

# BIRD SPECIES COMPOSITION AND ABUNDANCE IN RELATION TO NATIVE PLANTS IN URBAN GARDENS, HAMILTON, NEW ZEALAND

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## ABSTRACT

During a census in gardens in Hamilton, 71.8% of the 4428 birds observed belonged to introduced species. A total of 15 species were observed. Bird species richness was positively correlated with native plant biomass and, more strongly, with total plant biomass. More birds were present in gardens with more native plants. Among the most common species, the abundance of the House Sparrow (*Passer domesticus*) decreased with increasing percentage of native plants, the Silvereye (*Zosterops lateralis*) increased, while Blackbirds (*Turdus merula*) and Starlings (*Sturnus vulgaris*) showed no significant change. This was typical for all other introduced bird species. Most other birds, including the Fantail (*Rhipidura fuliginosa*) and the Grey Warbler (*Gerygone igata*), were most abundant in gardens with higher native plant biomass. Notable was the absence of the Tui (*Prothemadera novaeseelandiae*) from all censused areas in Hamilton at the time of observation. No significant variation between morning and evening samples was noted.

**KEYWORDS:** bird species composition, density, urban gardens, native plants.

## INTRODUCTION

In recent years in New Zealand there has been a trend to grow native plants in urban gardens. One of the reasons for planting natives has been to attract birds, especially the non-introduced species such as the Silvereye (*Zosterops lateralis*) and the Grey Warbler (*Gerygone igata*), into gardens. Several texts (eg. Matthews, 1987; Smith-Dodsworth, 1991) recommend native trees and shrubs that are thought to attract birds into city gardens. However, it appears no quantitative data have been gathered to determine whether native plants do, in fact, increase the number of birds that will use a garden.

Several articles record the birds of New Zealand gardens (e.g. Guest & Guest, 1987, 1993) but these are generally descriptive and do not contain detailed information on the relationship between plants and birds. Consequently, few data exist on the bird preference for "native" or "introduced" gardens.

There are 10 to 15 species of bird found commonly in New Zealand gardens; they include the Tui (*Prothemadera novaeseelandiae*), Silvereye, Fantail (*Rhipidura fuliginosa*) and the Grey Warbler (Falla *et al.*, 1991; Marshall *et al.*, 1990). In most gardens the introduced species such as the House Sparrows (*Passer domesticus*), Blackbirds (*Turdus merula*) and Starlings

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(*Sturnus vulgaris*) are more abundant. There are also other birds likely to use city gardens from time to time, either as resident birds or as floaters. The aims of this study were to determine: (1) the numbers and species of birds in 30 Hamilton gardens, (2) an index of plant biomass for those gardens and estimate the percentage of native plant biomass, (3) how native plants affect the species composition of birds in the gardens, and (4) if the proportions of each bird species changes relative to native plant biomass in the gardens.

## METHODS

The study was divided into two parts. The first involved determining the composition of vegetation in the gardens and the second part looked at the bird species composition within those gardens.

### Characterisation of garden vegetation

*Garden sites.* Thirty gardens were selected in Hamilton city, Waikato region, on the North Island of New Zealand, with plant composition ranging from almost entirely introduced to entirely native species. Each of the gardens was relatively flat and was between 1000m<sup>2</sup> and 2000m<sup>2</sup> in size. No neighbouring gardens were used in the study, so the same boundary vegetation was not included twice. All gardens were at least three properties apart to avoid autocorrelation.

TABLE 1 – Plant biomass index used to rank plants for estimating vegetation biomass in each garden.

Rank	Plant type
1	All plants < 0.5 m high (excluding lawns)
2	Small shrubs < 1.0 m high
3	Large shrubs 1.0 m to < 2.0 m high
4	Small trees < 3.0 m high
5	Tall trees (narrow) 3.0 m to < 5.0 m high
6	Tall trees (broad) 3.0 m to < 5.0 m high
7	Very large trees (narrow) > 5.0 m high
8	Very large trees (broad) > 5.0 m high

*Procedure.* In order to approximate the contribution of native and introduced plant species to the biomass of each of the garden sites, the plant life was ranked to give a "plant biomass index". Each plant in the survey area of the garden was recorded as being either native or introduced and given one of 8 ranks (Table 1). The ranks of all plants were summed to give a total biomass index for each garden. From this the percentage of native biomass was calculated by dividing the rank total for native plants by the total biomass index of the garden. This gave a native plant biomass index as a percentage of total biomass for each garden.

