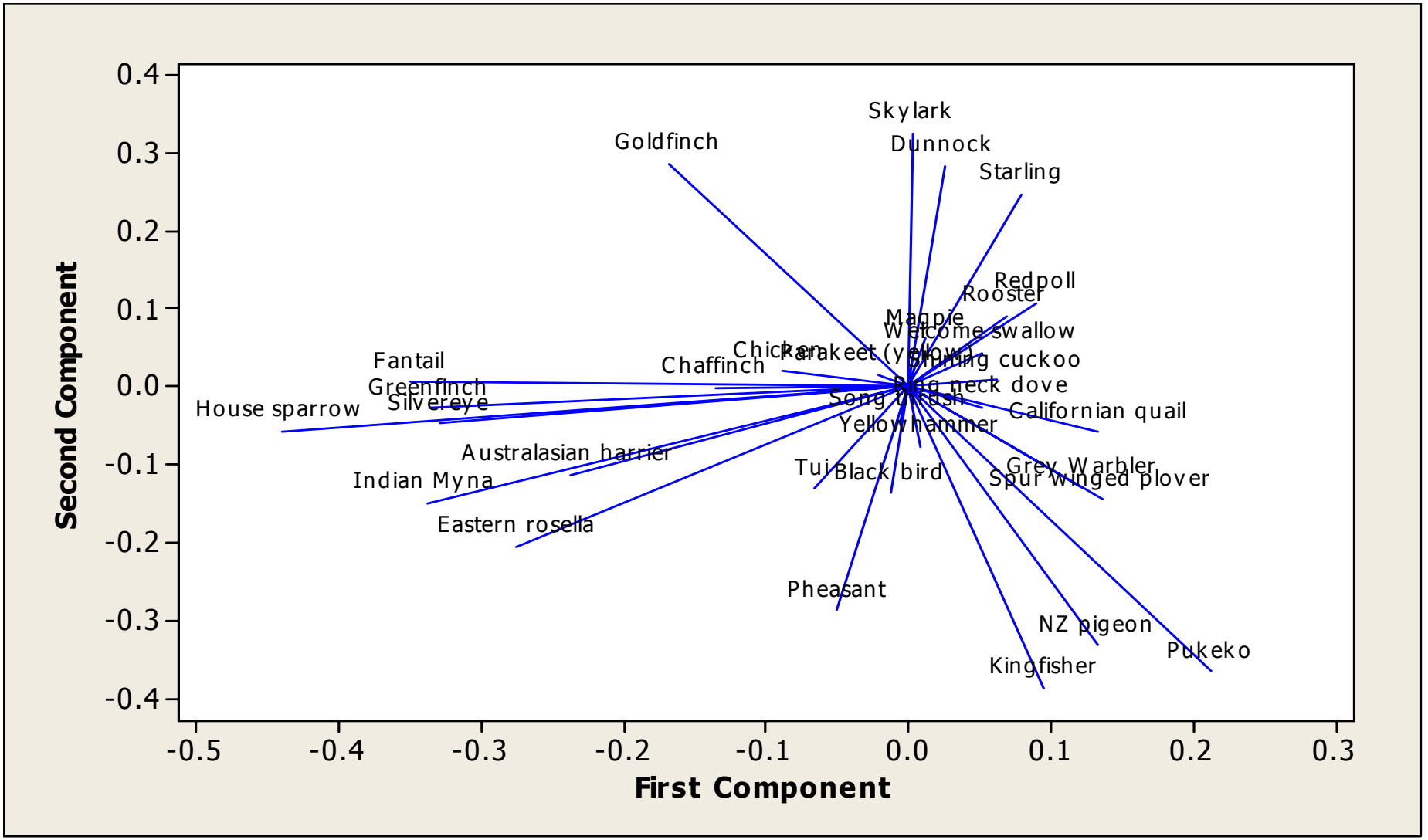


Figure 16. Loading plot of avifauna found in relation to farm clusters and farming systems type derived from a Principal Components Analysis using a correlation matrix.

4 Discussion and Conclusions

4.1 Factors affecting utility of bird counts for monitoring

Five-minute bird counts using the Dawson & Bull (1975) method can produce good baseline ecological data about the 'relative abundance' of different species, but it is important to note that they do not give an accurate count of all the birds present. Factors that can introduce variability into the results include: birds sing or call more frequently at some times of the day than at others (Thompson *et al.*, 1998); some birds are more conspicuous in the breeding season than at other times of the year (Freeman, 1999); habitats that are structurally complex such as forests have a greater effect on sound transmission than less complex, more open habitats (Thompson *et al.*, 1998); tall or dense woody vegetation obscures the birds from the observer; some birds tend to move towards or away from people while others may remain undetected (Dawson & Bull, 1975); birds can be affected by the weather or temperature, and detectability can by affected by background noise such as cicadas and vehicles (Dawson & Bull, 1975). Inter-observer differences can also affect detectability, as each person can differ in their ability to see, hear and identify birds and in their judgment of the number of birds present, with abilities changing with time (Dawson & Bull, 1975). Some of these factors weaken the value of the bird counts as relative indices of bird abundance by increasing variance and therefore decreasing precision. More serious limitations in the technique come from systematic variation in conspicuousness associated with the strata being compared. For example, if the birds are more easily seen in sheep/beef farms than in kiwifruit orchards, the higher bird counts recorded on farms (Figure 2) may not reflect the relative abundance in the two habitats.

We found significant differences in the ratio of birds seen to those heard between farming sectors, and also between clusters of the sheep/beef farms. The seen/heard ratio can be taken to broadly reflect habitat complexity, and the density of woody vegetation in particular. Consequently, orchards, where high sheterbelts and the kiwifruit vines themselves obscure vision, had lower average seen/heard ratios than sheep/beef farms. Also sheep/beef clusters with relatively large amounts of woody vegetation, such as Banks Peninsula, had ratios lower than the other sheep/beef clusters and similar to those found on kiwifruit orchards. It may be that the observers succeeded in hearing all the birds present that they otherwise would have seen had habitats been less woody, but it is also possible that a higher proportion of the birds were missed altogether where the observer's view was more obstructed. When comparing our counts on orchards to those from the other predominantly woody habitats like pine and native forest, there is probably only a minor effect of habitat structure on detectability. However, we cannot rule out the possibility that relatively high detectability in the sheep/beef farms inflated five-minute counts there relative to the other habitat types. It is also concerning that relatively strong and statistically significant differences in seen/heard ratios were detected between organic and IM sheep/beef farms. This weakens the use of the technique for testing the farming systems null hypothesis, an early emphasis of the ARGOS study (Moller *et al*., 2005).

Potential differences in habitat diversity and complexity between the different farming systems in the sheep/beef farms, and their putative impact on bird counts must be examined further if ARGOS is to rely on five-minute bird counts for long-term monitoring. Repeated bird counts on the same farms may allow robust detection of trends even if the counts can not adequately compare abundance between very different habitat types or farming systems. However, restoration of biodiversity in farming landscapes is probably dependent on creation of more varied and structured woody vegetation in the ecosystem (Moller *et al*., 2005). If farmers choose to add woody vegetation and if this alters the conspicuousness of the birds present, then the five-minute counts could also be affected enough to make the count method inadequate for measuring long-term trends in bird abundance.

The supreme advantage of the five-minute bird counts is their simplicity and low cost. This consideration must be offset against the above potential biases and lack of precision.

