Landbirds on Lord Howe Island, NSW

Survey report 1, September 2013



Prepared for the Lord Howe Island Board

by the Canberra Ornithologists Group

Peter Fullagar, Chris Davey, A O Nicholls and Ian Hutton

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Summary

This report describes a survey in September 2013 of landbirds on Lord Howe Island conducted by the Canberra Ornithologists Group (COG). It was the first of what is intended to be an annual assessment of the status of landbirds on the island. The survey will be repeated each September for at least the next four seasons (2014–2017). This and the further surveys have been commissioned by the Lord Howe Island Board as part of the necessary monitoring processes associated with a plan to eradicate rodents from the island.

The purpose of the survey is to provide baseline information on the numbers and distribution of landbirds on Lord Howe Island. Point counts were chosen as the preferred method for the island survey. The data collecting protocol used is one we believe best fitted the limitations for time and effort available in the field. Transects surveys were conducted over two evenings to survey most of the ground-feeding species present in the settlement area.

The results of the survey are compared with a similar survey conducted by the Canberra Ornithologists Group in March 2007 and with an environmental survey of the island conducted in 1971–72.

Forty-eight paired sites were selected across the survey area, stratified to represent various vegetation types and habitat zones with seven transects selected within the settlement area. For the plots four teams of two observers surveyed all paired sites in four days with approximately 75% of sites resurveyed over the following three days.

The mean abundance, mean reporting rate, frequency and group size for each of the 16 species recorded during the survey was calculated. Maps of species distribution for 12 species with sufficient data are compared with the observations obtained in 1971-72 and in March 2007.

The most common bird was the Golden Whistler followed by the Silvereye. A noticeable reduction in all indices occurred for the next three most frequently reported species – Blackbird, Magpie-lark and Pied Currawong – but for the rest all indices, except group size, were much smaller.

The protocol for this baseline survey provides a rigorous survey method for obtaining data giving statistically sound measures of significant changes in population numbers and distribution of species between surveys – particularly before and after the proposed rodent eradication for mid 2015.

Introduction

This report describes a survey in September 2013 of landbirds on Lord Howe Island (latitude 31° 33´S and longitude 159° 05´E). It was the first of what is intended to be an annual assessment of the status of landbirds on the island. The survey will be repeated each September for at least the next four seasons (2014–2017).

This and the further surveys have been commissioned by the Lord Howe Island Board as part of the necessary monitoring processes associated with a plan to eradicate rats and mice from the island. This eradication is now scheduled for mid 2015.

The purpose of the survey is to provide baseline information on the numbers and distribution of landbirds on Lord Howe Island. Landbirds are here defined as those species that are either breeding residents on the island or visitors that are land-based. Specifically, all seabirds are excluded but shorebirds are not.

A rigorous survey method was required to provide data that can give a statistically sound measure of significant changes in population numbers and distribution – if they occur. This survey was the first of two surveys made before the eradication program occurs.

Point counts were chosen as the preferred method for the island survey. Much of the vegetation is dense and often difficult to access; repeated line transects would have been difficult to follow in such circumstances. Point counts are easier to incorporate in a formally designed study, easier to locate and lay out, and they provide a more reproducible data set. As well, point counts are more efficient than transect counts because they allow for more data points (Bibby *et al.,* 1997).

We investigated the power of available statistical analyses achievable with this method of population assessment (Nicholls unpublished) and adopted the data collecting protocol we believe best fitted the limitations for time and effort available in the field. As an additional data set we did, however, use a simple transect procedure to assess the abundance of six species within the most closely settled area of the island. These transects were walked at dusk using the network of sealed roadways.

In September 2013 the Canberra Ornithologists Group (COG) surveyed birds in the same areas of the northern section of Lord Howe Island that was surveyed in March 2007. The earlier study was intended as a practical trial of the field methods proposed for the 2013 study. The data collected in 2007, although from a different time of the year, has been used in this September report to compare frequency distributions of species mapped in both surveys.

By early July 2013, in conjunction with the Lord Howe Island Board and Birdlife Australia, 24 Bird Monitoring Sites (LHI01-LHI24) had been identified for the general public to monitor bird populations on the island. Although not part of the present survey, a summary of these

observations is included to provide a full account of available data before and during the survey conducted by the Canberra Ornithologists Group in September 2013.

The historical record of birds on Lord Howe Island

Hutton (1991) provides a comprehensive review of the status of birds on Lord Howe Island up to 1990. McAllan *et al.* (2004) review all records up to the end of 2003 and provide a systematic list of all species recorded from the island.

From the time of the island's discovery in 1788, when several birds are clearly described (see Fidlon and Ryan, 1979), only occasional observations on the avifauna were reported for most of the nineteenth century, although specimens of several species were collected and deposited in museums within Australia and Europe (see McAllan *et al*., 2004). Early last century, however, Roy Bell was commissioned by Gregory M Mathews to collect bird specimens on the island as part of Mathews' major work on Australian birds (Mathews 1928; 1936). Bell collected extensively between 1912 and 1914 (unpublished MS) and his handwritten journal gives a clear indication of the species then present and some idea of their distribution and abundance. More recently, Hindwood (1940) describes the status of the surviving avifauna on Lord Howe Island following the disastrous accidental introduction of Black Rat (*Rattus rattus*) in 1918 when the trading vessel *Makambo* was stranded.