### **Bird species composition**

Observations were made in the morning and evening from an inconspicuous position in the garden and I remained there throughout the observation periods. Generally this was at one end or at the side of each garden.

Birds were recorded, after a five minute settling period, for 30 minutes. All observations in the morning were made between 06:30 and 08:30 and in the late afternoon between 15:30 and 17:30. One morning and one evening sample was taken in each garden.

The 30 gardens were observed in August 1993 and only during fine weather because rainy weather is known to reduce the number of bird species seen over a given period (Ratkowsky & Ratkowsky, 1979). As August is a very dynamic month in terms of vegetation change, the gardens were observed randomly to avoid seasonal bias in bird distribution. Gardens containing bird tables or nesting boxes were not included in the study.

At any one time, only a part of the garden could be observed. The study area was therefore divided into four sections and each was observed for 15 seconds at a time, thereby giving a 1 minute cycle for the entire garden. This reduced the angle of vision at any time to typically 45-50 degrees, making observation easier and reducing any bias from looking at one section of the garden more than others. Binoculars and a stopwatch were used as required.

The number and species of birds seen were recorded. If a bird moved from one section of the garden to another, it was not recorded again when that section was watched. Tracking birds in gardens proved easy due to the small area being surveyed at one time. Birds were identified when seen or heard, although they were not recorded as present until they had been sighted. By doing this there was no error resulting from recording birds that were singing in neighbouring properties. However, species that are less visually conspicuous were less likely to be recorded.

### **Analysis**

The number of bird species was graphed against two variables; percentage of native plants for each garden and total plant biomass for each garden. Regression analysis was performed on both sets of data to determine which variable the number of bird species was more highly correlated to. Significance levels of regression coefficients and the standard errors (S.E.) of y values were calculated.

Frequencies of each bird species were recorded at all sites for each of the sampling periods. The proportion of each sample made by each of the species was calculated. This was graphed in relation to the percentage of native plant biomass for the three most common introduced and three other bird species. Regression analysis was again performed to determine if individual bird species were more highly correlated to total plant biomass or to the proportion of native plants.

The number of birds per unit of total plant biomass at each site was graphed against percentage of native biomass. This was done to relate bird frequencies to native biomass units rather than total biomass in each garden. Differences in total garden biomass indexes were caused by variation in garden size, density of plants, garden structure and the type of garden planted.

## RESULTS

### Garden vegetation

From the 30 gardens, the range of native plant biomass varied from 3% to 100% (mean = 40.66, S.D. = 26.2%). Total plant biomass index ranged from 105 to 845 rank units (mean = 349.3, S.D. = 176.9 rank units). These large variations were due to differences in garden sizes and different densities of plants in similar sized gardens. The way in which the garden was planted affected the biomass index (eg. bark garden versus flower bed).

Generally gardens with greater percentages of native biomass also had higher total biomass (Figure 1). When selecting gardens it was difficult to find gardens with many native plants, as people tend to grow native plants in just one section of the garden rather than over the whole property.