Detection of differences in abundance will be a lot more reliable if distance methods are used to actually measure changes in species detectability and thereby factor their infuence out of the comparisons between habitats or between past, present of future abundance in the same habitat or farm. Distance data were collected during the current survey, but these results can not be compared with the results from New Zealand's natural habitats where no distance sampling analyses have been published.

4.2 Comparison of birds in production and natural habitats

For the PCA analysis, species that were recorded in at least one site or habitat were recorded as zeros in all other samples where they did not occur. It is not known if all of the species represented by zeros do not occur at those sites, or if they were present but missed by the sampling. Thus the PCA analysis more accurately represents differences in the detected bird communities, rather than the total community potentially present in a site or habitat.

This study showed that lowland sheep/beef farms in eastern South Island had a significantly higher bird counts and species richness of birds than either ARGOS kiwifruit orchards or in other studies conducted in public reserve habitats. Kiwifruit orchards had similar bird counts and species richness to other public-land habitats. However, the proportion of species found on sheep/beef farms and orchards that were native birds was significantly lower than that found in the reserve sites. The majority of birds in production landscapes were introduced passerine species such as redpoll, greenfinch and goldfinch, which are well adapted to modified landscapes (MacLeod *et al.*, 2004; Newton, 2004). Often the native species that were detected on farms were only present in very small numbers and in some cases were rare, with only one individual recorded. Our baseline measures of native bird abundance emphasizes the magnitude of the challenge ahead for farmers should they decide to restore native species populations in particular. Nevertheless our results emphasized that several native species do persist in farming landscapes rather than having been completely excluded by habitat change, potential competition with the predominating introduced species or predation-mediated exclusion. Trace numbers of a variety of native species suggests that, at least in some clusters, the insipient populations are present and can therefore be restored relatively rapidly if appropriate habitat and predator management were instigated. However, it is possible that regional-level landscape ecology will prevent the reappearance of some species, even if an individual farmer succeeds in creating locally suitable conditions. Amongst the ARGOS farms, the sheep/beef farms on the very simplified and highly modified Canterbury plain are the most vulnerable to such landscape-level blocks to restoration. The participating kiwifruit orchards are all within close proximity of extensive areas of native or relatively unmodified habitats, so nearby sources of native species could populate orchards if ecological conditions there are suitable.

The relatively high bird counts on farms and orchards compared to other habitats in New Zealand emphasizes the potential of production landscapes to flush with biodiversity. If such high abundance can be achieved without predator control or intensive habitat management, there is every prospect that bird numbers can eventually reach much higher levels overall on farms than largely unmanaged native habitats. This high abundance may primarily reflect the fertile and warm conditions prevailing in lowland sites with fertile soils, but it could also reflect the high biotic potential of cosmopolitan invasive species or the creation of relatively competitor-free space in disturbed pastoral landscapes. These landscapes support abundant feral house cats, ferrets and hedgehogs, but only low numbers of rats and stoats. Of the common species in farmland, only the hedgehogs are proficient climbers. The rats and stoats are the main climbing species that severely suppress bird abundance in native habitats. We do not yet know whether the pastoral systems offer comparative predator-free space for both introduced and native species.

4.3 The importance of habitats within farming landscapes

Whatever the role of predation in determining bird community compositon, it is immediately obvious from this baseline study that the type of birds present on a farm was strongly associated with the type, extent and variety of habitat that was in the area. Sites in large public reserves that contained a lot of native bush had a higher proportion of fruit and insect feeding birds such as kaka, weka, parakeet and robins. Farm sites with remnant bush patches (Owaka and Banks Peninsula) tended to have different species associated with the native bush such as tomtit, fantail, blackbird, grey warbler and bellbird. Freeman (1999) found similar results in small remnants of native bush in Kennedy's bush, Christchurch, which supported a more diverse range of species than in large forest tracts. There is a tendency to presume that the small forest reserves on farms may support less bird life because of combined effects of fragmentation, loss of ecological connectivity and the small size of the reserve (this might prevent the population reaching a minimum viable population size). However the surrounding farm landscape may offer added ecological opportunity for birds predominantly foraging in small reserves. Some species such as the tui, bellbird and kererū, tend to forage outside forest remnants so the ecological condition of the pastoral landscapes and orchards themselves may be important. In contrast, species such as tomtit and riflemen are usually only found in bush remnants that are connected to other remnants by habitat corridors and have seldom been recorded crossing any gaps between bush plots (Freeman, 1999). Small forest fragments can be strongly affected by edge effects, may have increased predation levels, or may provide fewer suitable nest sites and food supplies (McIntyre, 1995). However the ecotone on the margin of small reserves could offer increased floristic diversity and therefore more food and the competitor and predator balances in such reserves might also promote bird diversity and abundance. The ecological performance and processes in small bush reserves within farming landscapes deserves more study (Moller *et al*., 2005).

Within the production landscapes, sheep/beef farms mainly supported open habitat species, such as skylark, spur winged plover, pied oystercatcher, magpie and redpoll. Kiwifruit orchards mainly supported introduced woodland species, such as song thrush, blackbird, and house sparrow. These broad preferences were also seen at the smaller scale within the sheep/beef farms. Farms with more open habitats, especially around the Canterbury plain regions, were also found to have more skylarks, spur winged plovers and redpolls, and native birds such as Australasian harriers, southern black backed gulls, South Island pied oystercatchers (Lindsey & Morris, 2002). In comparison, on-farm scrub and shelterbelts were often associated with species such as yellowhammer, greenfinch, dunnock, goldfinch, chaffinch, magpie, song thrush and blackbird. These introduced species habitat associations reflect known natal-range habitat preferences (Newton, 2004; Vickery *et al.*, 2004)./ Our findings concur with those of MacLeod *et al.* (2004) who found that the majority of the introduced species were associated with open paddocks for feeding and hedgerows during the breeding season on Canterbury farms. Some native species like oystercatchers have been increasing since the 1940s (Sagar *et al*., 2000, 2002).

The PCAs presented here all explained relatively little of the overall variation in bird counts (Tables 1 – 3). This suggests that there is relatively little association amongst species abundances whatever the habitat type under consideation. This may result from several mechanisms: (i) bird community composition is presumably not driven by a few clearly defined factors, (ii) the crude nature of the five-minute bird counts has obscured real correations between the presence/absence and relative abundance of the species, (iii) several species may be ecological generalists, (iv) relatively few species are affected by competition for resources, so the abundance of other species in the community is largely irrelevant to their own abundance, and/or (v) a wide variety of habitats may be included within each study (certainly this was the case on our sheep/beef farms) so that spatial aggregation has confounded the discovery of more close linkages between species in different habitat types.

A multitude of predictors of individual species abundance can therefore be expected. The more sophisticated distance sampling data will provide the best basis for building individual species models to identify their habitat requirements and best management actions for restoring their populations.

The PCAs allowed preliminary generalization despite the low overall proportion of variance explained. When the PCA was restricted to just the sheep/beef farms, there appeared to be a broad scale association of PC1 and habitat diversity (Table 2, Figures 13-14). However there is no immediately obvious environmental factor correlating with PC2, nor any obvious associations between environmental predictors and either of the PCs for kiwifruit orchards (Table 3, Figures 15-16). We hypothesize that PC1 represents some aggregated measure of the degree of modification or proportion of native vegetation remaining for the analysis combining all habitats (Table 1, Figures 5 and 6). PC2 appears to represent some other unknown aspect of their ecology. More detailed measures of habitat characterstics within each study area would be needed to test these over-arching hypotheses and pinpoint ecological predictors of bird counts. Detailed research is needed to determine what is driving variation in bird community composition within each agricultural sector.