The next major study of birds on Lord Howe Island resulted from a broad environmental survey by the Australian Museum in 1971–2. The report by Recher and Clark (1974) includes a detailed review of the distribution and status of all birds on the island at that time (Fullagar *et al*., 1974). This 1971–2 environmental survey was designed to provide some basic ecological data for future planning decisions affecting the island (Hutton, 1991).

At the time of discovery in 1788 the species composition of the avifauna on Lord Howe Island probably included, with the exception of regular visitors and vagrants, a duck, seven petrels, a tropic-bird, a booby, four rails, five terns, two pigeons, a parakeet, a small owl, a kingfisher, a currawong, a gerygone warbler, a whistler, a fantail, two white-eyes, a thrush, and a starling. Of these birds, one of the rails, one of the pigeons, the parakeet, the small owl, the warbler, the fantail, one of the white-eyes, the thrush and the starling are now extinct. However, it seems unlikely that any seabirds became extinct on Lord Howe Island over this same period of two centuries.

Several species have been added to the avifauna of Lord Howe Island in historic times – either by natural colonization or in some instances by deliberate introduction. These include a duck (feral hybrids originating from New Zealand), a heron, a kestrel, a lapwing, a feral domestic pigeon, a large forest owl, the Magpie-lark, a swallow, two thrushes, and a starling (none of the last three species being the same as those that had become extinct). On balance, this number is slightly more than the number lost by extinction.

Methods

Choice of survey sites

For practical reasons, determined by the time available for surveying and the number of teams we could muster, only the northern part of Lord Howe Island was included. Mt Lidgbird and Mt Gower were excluded, Erskine Valley and any of the mountain slopes below these peaks beyond Mutton Bird Point and Little Island (see Figure 1).

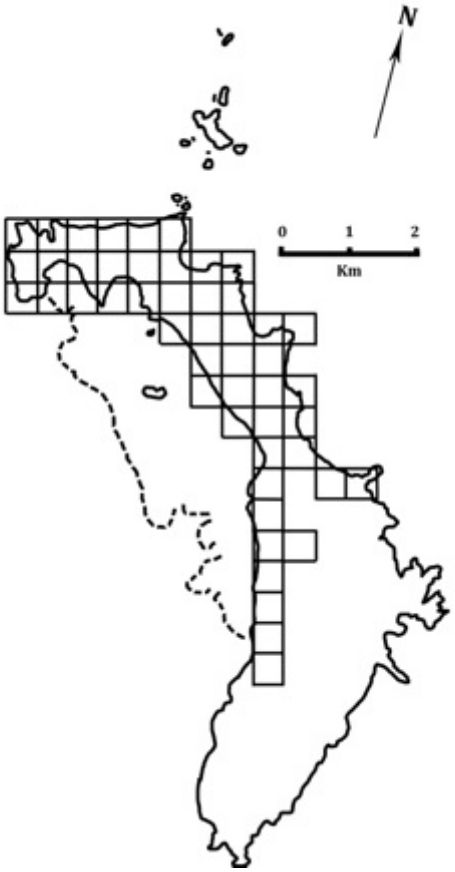


Figure 1. Grid cells, based on point counts, used for surveying distribution of landbirds on LHI, September 2013

Forty-eight paired sites were selected across the survey area, stratified to represent the various vegetation types and habitat zones. Vegetation types were taken from Pickard (1983). The vegetation maps produced by Pickard schematically represented the spatial distribution of the original vegetation, some of which has now been cleared or disturbed. The survey sites were distributed within 10 vegetation types and include both the original vegetation types and superimposed cleared or disturbed vegetation types. For simplicity, the 10 vegetation types were allocated to one of three vegetation groups – Lowland forest (1), Palm forest (2) and Open (3) – loosely based on vegetation structure (see Table 1).

Table 1. Vegetation classification of 96 sites on LHI, by code, group and number of sites

Vegetation type	*Vegetation code*[1]	*Vegetation group*	*Number of sites*
Drypetes australasica/Cryptocarya triplinervis	1	1	42
Drypetes australasica/Cryptocarya triplinervis (calcarenite variant)	2	1	1
Drypetes australasica/Cryptocarya triplinervis (exposed variant)	3	1	7
Cassinia tenuifolia-Poa poiformis	4	1	2
Howea forsterana	5	2	22
Pasture	6	3	14
Dune	7	3	2
Golf course	8	3	2
Cleistocalyx fullageri	9	2	2
Pasture/Howea forsterana	10	2	2

[1] Note: Calcarenite and exposed variants are treated as one type – giving a total of four paired sites.

In addition, the sites were grouped into five habitat zones representing various degrees of human settlement and activities that may affect the distribution of the avifauna (see Table 2).

Table 2. Habitat classification of 96 sites, LHI

Habitat zones	*Habitat zone*	*Number of sites*
North Hills	1	28
Settlement	2	28
Transect Hill	3	11
Suburban	4	12
South Hills	5	17

Point count protocol

Our protocol involved four teams of two observers surveying over seven days. Surveying was restricted to between sunrise and late morning. Each team had sufficient time to survey six sites per day. All 96 sites could be surveyed in four days. Approximately 75% of the sites were then resurveyed over the following three days.

The paired sites were a minimum of 100 metres apart but were similar in topography and vegetation (see Appendix A for site details of geolocation, vegetation and habitat type).

The count protocol at each site was to record the abundance of each species seen or heard within a 50-metre radius over a 10-minute period, with observers moving within the plot

area if required. Team members would survey a pair of sites independently and simultaneously before swapping sites and again counting for 10 minutes.