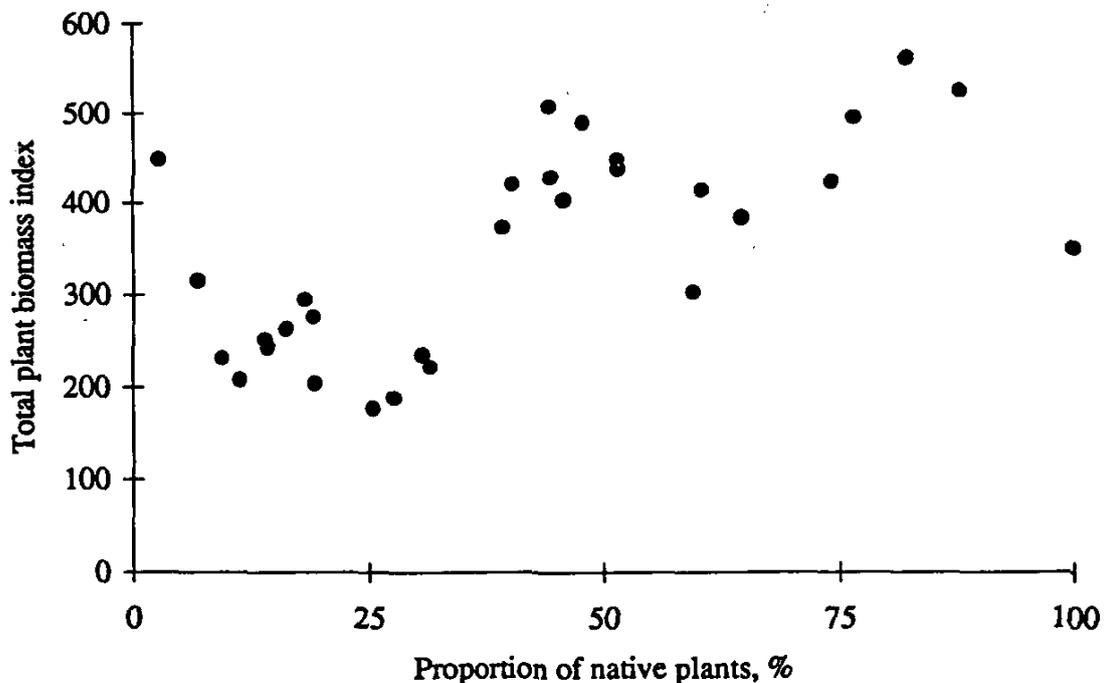


FIGURE 1 – Total plant biomass index in relation to the proportion of native plants in each garden.

TABLE 2 – Species and number of birds observed in Hamilton gardens, August 1993.

Species	Numbers observed	Relative abundance, %
House Sparrow, <i>Passer domesticus</i>	2080	47.0
Silvereye, <i>Zosterops lateralis</i>	1034	23.4
Blackbird, <i>Turdus merula</i>	410	9.3
Starling, <i>Sturnus vulgaris</i>	224	5.1
Chaffinch, <i>Fringilla coelebs</i>	152	3.5
Goldfinch, <i>Carduelis carduelis</i>	99	2.2
Greenfinch, <i>Carduelis chloris</i>	99	2.2
Grey Warbler, <i>Gerygone igata</i>	95	2.2
New Zealand Fantail, <i>Rhipidura fuliginosa</i>	84	1.9
Common Myna, <i>Acridotheres tristis</i>	59	1.3
Song Thrush, <i>Turdus philomelos</i>	54	1.2
Welcome Swallow, <i>Hirundo tahitica</i>	20	0.5
Sacred Kingfisher, <i>Halcyon sancta</i>	10	0.2
New Zealand Pigeon, <i>Hemiphaga novaeseelandiae</i>	4	0.1
Australian Magpie, <i>Gymnorhina tibicen</i>	4	0.1
<b>Total</b>	<b>4428</b>	<b>100.0</b>

### Bird species composition

The total number of birds seen was 4428, belonging to 15 species. The species observed, their frequencies and the percentage of observations they accounted for are shown on Table 2. Introduced birds made up 71.8% of the observations.

Regression analysis showed the number of bird species per garden to be more highly correlated to total plant biomass than to the percentage of native plant biomass (Table 3). The total number of birds per garden was significantly correlated to the proportion of native plants but not to the total plant biomass index. For the Silvereye, New Zealand Fantail, Grey Warbler and House Sparrow, abundance (in the form of proportion of sample) was more strongly correlated to the percentage of native plants than to total plant biomass in the garden. The Blackbird and the Starling showed no significant correlation to either native plants or total plant biomass. Standard errors for all regressions were similar between the two variables.

The number of bird species in each garden increased as the total plant biomass increased (Figure 2a) and as the percentage of native plants in the garden increased (Figure 2b). The number of birds per unit of plant biomass did not increase with a greater percentage of native plant biomass (Figure 3).

No significant differences were found between morning and evening bird frequency samples so results for each garden were combined. Of the introduced bird species, the House Sparrow (Figure 4a) was the most common, and the only bird species to show a decrease in relative abundance as the percentage of native plant biomass increased. All the other introduced

TABLE 3 – Results of the regression analysis for the number of birds species per garden, total number of birds per garden and the relative densities of six species for two variables: the proportion of native plants and total plant biomass index.