Although the overall bird community composition presented in this report has been well-known for decades (e.g. Williams, 1968, 1973), the PCA analysis hints at fascinating subtleties in the way introduced birds are associating within the farms and orchards. The sentinel nature of skylark and separation of the introduced passerines is highlighted in sheep/beef farms. If confirmed by PCAs on the more robust distance sampling methods, these differences will help the section of the most useful focal species for intensive monitoring and study.

Our broader habitat comparisons (Section 4.1) emphasized the value of pine forests for New Zealand birds, including native species. Most of the pine forests studied were part of extensive plantations, so we still need to check that small farm-forestry patches or even pine shelter-belts act in a similar way. Pine plantations are also excellent habitats for some native invertebrates (Perley *et al*., 2001). Planting pine trees in some marginal areas of farms or for soil protection may bring net conservation and economic gains (Moller *et al*., 2005).

Overall bird counts are lower in scrub than other habitats (Figure 2). This may reflect poor visibility for observers within closed low vegetation rather than a real difference in abundance. However the birds present in scrub are predominantly native species (Figure 4). As for pines, the areas of scrub on farms may be important biodiversity nursery areas for birds, as well as the sites of succession to create mature forest within the landscape. Attention to mapping and quantification of the extent and nature of scrub and pine habitats on ARGOS farms is scheduled.

4.4 Potential effects of different farming systems

The expansion of modern agriculture is one of the greatest threats to worldwide biodiversity due to natural habitat loss, disturbances and pollution (Mittermeier *et al.*, 1999). In Britain, the dramatic decline in farmland birds has been largely attributed to agricultural intensification through conventional style farming (Boatman *et al.*, 2004; Newton, 2004; Vickery *et al.*, 2004). More 'sustainable' farming systems such as organic and IM are now seen by many as a potential solution to this continued loss of biodiversity (Hole *et al.*, 2005).

We found no evidence of significant differences between organic, integrated and conventional sheep/beef farms in their bird species abundance, richness or the proportion of native species present. However, the relative coarseness of the five-minute bird count method and the potential confounding effects of different amounts of woody habitat between farms will have greatly reduced our power to detect any differences. Greater obstruction of bird observations in organic farms may have biased bird counts downwards on organic farms. However, the variation of seen/heard ratios between farming systems suggests that there may be differences in habitat composition and complexity between farming systems.

Specific quantification of diversity and structural composition of vegetation on the ARGOS farms is required to investigate this result. Once we can statistically control for such putative habitat differences, it may be that average abundance is different between sheep/beef farming systems.

Even if differences in bird abundance are eventually confirmed, increased bird diversity and abundance on organic compared to other farming systems can not be taken as unequivocal evidence that conversion to organics caused the difference. This would only result if the starting bird abundance and contributing habitat or predation drivers were the same on all farms before conversion. It remains possible that farmers seeking to establish organic farming choose land already with naturally diverse habitats or abundant wildlife. If so, the differences in biodiversity evident on the farms today will not reflect an effect of conversion to organic farming *per se*. ARGOS will check these alternative reasons for current differences in biodiversity by an analysis of historical photographs, oral testimony of growers and detection of trends in biodiversity monitored on ARGOS farms for the next 20 years.

In the meantime we accept the null hypothesis that organic, IM and conventional sheep/beef farms in eastern South Island support broadly the same abundance and diversity of birds. This preliminary conclusion is quite different from that of studies done on mixed pastoral and cropping farms in Britain, where organic farming practices have been undertaken for a lot longer than in New Zealand (Vickery *et al.*, 2004).

In contrast to on sheep/beef farms, we did detect significant differences in bird communities between organic and integrated kiwifruit orchards in this study. Organic orchards had greater total bird counts and a 35% increase in species richness (Figure 11). The reasons for these differences cannot be determined from the current study, but will now become the focus of follow-up research. They may relate to increased food availability on organic orchards, especially increased invertebrates and herbaceous vegetation under the vines, but there might also be generally more habitat diversity on organic and integrated orchards. This tentative early evidence suggests that the organic and integrated farming systems do indeed offer different pathways to sustainability (Fairweather & Campbell, 2003), at least in some circumstances.

The preliminary finding of more birds on organic orchards is one of other early indications of the ARGOS project that biodiversity is indeed different in different farming systems (Benge *et al*., 2004 for cicadas; Steven *et al*. 2004 for spiders; Pearson *et al*., 2005 for earthworms; Sarah Richards pers. comm. for nematodes; David Steven pers. comm. for foliar invertebrates).

We stress that we do not yet know if the lack of such differences in birds on sheep/beef farms reflects the bluntness of our methodology, confounding effects of habitats or a genuine lack of differences in birds between organic, integrated and conventional sheep/beef farms. However, the latter interpretation is consistent with an ARGOS meta-hypothesis that the differences between farming systems will be smaller for agricultural sectors that are less intensified (Moller *et al*., Submitted).

4.5 Conclusions and recommendations

We were not able to compare the bird communities found on ARGOS farms with all other habitats in New Zealand. The most glaring omissions were offshore islands used for conservation purposes, and urban areas. However the comparable data reviewed and analysed here suggests that bird abundance and species richness is comparable and in some instances higher that in native habitats in reserves. This signals the tremendous potential for bird conservation in the production habitats. However, at present the majority of birds on lowland sheep/beef farms in eastern South Island and in kiwifruit orchards in the North Island and Motueka are introduced passerine species. Relatively few native species found and where present, they usually were at low abundance. More focused wildlife management and habitat restoration will be needed to restore native birds in particular.

There are bird community surveys planned for ARGOS high country sheep stations and North Island dairy farms in summer 2005/06. A more complete analysis along the lines of that presented here will then be possible to allow the best possible choice of focal species for ongoing monitoring. Ideally we would select some species occurring in all sectors so that a stronger meta-analysis is possible. Prudent choice of focal species will help plan conservation effort, test links between farm management and bird communities, and explore ways that intensive conservation efforts on public lands and actions by landholders in private farmland can best complement one another.

Our tentative identification of changes in conspicuousness of birds between habitats, between clusters and even between farming systems underscores the limitations of the five-minute bird counting technique. We recommend that the relative accuracy and precision of five-minute counts and distance-based sampling are compared to test these warning signs. In the meantime the safer option is to use distance sampling or other techniques that explicitly account for differences in conspicuousness and detectability between species and habitats. Unfortunately it will then be several decades before comparable estimates of bird community composition and abundance will be available from all New Zealand habitats using the more robust distance sampling techniques.

This study provides no evidence that different sheep/beef farming practices (organic, Integrated Management and conventional) have any demonstrable effects on avian community composition. However, the short time since conversion to organic or integrated farming systems on the study farms, and evidence from the United Kingdom that organic pastoral farms have more diverse and abundant avian communities, suggest the impacts of farming system strategies on native New Zealand birds should be studied further. Differences in bird counts were found between organic and IM kiwifruit orchards, but in view of the courseness of the five-minute bird count technique, these must first be cross-checked by distance estimates before a real difference in bird communities is confirmed.

The results of this study suggest that the restoration of native bird species on farmland will require both an increase in the area and quality of native vegetation on farms and the adoption of suitable farming practices. The planting of native vegetation in ungrazed areas of farmlands provides environmental benefits through erosion control, soil and bank stabilization, and nutrient filtering. It can also encourage many more native species to use and eventually breed on the farm. Planting native vegetation instead of exotics as shelterbelts, with species such as flax, can provide new habitats for a lot of different native birds. Protection of mature scrub and the successional processes at work within it, will eventually create secondary forest. It will also bring an immediate gain in diversity and abundance of some native birds. However our analysis of bird abundance also emphasizes that pine forests and agri-forestry in general also provide potential gains in diversity and abundance of birds.