Twenty-one of the paired sites were visited twice while 27 of the paired sites were visited four times. This gave a total of 300 counts (see Table 3). No site was resurveyed by the same observer. Repeatability of counts at a site could therefore be tested between two observers over a short period (10 minutes) for 21 paired sites, and over a short period (10 minutes) and a long period (one day or more) for four observers for 27 paired sites.

Only experienced observers were chosen for the field work. All team members were well-trained, expert bird watchers with considerable previous involvement with similar style field work.

Table 3. Number of surveys for 96 sites, LHI

Site numbers	*Number of sites*	*Number of surveys*
1–24	24	48
25–48	24	96
49–54	6	12
55–72	18	72
73–78	6	12
79–90	12	48
91–96	6	12
Total	**96**	**300**

Statistical treatment of site counts

Several statistical parameters were used as population indices and these will become useful for comparison with data collected in future.

- *Mean abundance* (A). The average number of individuals of a species seen per observation and defined as the sum of the number of individuals reported divided by the total number of observations (300).
- *Mean reporting rate* (R). Defined as the number of recorded occurrences divided by the total number of observations (300).
- *Frequency* (F). The site occupancy rate or incidence rate defined as the number of sites on which a particular species was recorded divided by the total number of sites (96).
- *Group size* (G). Defined as the sum of the number of individuals divided by the number of observations in which a species was recorded

  .

Site counts in March 2007

In March 2007 a trial of our survey method was completed by a larger group of observers. A total of 136 site counts was made ranging across the same areas counted in 2013. In 2007 there were seven teams, each of two or more observers. The sites chosen were not the same as those used in 2013, and the count protocol differed to the extent that there was a predetermined GPS location to which was added (in the field) a nearby site, of similar habitat, at least 100 metres distant from the predetermined count site. A fresh GPS location was recorded for all count sites as they were made. In other respects the count protocol did not differ greatly from that used in 2013; no sites were counted more than once.

Transect surveys

In September 2013 seven transects of variable length (ranging from 570 to 970 metres) were walked at a slow pace (ranging from 1.9 to 4.5 km/hr) by a single observer twice (in one direction and then return) on two days. The transects followed sealed roads.

Figure 2 provides a map of the Lord Howe Island core settlement area, showing the location of transects A–G. The green pointers indicate junctions, where more than one transect starts or finishes. The yellow pointers indicate transect end points. See Appendix B for a description of the start and finish points for each transect.

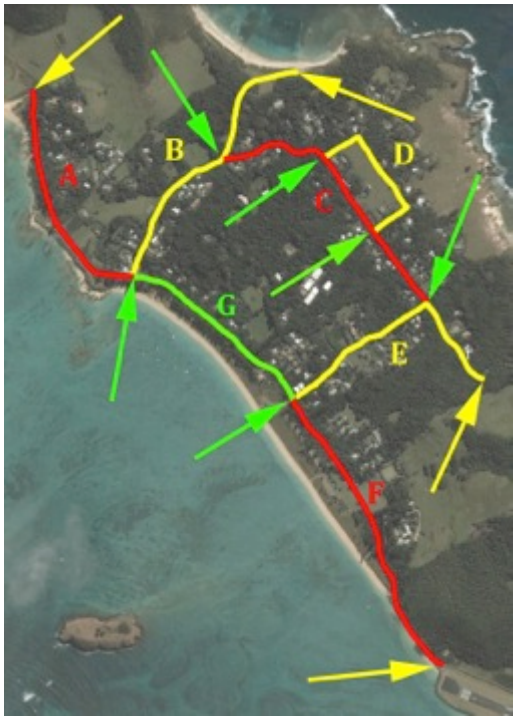


Figure 2. Map of core settlement area, LHI, with location of transects A–G

In general, no pair of observers walked the same two transects (see Table 4). For practical purposes only six species were targeted for the transect counts. The purpose of the transact counts was to survey most of the ground-feeding species present in the settlement area. It

is envisaged that in future, however, transect surveys will be conducted every available evening and may include other species.

Table 4. Allocation of observers to transects, LHI core settlement, September 2013

Observer	*Av. speed (km/hr)*	*Transects*						
		A	*B*	*C*	*D*	*E*	*F*	*G*
Ob1	2.9	0	2	0	0	0	2	0
Ob2	2.6	0	2	0	0	0	2	0
Ob3	2.7	2	0	2	0	0	0	0
Ob4	3.1	0	0	2	2	0	0	0
Ob5	3.9	0	0	0	0	2	0	2
Ob6	4.0	0	0	0	2	2	0	0
Ob7	3.2	2	0	0	0	0	0	2
Transect length (m)		*750*	*970*	*900*	*570*	*820*	*970*	*670*

Statistical analysis of transect data

The potential predictors of the abundance of a species include transect number, observer, date, transect length, survey duration and speed. The nature of the predictors suggests that a multilevel or mixed model should be considered. In addition, the fact that the abundance estimates are simple counts of individual birds seen also suggests that a generalized linear model be fitted. The first three factors of the above list are categorical variables and could all be considered as random effects, while the last three are continuous variables and are probably better thought of as fixed effects.