	Proportion of native plants			Total plant biomass index		
	Coefficient	Significance	S.E.	Coefficient	Significance	S.E.
No. of species	0.8080	***	y±1.05	0.8623	***	y±0.90
No. of birds	0.4402	*	y±63	0.2037	N.S.	y±68
Silvereye	0.6538	***	y ±0.06	0.3430	N.S.	y±0.08
Fantail	0.9116	***	y±0.01	0.7413	***	y±0.01
Grey Warbler	0.7759	***	y±0.02	0.5813	**	y±0.02
House Sparrow	-0.8862	***	y±0.07	-0.6783	***	y±0.11
Blackbird	0.1004	N.S.	y±0.02	0.2392	N.S.	y±0.02
Starling	0.0453	N.S.	y±0.03	0.0550	N.S.	y±0.03

N.S. = not significant; \* = P<0.05; \*\* = P<0.01; \*\*\* = P<0.001

species showed little variation in abundance with increasing percentage of native biomass. Blackbirds and Starlings were typical of this trend (Figures 4b and 4c).

Almost all non-introduced bird species increased in relative abundance at higher percentages of native plants; for example the Silvereye, Fantail and Grey Warbler (Figure 5).

## DISCUSSION

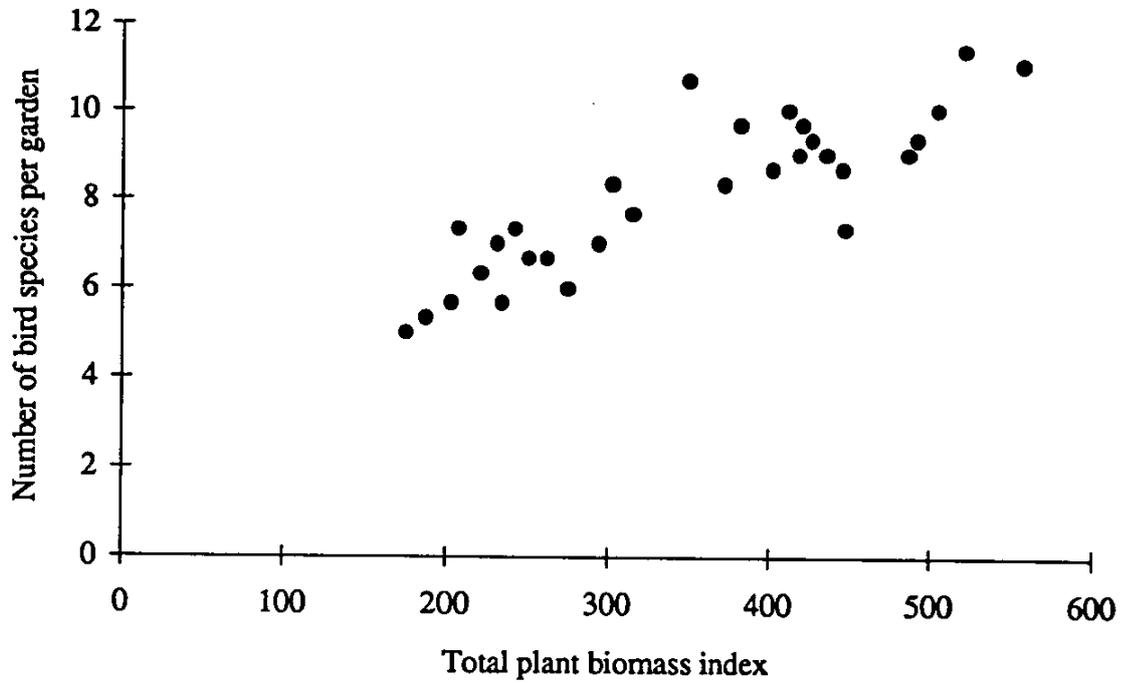
### Vegetation and structural factors

The method used to provide biomass estimates of native versus introduced plant species should make it possible to compare the birds present in gardens of different composition. Complete measurement of all plants in a given habitat is often impractical. Although the method used is semi-quantitative, it allowed nearly all plants in the garden to be assessed (not just a sample of them) so that the accuracy of plant biomass indices for each site would be high.

The amount of lawn in gardens was not quantified due to its small contribution to the total biomass of each section and the fact that it affects more the plant distribution and garden structure than its biomass.