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6 Appendices

6.1 Appendix 1: List of common and scientific names of birds

Common name	Scientific name
Native species:	
Australasian harrier	*Circus approximans*
Bellbird	*Anthornis melanura*
Black billed gull	*Larus bulleri*
Brown creeper	*Finschia novaeseelandiae*
Falcon	*Falco novaeseelandiae*
Fantail	*Rhipidura fuliginosa*
Grey Warbler	*Gerygone igata*
Grey duck	*Anas superciliosa*
Kaka	*Nestor meridionalis*
Kingfisher	*Halcyon sancta*
Long-tailed cuckoo	*Eudynamis taitensis*
Morepork	*Ninox novaeseelandiae*
NZ pigeon	*Hemiphaga novaeseelandiae*
Paradise shelduck	*Tadorna variegata*
Parakeet (yellow-crowned)	*Cyanoramphus auriceps*
Pied stilt	*Himantopus leucocephalus*
Pipit	*Anthus novaseelandiae*
Pūkeko	*Porphyrio porphyrio*
Riflemen	*Acanthisitta chloris*
Robin	*Petroica australis*
Shining cuckoo	*Chalcites lucidus*
Silvereye	*Zosterops lateralis*
Southern black backed gull	*Larus dominicanus*
South Island pied oystercatcher	*Haematopus finschi*
Tomtit	*Petroica macrocephala*
Tui	*Prosthemadera novaeseelandiae*
Weka	*Gallirallus australis*
Welcome swallow	*Hirundo neoxena*
White faced heron	*Ardea novaehollandiae*
Introduced Species:	
Blackbird	*Turdus merula*
Californian quail	*Lophortyx californica*
Chaffinch	*Fringilla coelebs*
Cirl bunting	*Emberiza cirlus cirlus*
Dunnock	*Prunella modularis*
Greenfinch	*Carduelis chloris*
Goldfinch	*Carduelis carduelis*
House sparrow	*Passer domesticus*
White backed magpie	*Gymnorhina tibicen*
Mallard duck	*Anas platyrhynchos*
Redpoll	*Acanthis flammea*
Rock Pigeon	*Columba livia*
Skylark	*Alauda arvensis*
Spur winged plover	*Vanellus miles*
Song thrush	*Turdus philomelos*
Starling	*Sturnus vugaris*
Turkey	*Meleagris galloparo*
Yellowhammer	*Emberiza citrinella*

6.2 Appendix 2: Mean five-minute counts for each site

Mean counts (number of birds per five-minute count averaged) recorded on different sheep/beef farms and kiwifruit orchards around New Zealand (see Fig. 1) and comparative mean annual counts on public land. GO = Hayward Hort 16A (Gold), GR = Hayward KiwiGreen, O = organic, A = organic, B = Integrated, 3 = conventional sheep/beef.

Code Type	1GO KF Orchard	1GR KF Orchard	1O KF Orchard	1T KF Orchard	2GO KF Orchard	2GR KF Orchard	2O KF Orchard	3GO KF Orchard
Australasian harrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bellbird	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.50	1.00	0.09	0.00	0.00	0.00	0.33	0.00
Grey Warbler	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.67	0.18	0.17	0.00	0.27	0.83	0.00
Long tailed cuckoo	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paradise shelduck	0.00	0.00	0.27	0.17	0.00	0.00	0.00	0.00
Parakeet (yellow)	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.09	0.00	0.00	0.09	0.00	0.13
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shining cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silvereye	0.50	0.67	0.00	0.00	0.00	0.00	0.17	0.25
Southern black backed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomtit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tui	1.75	2.00	1.05	0.00	0.00	0.00	0.00	0.00
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black bird	0.25	2.33	0.55	0.50	1.89	1.73	1.17	3.88
Californian quail	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00
Chaffinch	0.25	0.00	0.09	0.00	1.00	1.27	1.17	1.13
Chicken	0.50	0.33	0.09	0.00	0.00	0.09	0.17	0.00
Ducks	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00
Dunnock	0.00	0.00	0.00	0.00	0.33	0.45	0.00	0.00
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	1.25	1.67	0.82	1.00	0.78	0.45	0.17	0.00
Goldfinch	1.00	0.33	0.82	0.67	0.33	0.18	0.50	0.25
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	2.75	1.33	1.18	1.67	0.33	0.36	1.00	0.25
Indian Myna	0.00	0.00	0.00	0.33	0.11	0.09	0.00	0.13
Magpie	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63
Mallard duck	0.00	0.00	0.68	0.42	0.33	0.23	0.00	0.00
Pheasant	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.25
Redpoll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Ring neck dove	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooster	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skylark	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spur winged plover	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00
Song thrush	0.25	2.00	0.27	0.17	1.89	1.45	1.50	3.50
Starling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	0.00	0.00	0.36	0.33	0.67	0.36	0.00	0.00
Unknown	0.75	0.00	0.73	0.17	0.22	0.18	0.50	0.00

Code Type	3GR KF Orchard	3O KF Orchard	4GO KF Orchard	4GR KF Orchard	4O KF Orchard	5GO KF Orchard	5GR KF Orchard	5O KF Orchard
Australasian harrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bellbird	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.00	0.13	0.00	0.00	0.10	0.00	0.00	0.30
Grey Warbler	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.00	0.00	0.17	0.00	0.00	0.14	0.44
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.24
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paradise shelduck	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.25	0.17	0.17	0.00	0.00	0.00	0.30
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shining cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silvereye	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Southern black backed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomtit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tui	0.00	0.00	0.17	0.17	0.00	0.00	0.00	0.20
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black bird	1.75	1.50	1.83	2.17	0.80	1.45	1.14	1.90
Californian quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Chaffinch	0.25	0.13	1.33	0.67	0.10	0.82	0.57	0.60
Chicken	0.00	0.13	0.00	0.00	0.00	0.00	0.43	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunnock	0.25	0.88	0.33	0.00	0.30	0.09	0.29	0.00
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Greenfinch	0.00	0.00	0.00	0.00	0.00	0.45	0.43	0.70
Goldfinch	0.25	0.00	0.00	0.5	0.10	0.09	0.14	0.10
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	0.25	1.00	0.17	1.83	0.50	1.09	0.29	0.00
Indian Myna	0.00	0.13	0.00	0.00	0.00	0.09	0.00	0.00
Magpie	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mallard duck	1.25	0.63	0.17	0.00	0.10	0.00	0.36	0.00
Pheasant	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00
Redpoll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ring neck dove	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.38	0.00	0.00	0.30	0.00	0.29	0.00
Rooster	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00
Skylark	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00
Spur winged plover	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Song thrush	2.75	1.38	1.33	1.00	1.90	1.00	0.43	1.10
Starling	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	2.25	3.50	0.50	0.67	1.00	0.18	0.29	0.30
Unknown	0.00	0.25	0.50	0.00	0.60	0.00	0.14	0.40