Generalized linear mixed models were fitted to the count data of the following species: Blackbird, Buff-banded Rail, Emerald Dove and Song Thrush. Statistical software R (R Core Team, 2013) was used. The core packages were supplemented with "lme4" (Bates *et al.,* 2013) and "Arm" (Gelman and Yu-Sung, 2013) packages. A full model was fitted for each species and the random effects removed one by one and tested to establish which random effects contribute to the model. The fixed effects were then removed, again one by one and tested using a log likelihood ratio test.

The estimated number of individuals and 95% confidence limits were derived from the final fitted model taking into account the random effects, if necessary, following procedures outlined in Gelman and Hill (2007)**.**

Species names

Species names used in this report follow current preferred internationally accepted nomenclature (see Appendix C). For simplicity, some of the common names have been shortened to conform with island usage.

Survey dates and weather conditions

The 2013 survey was conducted between 8 and 14 September. Teams were in the field soon after dawn each day and ready to start by about 0600. Teams often worked through until late morning. The time to complete a set of counts varied mostly due to the time taken to reach all allotted count sites.

Most days were overcast with light winds, which generally blew from the W or N except on the second survey day (E) and on the sixth survey day (SSW). Light showers delayed departure by about an hour on the second morning; it was windy on the third and fourth mornings when conditions may have been marginal for optimal surveying at a few count sites because the rustle of tree leaves was noisy. However, detection of birds by call was probably not diminished significantly within the short range of 50 metres from an observer. Day five was a perfect surveying day – warm with no wind and a clear sky. It was again windy with the threat of rain on the last day but conditions were not so serious that we needed to abandon surveying. Some weather observations for the week are shown in Table 5.

Table 5. Selected daily weather observations, LHI, 7–14 September 2013

					Max wind gust		
Date	*Day*	*Min °C*	*Max °C*	*Rain (mm)*	*Direction*	*Speed (km/h)*	*Time*
7	Sat	11.2	20.5	0	W	28	08:54
8	Sun	17.4	21.0	0	WNW	31	12:08
9	Mon	14.7	20.8	3.6	E	52	04:55
10	Tue	16.6	21.9	0	NNW	43	19:47
11	Wed	18.9	22.3	0	N	57	03:17
12	Thu	12.1	21.0	0.4	NW	57	03:17
13	Fri	15.3	18.4	13.6	SSW	50	12:47
14	Sat	11.4	19.8	0	NNE	54	20:23

Source: Bureau of Meteorology website

Results and discussion

Site counts

The maximum number of times that any one species could be recorded was 300: the sum of 42 sites each with two visits and 54 sites each with four visits. Table 6 shows the distribution of the *sites* in the vegetation groups and habitat zones.

Table 6. No. of count sites in three vegetation types in five habitat zones, LHI

Vegetation group[1]	*Habitat zone*[2]					**Total count sites**
	1	*2*	*3*	*4*	*5*	
Lowland forest	26	6	8	4	8	**52**
Palm forest	2	14	2	0	8	**26**
Open	0	8	1	8	1	**18**
Total surveys	**28**	**28**	**11**	**12**	**17**	**96**

[1] See Table 1.
[2] See Table 2.

By contrast, Table 7 shows the distribution of *counts* within the 10 vegetation groups in the five habitat zones.

Table 7. No. of counts in three vegetation groups in five habitat zones, LHI

Vegetation group[1]	*Habitat zone*[2]					**Total counts**
	1	*2*	*3*	*4*	*5*	
Lowland forest	60	24	28	16	16	**144**
Palm forest	4	52	4	0	28	**88**
Open	0	32	4	28	4	**68**
Total surveys	**64**	**108**	**36**	**44**	**48**	**300**

[1] See Table 1.
[2] See Table 2.

Abundance, reporting rate, frequency and group size

Table 8 shows the abundance, reporting rate, frequency and group size, irrespective of vegetation or habitat, for 16 birds recorded in 96 survey sites on Lord Howe Island. The reporting rate is given in descending order.

The most common bird in terms of reporting rate and abundance was the Golden Whistler. The number of Silvereye individuals in a survey plot was difficult to estimate given their flocking behaviour, their quick passage through the survey plots and the fact that they were usually detected only by calls. For the Silvereye, only occurrence was analysed and no estimate of abundance or group size was possible.

A noticeable reduction in all indices occurred for the next three most frequently reported species – Blackbird, Magpie-lark and Pied Currawong – but for the rest all indices, except group size, were much smaller.

Table 8. Abundance, reporting rate, frequency and group size for 16 bird species recorded in 96 survey sites, LHI

Species Name	*Abundance*	*Reporting rate*	*Frequency*	*Group size*
Golden Whistler	1.65	0.71	0.88	2.33
Silvereye		0.69	0.83	
Blackbird	0.50	0.24	0.29	2.11
Magpie-lark	0.46	0.23	0.33	2.03
Pied Currawong	0.29	0.20	0.36	1.46
Emerald Dove	0.18	0.14	0.28	1.29
Buff-banded Rail	0.17	0.11	0.17	1.55
Sacred Kingfisher	0.11	0.09	0.18	1.19
Swamphen	0.13	0.06	0.10	2.05
Woodhen	0.08	0.06	0.11	1.21
Masked Lapwing	0.07	0.05	0.10	1.57
Song Thrush	0.04	0.04	0.08	1.18
Feral Pigeon	0.05	0.01	0.04	3.75
Feral Duck	0.05	0.01	0.02	5.00
White-faced Heron	0.01	0.01	0.02	1.00
Starling	0.01	0.01	0.02	1.50

Table 9 shows the reporting rate, abundance and frequency for the most commonly reported species, the Golden Whistler, and the two species of greatest concern: the Woodhen and the Pied Currawong. The three indices for observations within the plot area are presented defined by vegetation and habitat zone. For the Golden Whistler, the lowest reporting rate and abundance was in vegetation group 3 (Pasture, Dune, Golf course) within habitat zone 2 (Settlement) and 4 (Suburban), while the highest frequency was in vegetation group 1 *(Drypetes/Cryptocarya*) within habitat zone 1 (North Hills).