This vegetation analysis cannot be used to quantify the bird-plant interaction as several factors influencing birds have not been quantified in the present study. The maturity of plants was not taken into account nor was the structure of gardens. For example, a garden with a large row of trees may be less valuable to a bird than a tight clump of exactly the same trees if shelter is desired for a nesting site.

a) Number of bird species in relation to total plant biomass



b) Number of bird species per garden in relation to percentage of native plants

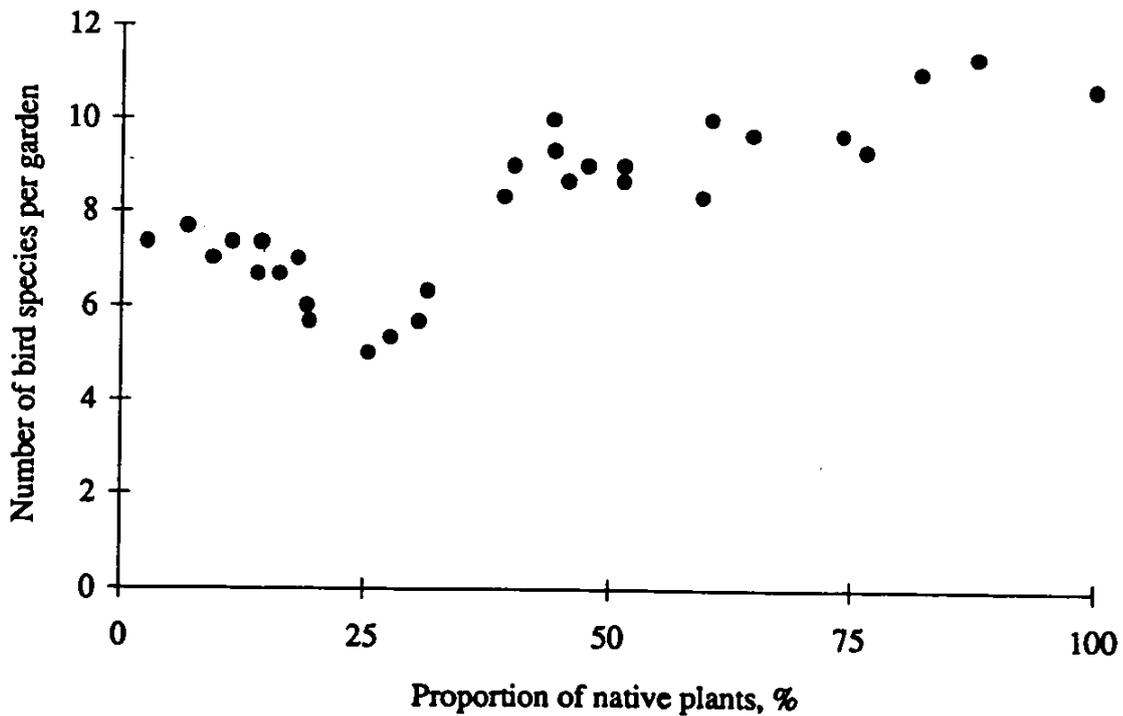


FIGURE 2 – The number of bird species seen in each garden in relation to a) total plant biomass index, b) proportion of native plants.