Code Type	6GO KF Orchard	6GR KF Orchard	6O KF Orchard	7GO KF Orchard	7GR KF Orchard	7O KF Orchard	8GO KF Orchard
Australasian harrier	0.00	0.00	0.13	0.00	0.00	0.00	0.00
Bellbird	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.00	0.22	0.63	0.50	0.17	0.11	0.07
Grey Warbler	0.00	0.11	0.00	0.00	0.00	0.00	0.27
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.11	0.25	0.17	0.17	0.89	0.33
Long tailed cuckoo	0.50	0.00	0.13	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Paradise shelduck	0.00	0.00	0.00	0.00	0.17	0.33	0.00
Parakeet (yellow)	0.00	0.22	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.00	0.00	0.56	0.00
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shining cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Silvereye	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Southern black backed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomtit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tui	0.00	0.00	0.00	0.17	0.50	0.56	0.40
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.00	0.33	0.00	0.00	0.00
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black bird	0.00	3.33	3.38	5.67	3.17	1.89	0.33
Californian quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaffinch	0.00	1.33	0.25	0.67	0.50	0.67	0.53
Chicken	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunnock	1.00	0.00	0.13	0.00	0.67	0.44	0.13
Eastern rosella	0.00	0.00	0.13	0.00	0.00	0.00	0.00
Greenfinch	0.00	0.67	1.13	0.50	0.17	0.11	0.27
Goldfinch	0.00	0.00	0.00	0.00	0.00	0.00	0.47
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	0.00	2.00	3.25	0.33	1.67	0.78	0.93
Indian Myna	0.00	0.22	0.38	0.00	0.00	0.11	0.07
Magpie	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mallard duck	0.00	0.00	1.69	0.00	3.67	0.22	0.00
Pheasant	0.00	0.11	0.13	0.17	0.33	0.56	0.00
Redpoll	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.00	0.33	0.44	0.00
Rooster	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skylark	0.00	0.22	0.00	0.00	0.00	0.00	0.00
Spur winged plover	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Song thrush	0.00	2.44	2.00	2.67	1.33	0.78	1.47
Starling	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	4.50	0.00	1.25	0.00	1.00	1.11	0.80
Unknown	0.00	0.00	0.25	0.00	0.00	0.22	0.60

Code Type	8GR KF Orchard	8O KF Orchard	9GO KF Orchard	9GR KF Orchard	9O KF Orchard	10GO KF Orchard	10GR KF Orchard
Australasian harrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bellbird	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.00	0.14	0.18	0.00	0.33	0.30	0.14
Grey Warbler	0.00	0.14	0.00	0.00	0.00	0.00	0.00
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.29	0.18	0.13	0.11	0.00	0.14
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paradise shelduck	0.00	0.00	0.00	0.25	0.11	0.00	0.00
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.43	0.00	0.00	0.00	0.00	0.00
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shining cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silvereye	0.00	0.14	0.00	0.00	0.33	0.30	0.00
Southern black backed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomtit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tui	0.33	0.43	0.09	0.00	0.33	0.00	0.00
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black bird	5.33	1.86	1.73	1.88	2.67	0.60	1.57
Californian quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaffinch	1.00	0.71	1.64	0.75	0.44	0.80	2.14
Chicken	0.00	0.00	0.00	0.00	0.11	0.00	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunnock	0.00	0.43	0.00	0.88	0.22	1.10	0.00
Eastern rosella	0.00	0.00	0.00	0.63	0.00	0.00	0.00
Greenfinch	1.00	0.14	0.18	0.00	0.56	0.30	1.71
Goldfinch	0.00	0.14	1.00	0.38	0.33	0.30	0.29
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	1.00	0.57	0.73	0.50	0.33	2.10	4.71
Indian Myna	0.00	0.71	0.00	0.38	0.11	0.60	0.43
Magpie	0.00	0.00	0.00	0.00	0.00	0.00	0.29
Mallard duck	0.00	0.29	0.00	1.56	0.00	2.20	0.00
Pheasant	0.00	0.29	0.09	0.00	0.33	0.20	0.43
Redpoll	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.00	0.11	0.50	0.00
Rooster	0.00	0.00	0.18	0.00	0.00	0.00	0.00
Skylark	0.00	0.00	0.00	0.00	0.11	0.00	0.00
Spur winged plover	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Song thrush	4.67	2.43	0.91	1.13	1.78	1.30	2.29
Starling	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	0.00	0.71	0.00	0.50	1.00	0.90	0.00
Unknown	0.33	0.14	0.18	0.00	0.22	0.10	0.14

Code	10O	11GO	11GR	11O	12GO	12GR	12O

Type	KF Orchard	KF Orchard	KF Orchard	KF Orchard	KF Orchard	KF Orchard	KF Orchard
Australasian harrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bellbird	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.25	0.60	0.33	0.20	0.00	0.13	0.00
Grey Warbler	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.13	0.00	0.00	2.00	0.00	0.00	0.00
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paradise shelduck	0.13	0.00	0.00	0.00	0.00	0.00	0.00
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shining cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silvereye	0.00	0.00	0.00	0.40	0.20	0.00	0.00
Southern black backed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomtit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tui	0.63	0.00	0.00	0.00	0.80	0.00	0.17
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.00	0.00	0.10	0.00	0.00
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black bird	1.13	0.80	1.67	1.20	1.80	0.00	1.83
Californian quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaffinch	0.88	2.00	1.00	1.00	0.40	0.00	0.17
Chicken	0.00	0.00	0.00	0.20	0.00	0.00	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunnock	0.50	0.00	0.00	3.00	0.10	0.13	0.33
Eastern rosella	0.13	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	1.00	0.20	1.00	0.80	0.20	0.50	0.67
Goldfinch	0.13	1.00	1.83	1.40	0.80	0.50	0.17
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	2.13	2.60	1.83	1.20	1.50	1.88	0.33
Indian Myna	0.38	0.00	0.92	1.80	0.15	1.06	0.58
Magpie	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mallard duck	7.94	0.00	0.00	1.30	0.25	1.06	0.00
Pheasant	0.25	0.60	0.17	0.00	0.00	0.00	0.00
Redpoll	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.13	0.00	0.00	0.00	0.00	0.00	0.00
Rooster	0.00	0.00	0.00	0.00	0.00	0.00	0.17
Skylark	0.00	0.00	0.33	0.00	0.40	0.38	0.00
Spur winged plover	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Song thrush	0.88	0.60	1.33	0.80	0.90	0.63	2.67
Starling	0.00	0.00	0.00	0.00	0.10	0.25	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	1.13	0.00	0.00	4.00	0.30	0.38	1.50
Unknown	0.25	0.20	0.17	0.20	0.10	0.50	1.17