For the Woodhen, the highest reporting rate and abundance was in habitat zone 4 (Suburban) within vegetation group 1 (*Drypetes/Cryptocarya*) and group 3 (Pasture, Dunes, Golf course). The highest reporting rate and abundance for the Pied Currawong was in habitat zone 4 (Suburban) within vegetation group 1 (*Drypetes/Cryptocarya*).

Table 9. Reporting rate, abundance and frequency for the Golden Whistler, Woodhen and Pied Currawong, defined by vegetation group and habitat zone

Golden Whistler									
	Reporting rate			Abundance			Frequency		
Vegetation Group	1	2	3	1	2	3	1	2	3
Habitat zone									
1	0.88	1.00		1.92	2.25		0.27	0.02	
2	0.92	0.79	0.09	2.38	2.10	0.09	0.06	0.14	0.03
3	0.96	1.00	0.50	2.39	2.50	1.50	0.08	0.02	0.01
4	0.88		0.29	1.94		0.39	0.04		0.04
5	0.75	0.68	1.00	1.81	1.50	1.75	0.07	0.07	0.01

Woodhen									
	Reporting rate			Abundance			Frequency		
Vegetation Group	1	2	3	1	2	3	1	2	3
Habitat zone									
1	0.02	0.00		0.02	0.00		0.01	0.00	
2	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.38		0.21	0.56		0.21	0.03		0.03
5	0.06	0.14	0.00	0.06	0.18	0.00	0.01	0.02	0.00

Pied Currawong									
	Reporting rate			Abundance			Frequency		
Vegetation Group	1	2	3	1	2	3	1	2	3
Habitat zone									
1	0.23	0.00		0.27	0.00		0.09	0.00	
2	0.13	0.08	0.03	0.25	0.12	0.06	0.02	0.04	0.01
3	0.25	0.50	0.25	0.32	0.50	0.25	0.04	0.01	0.01
4	0.75		0.00	1.38		0.00	0.04		0.00
5	0.19	0.43	0.00	0.19	0.68	0.00	0.02	0.07	0.00

Species distribution

Figures 3–5 show the 2013 frequency distribution of 12 species across the lowlands of Lord Howe Island. These distribution maps are based on the relative occurrence of each species derived from the accumulated site counts. Site counts have been distributed within a grid pattern extending across the survey area (see Figure 1). For most grids there are two paired counts available, but for some only a single count was within the grid. For one grid three paired count sites were included. Correction for differences in the number of paired site counts for each grid were taken into account, bearing in mind that some paired sites were counted twice and others four times during this survey (see Methods). Distribution maps were not prepared for four species with too little data: White-faced Heron, Feral Duck, Feral Pigeon and Starling.