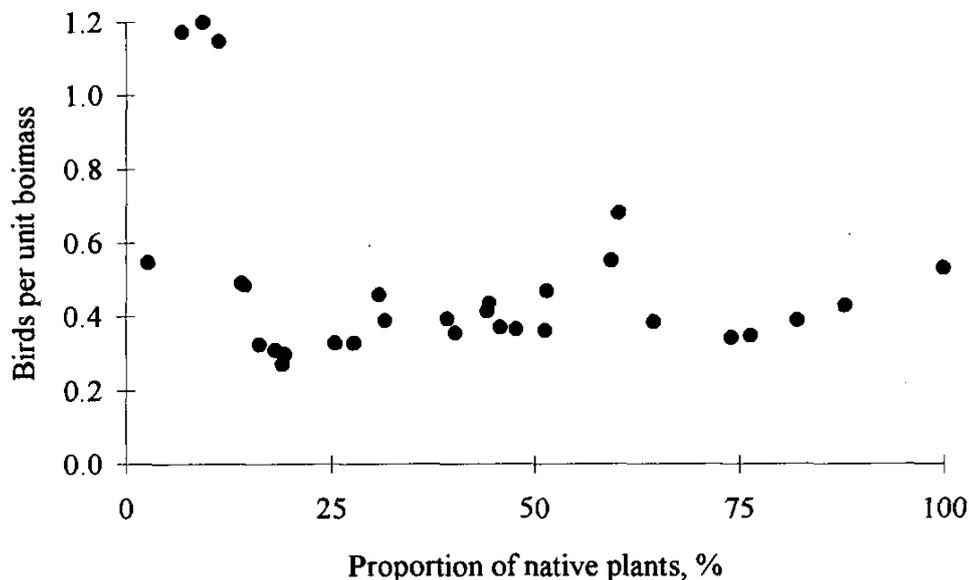


FIGURE 3 – The number of birds per unit of biomass in relation to the proportion of native plants in each garden.

Garden size will also influence the way birds use it. Changes in available biomass and the availability of open spaces for display or courtship may be important to the birds in habitat choice. Neighbouring properties may also influence birds in the gardens being studied. It is likely that the home range of most birds exceeded the size of a single garden. While boundary vegetation between properties was included, the neighbouring properties could not be accounted for in this study. Traffic noise (and proximity to busy roads) may have little effect on some species of birds while others may shy away from noisy areas despite suitable plant life.

Closeness to water (the Waikato River in Hamilton) or the presence of fish ponds in the garden may be important to species such as the Sacred Kingfisher (*Halcyon sancta*) or the Welcome Swallow (*Hirundo tahitica*); thus, species composition could be influenced by distance from valuable resources for different bird species.

Pets (cats and dogs in particular) and children may also influence bird density and species composition in the garden. The risk of predation by pets may be too great to inhabit certain gardens and children may either attract birds by feeding them, or discourage them by chasing or trying to catch them.

These constraints imposed by such a highly variable environment need to be considered when evaluating the relationship between bird species and vegetation composition in gardens.