Code Type	1A S/B Farm	1B S/B Farm	1C S/B Farm	2A S/B Farm	2B S/B Farm	2C S/B Farm	3A S/B Farm
Australasian harrier	0.00	0.13	0.00	0.00	0.00	0.00	0.00
Bellbird	0.00	0.00	0.00	0.00	0.00	0.00	0.80
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.00	0.00	0.00	0.00	0.00	0.10	0.10
Grey Warbler	0.00	0.00	0.00	0.00	0.13	0.20	0.20
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.13	0.00	0.00	0.00	0.00	0.00
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paradise shelduck	0.00	0.00	0.00	19.88	0.00	0.00	0.00
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shining cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silvereye	0.00	0.25	0.00	0.00	0.00	0.30	0.00
Southern black backed gull	0.38	0.13	3.17	0.00	0.00	0.00	0.10
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomtit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tui	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.00	0.00	0.00	0.00	0.40
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black bird	0.00	0.44	0.00	0.13	0.13	0.10	0.00
Californian quail	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Chaffinch	0.00	0.00	0.00	0.00	0.25	0.00	0.20
Chicken	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.60
Dunnock	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	1.00	0.25	0.61	0.25	0.63	1.60	0.40
Goldfinch	0.88	1.56	2.92	3.56	2.50	2.35	0.80
Gull	0.00	0.00	0.44	0.00	0.00	0.00	0.00
House sparrow	5.69	0.88	2.22	9.81	4.16	5.45	0.20
Indian Myna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magpie	0.38	0.25	0.72	0.75	0.50	1.10	0.20
Mallard duck	0.00	0.50	0.00	4.88	0.00	0.00	0.00
Pheasant	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Redpoll	0.00	0.00	0.11	0.13	0.25	0.00	1.40
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.63	0.00	0.00	0.00
Rooster	0.00	0.13	0.00	0.00	0.00	0.00	0.00
Skylark	4.56	5.31	3.00	1.00	1.38	1.30	0.10
Spur winged plover	0.00	3.25	0.11	1.13	0.25	0.10	0.00
Song thrush	0.00	0.38	0.00	0.00	0.00	0.00	0.20
Starling	0.00	2.50	0.44	0.00	0.00	1.50	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	1.00	1.13	0.67	0.38	1.38	1.10	1.20
Unknown	0.13	0.63	0.44	5.19	0.25	1.10	0.40

Code Type	3B S/B Farm	3C S/B Farm	4A S/B Farm	4B S/B Farm	4C S/B Farm	5A S/B Farm	5B S/B Farm
Australasian harrier	0.00	0.00	0.00	0.10	0.30	0.00	0.00
Bellbird	0.91	1.88	0.00	0.00	0.00	0.00	0.00
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.00	0.13	0.13	0.00	0.00	0.00	0.00
Grey Warbler	0.18	0.75	0.00	0.00	0.10	0.00	0.00
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paradise shelduck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.20	0.00	0.00	0.00
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shining cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silvereye	0.18	0.00	0.00	0.00	0.00	0.00	0.00
Southern black backed gull	0.00	0.00	1.13	0.30	1.10	0.22	0.25
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.70	0.00	0.00
Tomtit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tui	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.25	0.00	0.00	0.00	0.00
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black bird	0.18	0.00	0.50	0.00	0.10	0.33	0.25
Californian quail	0.09	0.00	0.00	0.00	0.00	0.00	0.00
Chaffinch	0.45	0.50	0.38	0.10	0.70	0.33	0.25
Chicken	0.00	0.00	0.00	0.00	0.00	0.66	0.00
Ducks	0.00	0.00	0.00	0.20	0.00	0.00	0.00
Dunnock	0.00	0.00	0.00	0.20	0.30	0.00	0.13
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	0.64	0.50	0.63	1.00	2.90	1.88	1.75
Goldfinch	0.92	0.88	3.75	0.10	0.80	0.33	0.00
Gull	0.00	0.00	0.00	0.00	0.00	0.11	0.00
House sparrow	0.00	0.25	0.38	0.00	0.00	0.77	0.13
Indian Myna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magpie	0.92	0.38	0.13	0.70	1.80	0.22	1.13
Mallard duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pheasant	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Redpoll	0.92	1.63	0.63	0.70	0.40	0.33	0.25
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.00	0.20	0.77	0.00
Rooster	0.00	0.00	0.00	0.00	0.10	0.00	0.00
Skylark	0.45	0.13	2.38	4.90	2.50	0.55	1.25
Spur winged plover	0.09	0.00	0.63	0.10	0.50	1.00	1.00
Song thrush	0.27	0.38	0.13	0.00	0.00	0.22	0.13
Starling	0.82	0.25	5.75	20.70	0.80	1.00	32.50
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	1.63	1.30	0.50	0.40	0.40	0.11	1.13
Unknown	3.27	1.38	6.26	2.50	2.10	2.88	1.75

Code Type	5C S/B Farm	6A S/B Farm	6B S/B Farm	6C S/B Farm	7A S/B Farm	7B S/B Farm	7C S/B Farm
Australasian harrier	0.00	0.00	0.00	0.00	0.00	0.09	0.20
Bellbird	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.30
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grey Warbler	0.00	0.00	0.00	0.00	0.00	0.00	0.20
Grey duck	0.00	0.00	0.00	0.22	0.09	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paradise shelduck	0.00	0.00	0.00	0.00	0.00	0.36	0.20
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.82	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shining cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silvereye	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Southern black backed gull	0.50	0.38	8.33	0.77	0.64	0.09	3.00
South Island Pied Oystercatcher	0.20	0.00	0.33	0.11	0.36	3.09	0.30
Tomtit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tui	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.00	0.00	0.00	0.09	0.00
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.45	0.10
Black bird	0.30	0.25	0.55	0.22	0.09	0.00	0.50
Californian quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaffinch	0.50	0.13	0.55	0.22	0.64	0.18	0.09
Chicken	0.00	0.00	0.00	0.00	0.09	0.00	0.00
Ducks	0.80	0.00	0.00	0.00	0.00	0.91	0.00
Dunnock	0.50	0.75	0.00	0.33	0.00	0.36	0.30
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	0.50	0.13	2.33	1.00	0.00	0.09	0.20
Goldfinch	0.10	1.38	1.33	0.11	0.09	0.09	0.10
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	0.00	1.00	1.22	0.00	0.00	0.55	0.00
Indian Myna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magpie	0.40	1.50	0.22	1.11	0.64	2.55	1.10
Mallard duck	0.00	0.00	0.00	0.00	0.00	0.18	0.00
Pheasant	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Redpoll	0.20	2.38	0.55	0.55	2.18	0.00	0.60
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.33	0.00	0.18	0.00
Rooster	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skylark	2.30	4.13	2.77	2.20	2.27	1.91	0.50
Spur winged plover	1.20	0.63	0.55	0.33	0.09	1.27	1.20
Song thrush	0.00	0.25	0.55	0.55	0.00	0.00	0.50
Starling	12.10	0.00	2.22	0.22	0.82	2.82	0.70
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	0.40	0.38	0.77	0.11	0.55	0.46	0.30
Unknown	2.80	1.13	4.11	15.10	9.57	3.19	0.80

Code Type	8A S/B Farm	8B S/B Farm	8C S/B Farm	9A S/B Farm	9B S/B Farm	9C S/B Farm	10A S/B Farm
Australasian harrier	0.14	0.00	0.42	0.11	0.00	0.20	0.00
Bellbird	0.00	0.00	0.14	0.66	0.90	0.20	0.09
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.00	0.00	0.14	0.00	0.09	0.40	0.00
Grey Warbler	0.00	0.00	0.00	0.22	0.45	0.30	0.00
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.00	0.00	0.09	0.00	0.00
Paradise shelduck	0.29	1.88	2.29	0.00	0.00	0.00	0.00
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shining cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silvereye	0.00	0.00	0.00	0.33	0.45	0.60	0.00
Southern black backed gull	0.57	1.38	1.86	0.00	0.00	0.00	0.27
South Island Pied Oystercatcher	0.14	0.00	0.14	0.11	0.18	0.00	0.09
Tomtit	0.00	0.00	0.00	0.11	0.09	0.00	0.00
Tui	0.00	0.00	0.00	0.00	0.00	0.20	0.00
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.14	1.00	0.14	0.00	0.18	0.10	0.00
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black bird	0.71	0.13	1.00	0.66	3.18	0.10	1.00
Californian quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaffinch	0.71	0.38	0.71	0.11	0.18	0.00	0.64
Chicken	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunnock	0.29	0.38	0.00	0.00	0.00	0.00	0.09
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	0.00	0.00	0.00	0.22	0.64	0.20	0.18
Goldfinch	0.14	0.38	0.00	0.66	0.36	0.10	0.00
Gull	0.00	0.00	0.00	0.33	0.00	0.00	0.00
House sparrow	0.00	0.00	0.00	0.00	0.00	0.20	0.00
Indian Myna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magpie	0.14	0.00	0.14	0.55	0.27	0.50	0.18
Mallard duck	0.00	0.00	0.00	0.00	1.18	0.00	0.00
Pheasant	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Redpoll	2.29	0.38	3.86	2.33	2.18	2.90	1.09
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooster	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skylark	1.86	2.00	0.71	0.22	0.18	0.30	1.00
Spur winged plover	0.00	0.00	0.00	1.22	1.82	0.00	0.09
Song thrush	0.71	0.13	0.42	0.55	1.82	0.30	0.27
Starling	0.00	0.25	1.57	1.00	0.64	0.00	0.18
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.73
Yellowhammer	0.00	0.50	0.29	0.77	0.00	1.30	0.91
Unknown	0.57	0.51	1.71	1.77	1.18	1.10	1.28