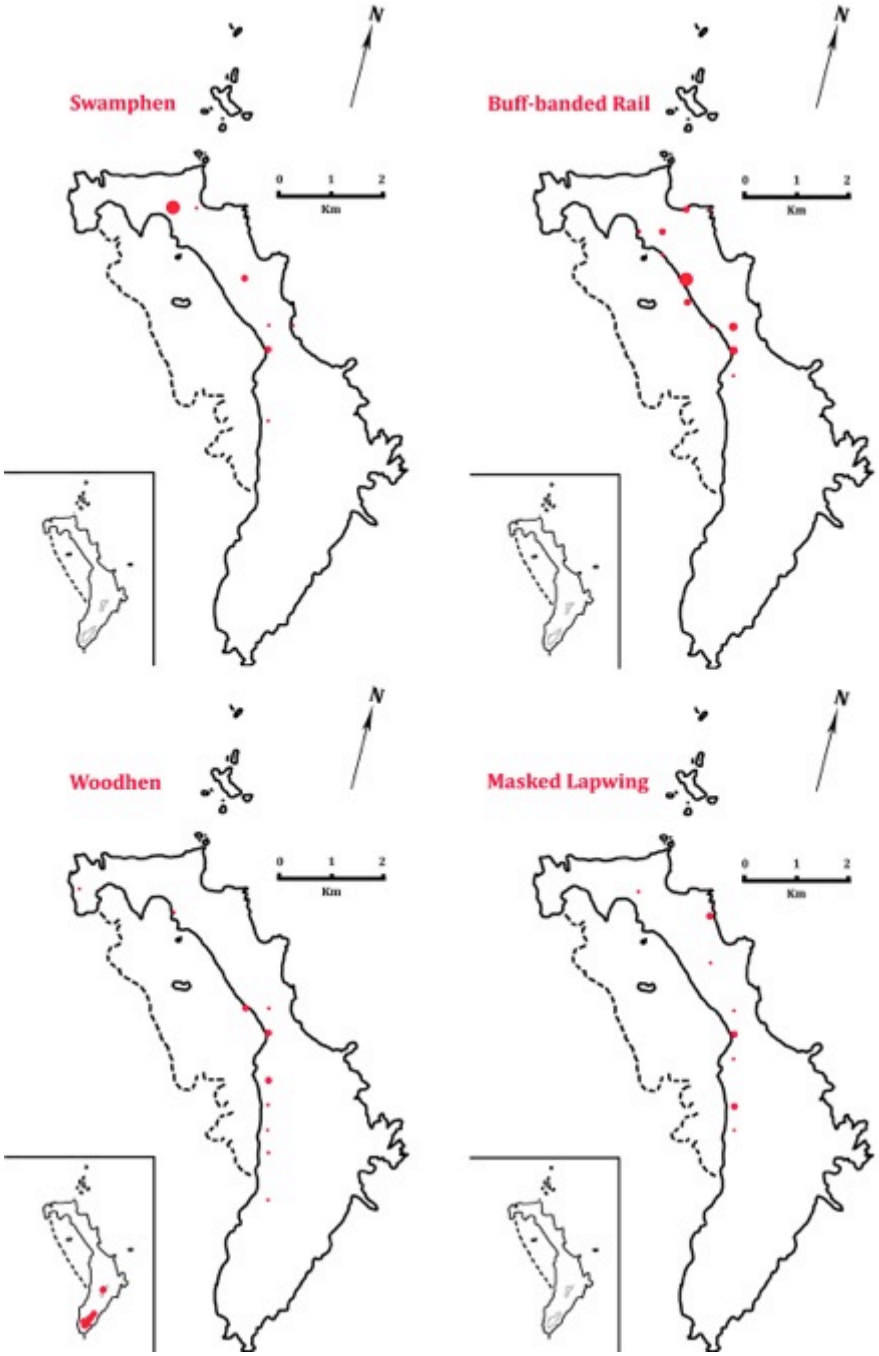


Figure 3. Distribution of Swamphen, Buff-banded Rail, Woodhen and Masked Lapwing, September 2013, across northern LHI, by frequency of occurrence at count sites

The size of each dot corresponds to the number of times each species is recorded as present within each grid cell. The smallest dot indicates a single occurrence, with increasing dot size for 2–4 and 5–7 occurrences, leaving the largest dot to indicate a maximum of 8 out of 8 counts. On each species map the vignette (lower left) shows the distribution of that species as recorded in 1971–2 (reproduced from Fullagar *et al*., 1974). Note that the Swamphen, Buff-banded Rail and Masked Lapwing did not occur on Lord Howe Island at that time.