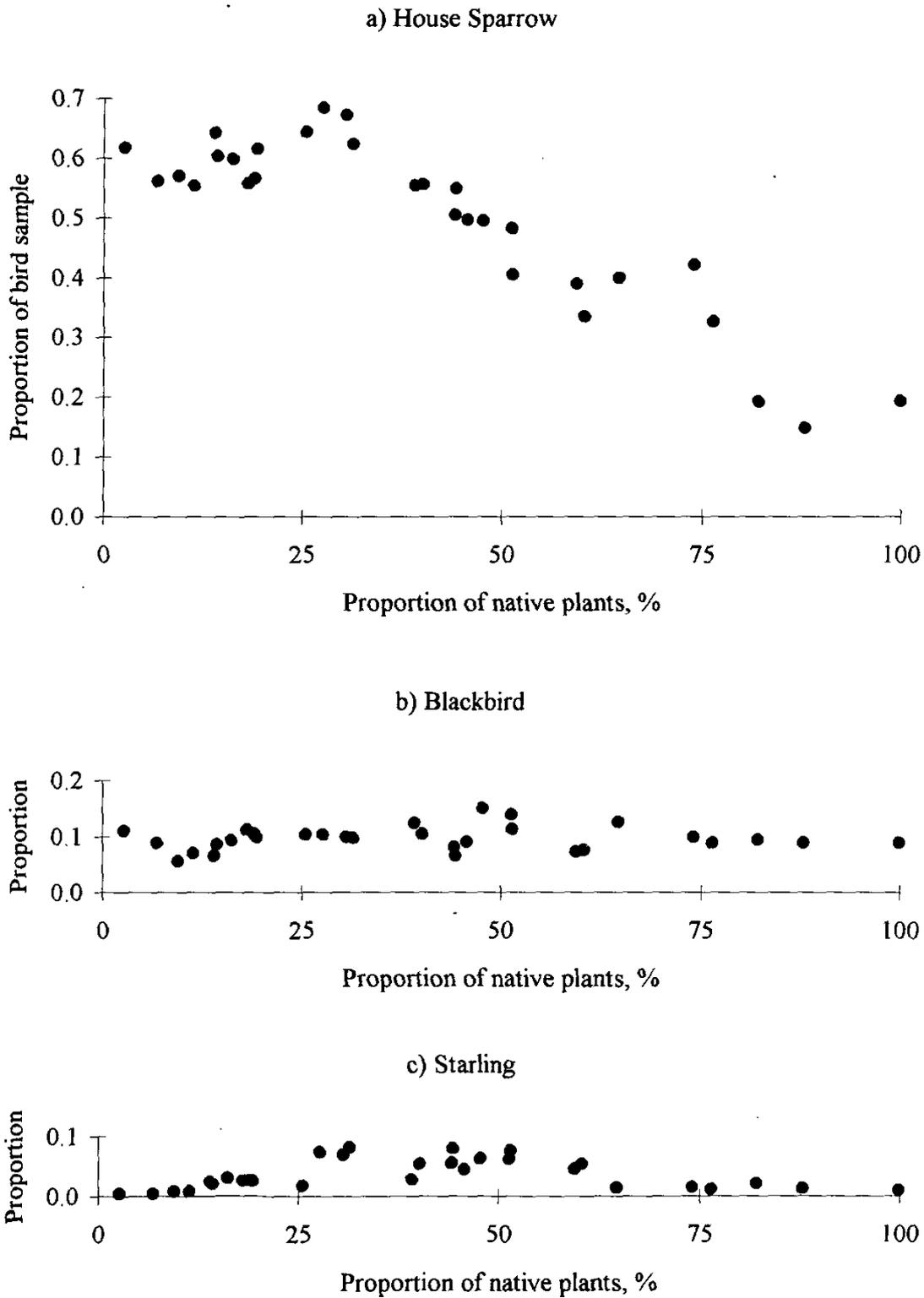


FIGURE 4 – The proportion in the sample of the three most common introduced bird species in relation to the proportion of native plants.