Code Type	10B S/B Farm	10C S/B Farm	11A S/B Farm	11B S/B Farm	11C S/B Farm	12A S/B Farm	12B S/B Farm	12C S/B Farm
Australasian harrier	0.25	0.10	0.09	0.00	0.00	0.00	0.25	0.08
Bellbird	0.00	0.00	0.72	0.00	0.00	0.00	0.13	0.00
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00
Grey Warbler	0.00	0.00	0.09	0.20	0.11	0.00	0.25	0.08
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00
Paradise shelduck	0.00	0.00	0.00	0.00	0.00	0.80	0.50	1.00
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shining cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silvereye	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
Southern black backed gull	0.13	0.00	0.00	0.70	0.55	0.10	0.00	0.00
South Island Pied Oystercatcher	1.00	0.60	0.00	0.00	0.00	0.60	0.00	0.16
Tomtit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tui	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.09	0.10	0.55	0.00	0.38	0.75
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black bird	0.38	1.00	0.64	0.40	0.22	0.20	0.25	0.25
Californian quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaffinch	0.25	1.30	0.18	0.20	0.00	0.50	1.25	0.33
Chicken	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunnock	0.00	0.10	0.09	0.00	0.00	0.00	0.00	0.16
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	0.13	0.40	1.00	1.40	0.33	0.00	0.13	0.08
Goldfinch	0.00	0.60	0.82	3.10	1.33	0.00	0.00	0.75
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	0.00	0.00	1.55	0.50	2.33	0.00	0.00	0.16
Indian Myna	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magpie	0.13	0.20	1.00	7.60	1.00	1.20	0.75	0.75
Mallard duck	6.75	0.30	0.00	0.00	0.00	0.20	0.00	0.00
Pheasant	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Redpoll	0.38	3.60	1.36	1.10	0.22	1.10	1.86	0.58
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00
Rooster	0.13	0.10	0.00	0.00	0.00	0.00	0.13	0.00
Skylark	3.38	0.80	0.27	0.50	3.33	2.10	1.25	0.75
Spur winged plover	0.63	0.50	0.00	0.80	0.55	0.40	0.63	0.08
Song thrush	0.13	0.40	0.27	0.20	0.77	0.10	0.00	0.16
Starling	2.38	1.10	3.18	0.70	0.00	0.20	2.50	1.08
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00
Yellowhammer	0.25	0.90	1.09	0.60	1.66	0.10	0.75	0.25
Unknown	0.00	1.70	2.37	5.60	4.77	0.30	1.88	4.91

Code Type	Nth Okarito Forest Native	Rangitoto Native	Ohau Gorge Native	Coastal Native	Old Tertiary Native	Karst Native	Limestone Talus Native
Australasian harrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bellbird	2.88	0.00	0.71	3.20	1.20	2.40	2.10
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.57	0.45	0.68	0.57	0.79	0.86	1.00
Grey Warbler	1.44	1.16	0.70	2.50	1.70	2.00	2.80
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.09	0.00	0.50	0.12
Kingfisher	0.00	0.15	0.00	0.00	0.05	0.00	0.00
Long tailed cuckoo	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	1.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.37	0.00	0.00	0.16	0.00	0.43	0.94
Paradise shelduck	0.00	0.05	0.00	0.00	0.00	0.00	0.00
Parakeet (yellow)	0.08	0.00	0.00	0.09	0.26	0.69	0.24
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rifleman	0.32	0.00	0.00	0.00	0.00	0.43	0.53
Robin	0.52	0.00	0.00	0.00	0.63	1.40	0.59
Shining cuckoo	0.00	0.00	0.00	0.33	0.00	0.00	0.00
Silvereye	1.68	2.40	1.79	1.40	0.21	2.10	4.80
Southern black backed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomtit	1.02	0.02	0.54	1.30	0.95	1.80	3.10
Tui	0.29	0.20	0.00	0.41	0.79	0.86	1.10
Weka	0.00	0.00	0.00	0.14	0.05	0.07	0.29
Welcome swallow	0.00	0.08	0.00	0.00	0.00	0.00	0.00
White faced Heron	0.56	0.00	0.00	0.00	0.00	0.07	0.00
Black bird	0.29	0.77	0.27	1.20	0.50	1.10	1.50
Californian quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaffinch	0.46	1.01	0.00	1.10	0.50	1.00	0.30
Chicken	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunnock	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	0.06	0.12	0.00	0.00	0.00	0.00	0.00
Goldfinch	0.09	0.43	0.00	0.00	0.00	0.00	0.00
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	0.00	0.34	0.00	0.00	0.00	0.00	0.00
Indian Myna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magpie	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mallard duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pheasant	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Redpoll	0.41	0.00	0.00	0.00	0.00	0.00	0.00
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooster	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skylark	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spur winged plover	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Song thrush	0.01	0.14	0.00	0.10	0.10	0.20	0.20
Starling	0.00	0.06	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0.00	0.00	0.22	0.00	0.00	0.00	0.00