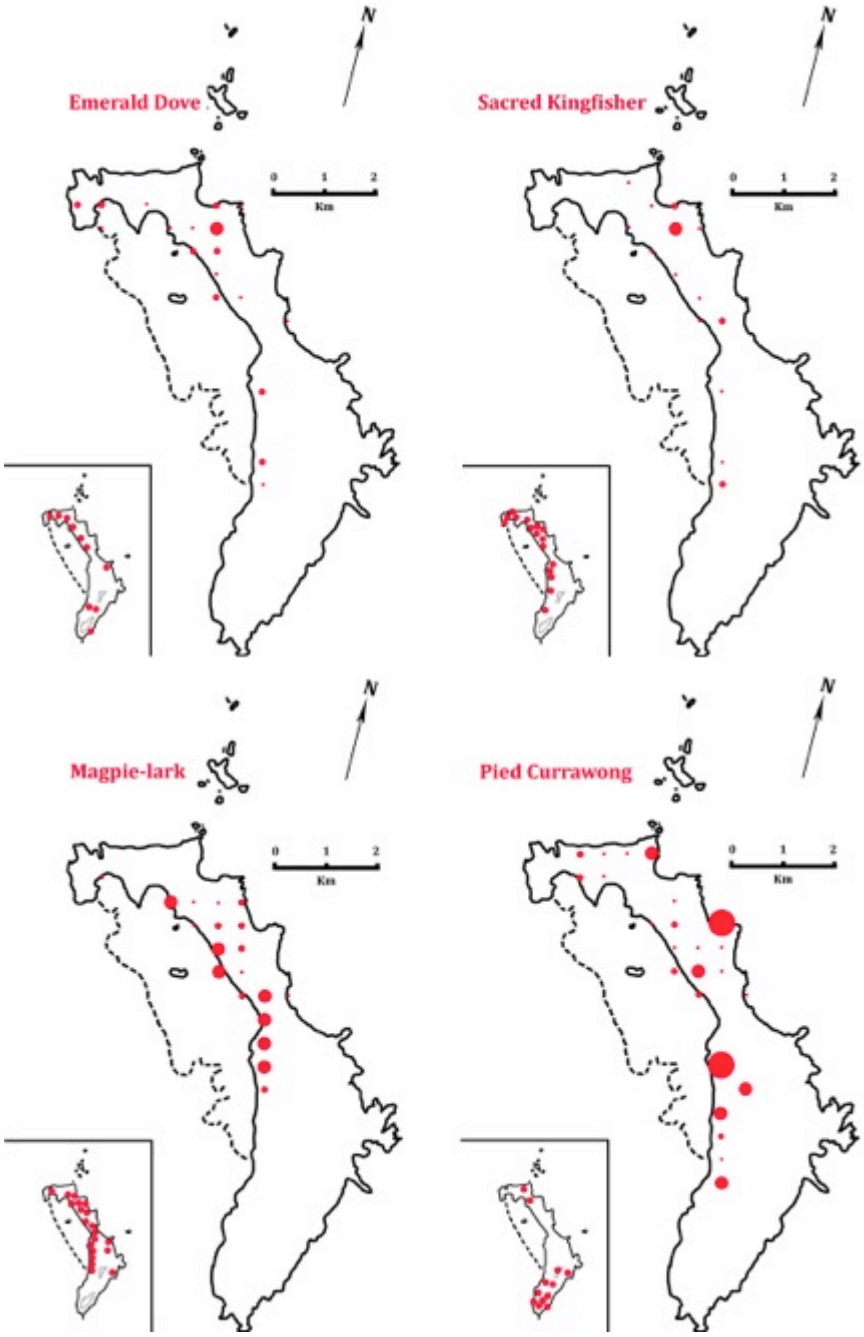


Figure 4. Distribution of Emerald Dove, Sacred Kingfisher, Magpie-lark and Pied Currawong, September 2013, across northern LHI, by frequency of occurrence at count sites

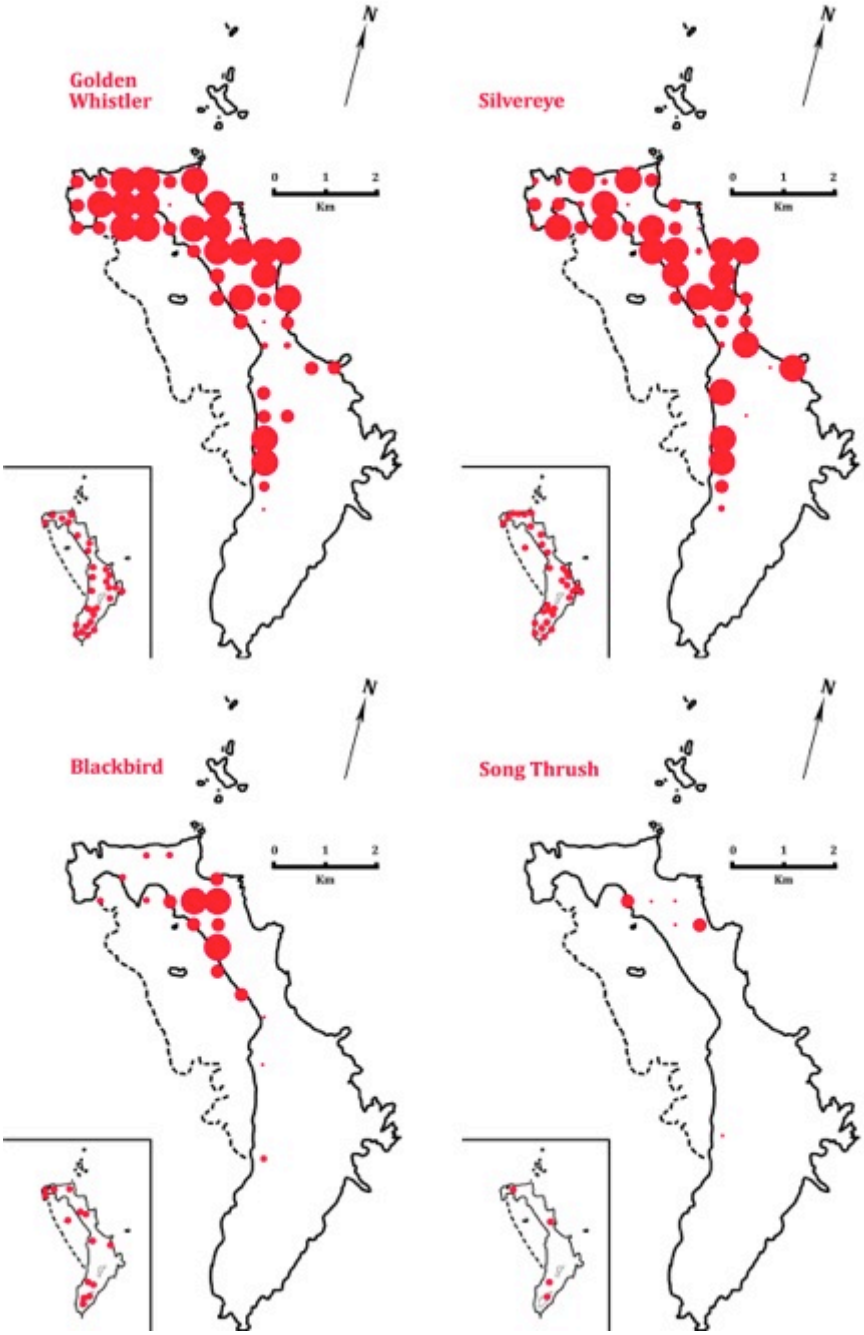


Figure 5. Distribution of Golden Whistler, Silvereye, Blackbird and Song Thrush, September 2013, across northern LHI, by frequency of occurrence at count sites

Count sites in 2007 were distributed within a pattern of grid cells similar to those used for the 2013 mapping (see Figure 6).