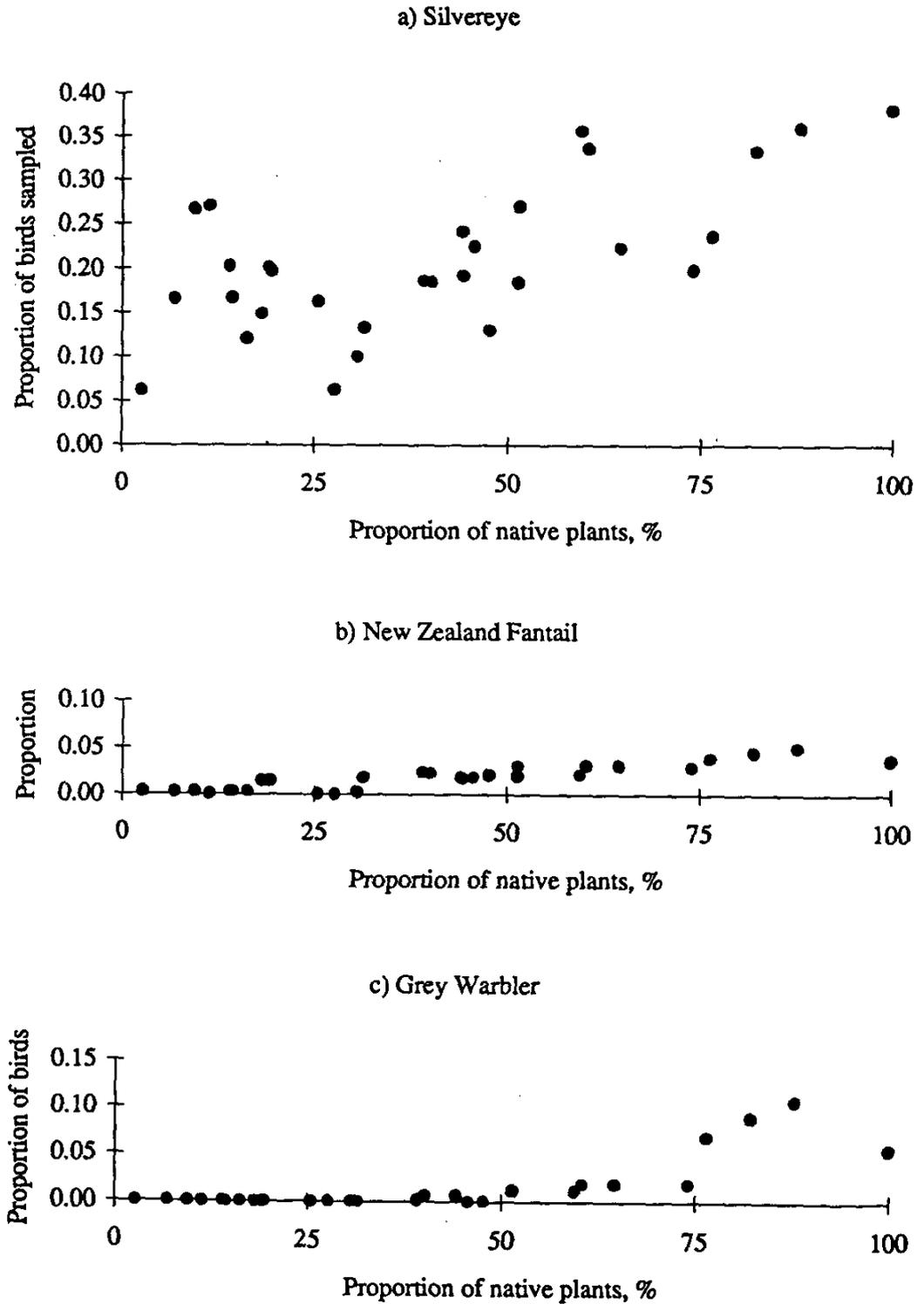


FIGURE 5 – The proportion in the sample of the three most common non-introduced bird species in relation to the proportion of native plants.

### **Bird species composition**

There were no significant variations in abundance for each bird species between morning and evening samples, perhaps because the birds observed were mostly residents. It should be noted that a 30 minute sampling period for bird observations could allow some birds to leave and enter gardens several times during observation.

More bird species were seen in gardens with higher total biomass. This is not surprising as there is more available habitat for use in these gardens, and this biomass may have a greater variety of plants suiting different bird species. Preference for native plants by some New Zealand birds may explain the greater number of bird species seen in gardens containing more native plants. While the number of species increased with increasing native plant percentages, the actual number of birds per unit of plant biomass stayed relatively constant over the range of native plants. In other words, a native plant may be attractive to a wider range of bird species than an introduced plant, but it will not necessarily attract more individual birds.

However, individual features in a garden can markedly affect the composition of birds found there (Spurr, 1986). This was highlighted in one garden included in the study, where densely clumped evergreen conifers provided excellent cover for a large number of birds. The resulting increase in the number of birds per unit of plant biomass in that garden was a feature of garden structure rather than the percentage of native plants found there.

Native plants affected the density of individual bird species differently. House Sparrow density showed the opposite trend to the Silvereye, possibly indicating competition between the two species for limited resources. It may be that the House Sparrow is better adapted to the conditions posed by introduced plants, or that some resource it requires is found at greater density in these types of garden.

The Blackbird and the Starling are both primarily ground feeders (Marshall *et al.*, 1990; Falla *et al.*, 1991) so their distribution is unlikely to be affected by the percentage of native plants. All other introduced bird species seem to be able to meet their habitat requirements equally well from native or introduced plants.

The variable abundance shown by the Silvereye over the range of native plants present may be due to the flocking habit of the Silvereye over winter, with some flocks remaining in late August (Falla *et al.*, 1991). The presence or absence of a flock in a garden during observation would account for the variability seen. The Fantail and Grey Warbler are both insect gleaning birds. The insects found on native plants may be different to those on introduced species. The Grey Warbler feeds readily on insects common to native plants (Moed & Fitzgerald, 1982) so this may explain the distribution of this bird. In August, many deciduous plants have lost their leaves. Many native plants are evergreen and possibly provide more insects to birds at this time of the year, which may have influenced the trends observed.

All the non-introduced bird species were most abundant where more native plants were present, possibly due to their adaptation to these plants.

However, species such as the Kingfisher and Welcome Swallow may be affected by the presence of water as well as native vegetation.

The Tui was a notable absentee from areas sampled in Hamilton, in spite of the abundance of suitable food resource. This could be due to Hamilton's isolation from other large areas suitable for Tuis.

This study has showed that some bird species are affected by the composition of plants in the garden. Growing native plants in gardens in Hamilton encourages a more diverse range of birds and attracts more of the non introduced species present in the city. The total number of bird species seen in the garden increases if more native plants are present, and also if the total plant biomass is increased. However, the actual number of birds in a garden won't increase just by replacing introduced plants with natives. At higher native plant biomass, the Silvereye becomes more abundant in the garden than the House Sparrow. Most of the introduced bird species show little variation in their abundance given different amounts of native plant biomass. The other bird species tend to increase in abundance as more native vegetation is available to them.

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