Code Type	Cutover Native	Cutover near Road Native	Auckland Domain Native	Buller Native	Lower Ohikanui Native	Kennedy's Bush Scrub	Kowhai Bush 1 Scrub
Australasian harrier	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Bellbird	0.75	1.30	0.00	1.60	0.80	1.70	1.30
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Fantail	0.62	0.66	1.40	0.20	0.15	0.29	0.40
Grey Warbler	1.10	2.00	0.52	0.45	0.30	0.82	0.71
Grey duck	0.00	0.08	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.08	0.19	0.00	0.00	0.00	0.00
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.02	0.10	0.03	0.17	0.00
Paradise shelduck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rifleman	0.00	0.00	0.00	0.05	0.10	0.00	0.00
Robin	0.25	0.00	0.00	0.15	0.20	0.00	0.00
Shining cuckoo	0.12	0.08	0.00	0.00	0.00	0.13	0.00
Silvereye	0.38	0.58	3.22	3.20	0.60	2.04	0.73
Southern black backed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomtit	1.50	2.30	0.00	0.10	0.60	0.01	0.00
Tui	0.62	0.83	0.24	0.60	0.20	0.00	0.00
Weka	0.00	0.08	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black bird	1.20	2.60	1.59	0.65	0.20	0.51	0.00
Californian quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaffinch	1.00	3.50	0.49	0.10	0.35	0.42	0.66
Chicken	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunnock	0.00	0.50	0.00	0.00	0.00	0.06	0.00
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	0.00	0.00	0.29	0.00	0.00	0.01	0.00
Goldfinch	0.00	0.00	0.10	0.00	0.00	0.05	0.85
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	0.00	0.10	0.00	0.00	0.00	0.00	0.00
Indian Myna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magpie	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mallard duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pheasant	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Redpoll	0.00	0.40	0.00	0.00	0.00	0.58	1.84
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooster	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skylark	0.00	0.30	0.00	0.00	0.00	0.00	0.00
Spur winged plover	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Song thrush	0.40	1.60	0.31	0.50	0.05	0.00	0.00
Starling	0.00	0.10	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	0.00	0.10	0.00	0.00	0.00	0.00	0.00
Unknown	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Code Type	Kowhai Bush 2 Scrub	Kowhai Bush 3 Scrub	Fletcher Creek Native	Reefton Saddle Native	Inwoods Pine Pine	Olivers Pine Pine	Hiwipango Pine Pine
Australasian harrier	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Bellbird	1.35	2.14	2.72	4.22	0.25	0.50	0.50
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.29	0.16	1.17	0.75	0.30	0.41	0.79
Grey Warbler	1.03	0.70	1.25	1.16	0.44	0.42	0.77
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.00	0.27	0.00	0.00	0.00
Paradise shelduck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.02	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rifleman	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Robin	0.00	0.00	0.00	0.00	0.00	0.00	0.54
Shining cuckoo	0.00	0.00	0.23	0.24	0.00	0.02	0.00
Silvereye	0.53	0.70	3.08	3.78	1.98	1.34	0.54
Southern black backed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomtit	0.00	0.00	0.00	0.81	0.00	0.08	0.02
Tui	0.00	0.00	0.00	0.00	0.00	0.06	0.12
Weka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Welcome swallow	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White faced Heron	0.00	0.00	0.00	0.00	0.00	0.00	1.14
Black bird	0.00	0.00	0.69	0.51	0.32	0.16	0.29
Californian quail	0.00	0.00	0.00	0.00	0.04	0.01	0.02
Chaffinch	0.37	0.35	0.57	0.33	2.02	1.10	1.99
Chicken	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunnock	0.00	0.00	0.00	0.01	0.85	0.42	0.06
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	0.00	0.00	0.06	0.08	0.06	0.04	0.07
Goldfinch	0.30	0.40	0.01	0.02	0.42	0.66	0.53
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indian Myna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magpie	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mallard duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pheasant	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Redpoll	0.52	0.19	0.09	0.28	1.49	0.72	0.09
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooster	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skylark	0.00	0.00	0.00	0.00	0.15	0.00	0.00
Spur winged plover	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Song thrush	0.00	0.00	0.00	0.00	0.23	0.04	0.23
Starling	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Code Type	Douglas Fir Pine	Graham Pine Pine	Tinline Pine Pine	Camp Pine Pine	Tineline Pine Native	Camp Bush Native	Winns Bush Native
Australasian harrier	0.00	0.00	0.02	0.00	0.01	0.00	0.00
Bellbird	0.64	0.48	0.54	0.31	2.14	1.61	5.96
Black billed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Falcon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fantail	0.38	0.45	0.53	0.27	0.32	0.28	0.19
Grey Warbler	0.78	0.78	0.91	1.14	1.07	1.25	0.53
Grey duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kaka	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingfisher	0.00	0.00	0.00	0.02	0.00	0.02	0.03
Long tailed cuckoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morepork	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NZ pigeon	0.00	0.00	0.04	0.04	0.30	0.31	0.15
Paradise shelduck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parakeet (yellow)	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Pied stilt	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pipit	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pūkeko	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rifleman	0.00	0.00	0.00	0.00	0.07	0.09	0.00
Robin	0.86	0.00	0.01	0.00	0.00	0.00	0.00
Shining cuckoo	0.01	0.00	0.00	0.00	0.00	0.02	0.03
Silvereye	0.98	1.96	1.60	1.02	1.81	2.60	1.19
Southern black backed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Island Pied Oystercatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomtit	0.09	0.21	0.21	0.11	0.63	0.49	0.54
Tui	0.08	0.04	0.12	0.03	0.34	0.25	0.60
Weka	0.00	0.01	0.00	0.00	0.02	0.01	0.00
Welcome swallow	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White faced Heron	2.49	0.00	0.00	0.00	0.00	0.03	0.00
Black bird	0.31	0.17	0.25	0.29	0.25	0.36	0.38
Californian quail	0.02	0.01	0.01	0.00	0.00	0.00	0.00
Chaffinch	1.24	0.59	1.07	1.48	0.43	0.63	1.52
Chicken	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ducks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunnock	0.07	0.10	0.30	0.23	0.02	0.03	0.13
Eastern rosella	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenfinch	0.01	0.00	0.08	0.07	0.01	0.00	0.13
Goldfinch	0.33	0.17	0.50	0.44	0.08	0.40	0.56
Gull	0.00	0.00	0.00	0.00	0.00	0.00	0.00
House sparrow	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indian Myna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magpie	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mallard duck	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pheasant	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Redpoll	0.05	0.58	0.18	0.04	0.10	0.09	0.23
Ring neck dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock pigeon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooster	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skylark	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spur winged plover	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Song thrush	0.33	0.09	0.11	0.11	0.04	0.10	0.11
Starling	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellowhammer	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Code Type	Spooner's Bush Native	Graham Bush Native
Australasian harrier	0.01	0.00
Bellbird	3.50	1.43
Black billed gull	0.00	0.00
Falcon	0.00	0.00
Fantail	0.50	0.34
Grey Warbler	1.02	0.89
Grey duck	0.00	0.00
Kaka	0.00	0.00
Kingfisher	0.00	0.01
Long tailed cuckoo	0.00	0.00
Morepork	0.00	0.00
NZ pigeon	0.27	0.09
Paradise shelduck	0.00	0.00
Parakeet (yellow)	0.00	0.00
Pied stilt	0.00	0.00
Pipit	0.00	0.00
Pūkeko	0.00	0.00
Rifleman	0.40	0.18
Robin	0.00	0.00
Shining cuckoo	0.00	0.01
Silvereye	2.42	2.48
Southern black backed gull	0.00	0.00
South Island Pied Oystercatcher	0.00	0.00
Tomtit	0.51	0.48
Tui	0.75	0.13
Weka	0.00	0.00
Welcome swallow	0.00	0.00
White faced Heron	0.00	0.00
Black bird	0.26	0.20
Californian quail	0.00	0.00
Chaffinch	0.97	0.26
Chicken	0.00	0.00
Ducks	0.00	0.00
Dunnock	0.02	0.02
Eastern rosella	0.00	0.00
Greenfinch	0.11	0.01
Goldfinch	0.94	0.04
Gull	0.00	0.00
House sparrow	0.00	0.00
Indian Myna	0.00	0.00
Magpie	0.00	0.00
Mallard duck	0.00	0.00
Pheasant	0.00	0.00
Redpoll	0.04	0.01
Ring neck dove	0.00	0.00
Rock pigeon	0.00	0.00
Rooster	0.00	0.00
Skylark	0.00	0.00
Spur winged plover	0.00	0.00
Song thrush	0.07	0.09
Starling	0.00	0.00
Turkey	0.00	0.00
Yellowhammer	0.00	0.00
Unknown	0.00	0.00