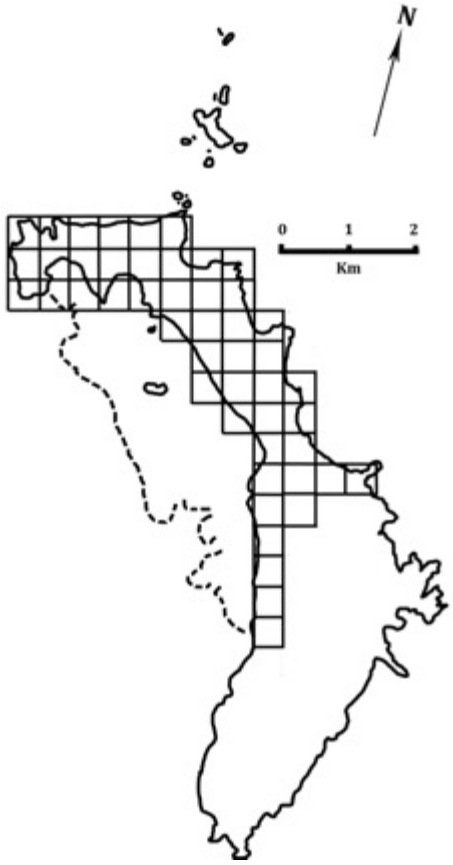


Figure 6. Grid cells used for surveying distribution of landbirds on LHI, based on March 2007 point counts

Maps prepared from data collected in March 2007 are shown in Figures 7–9. The original intention in 2007 was that each grid cell would be represented by two paired counts giving a total of four counts for the grid. However, in preparing the maps in Figures 7–9, allowance had to be made for grids with less than two paired counts (25 grid cells had only one paired count, two grids had only one count and one had three counts) with proportional adjustments made to the available numbers to make them comparable with grids having four counts.

The size of each dot corresponds to the number of times each species is recorded as present within each grid cell. The smallest dot indicates a single occurrence with increasing dot size for 2 and 3 occurrences leaving the largest dot to indicate a maximum of 4 out of 4 counts.

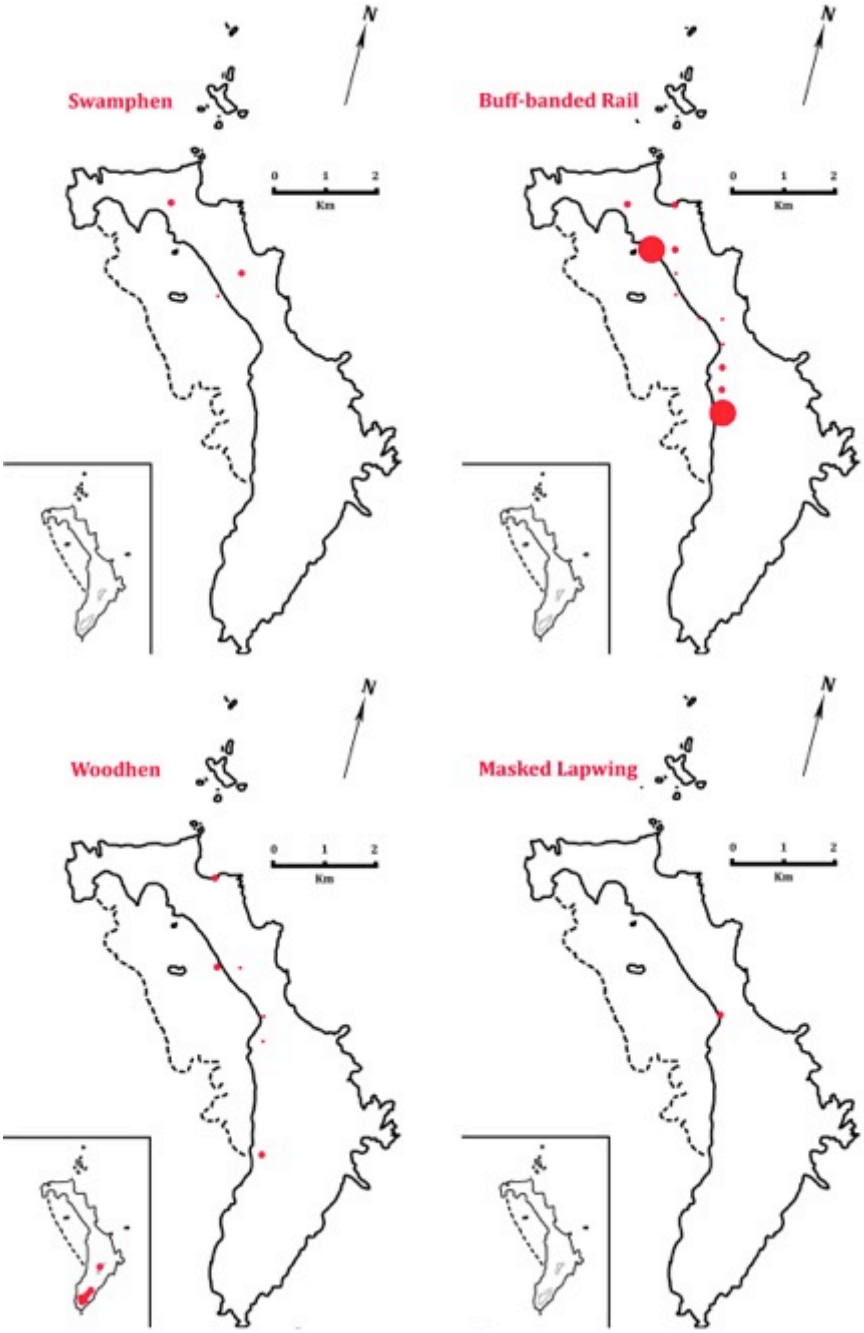


Figure 7. Distribution of Swamphen, Buff-banded Rail, Woodhen and Masked Lapwing, March 2007, across the northern areas of LHI, by frequency of occurrence at count sites

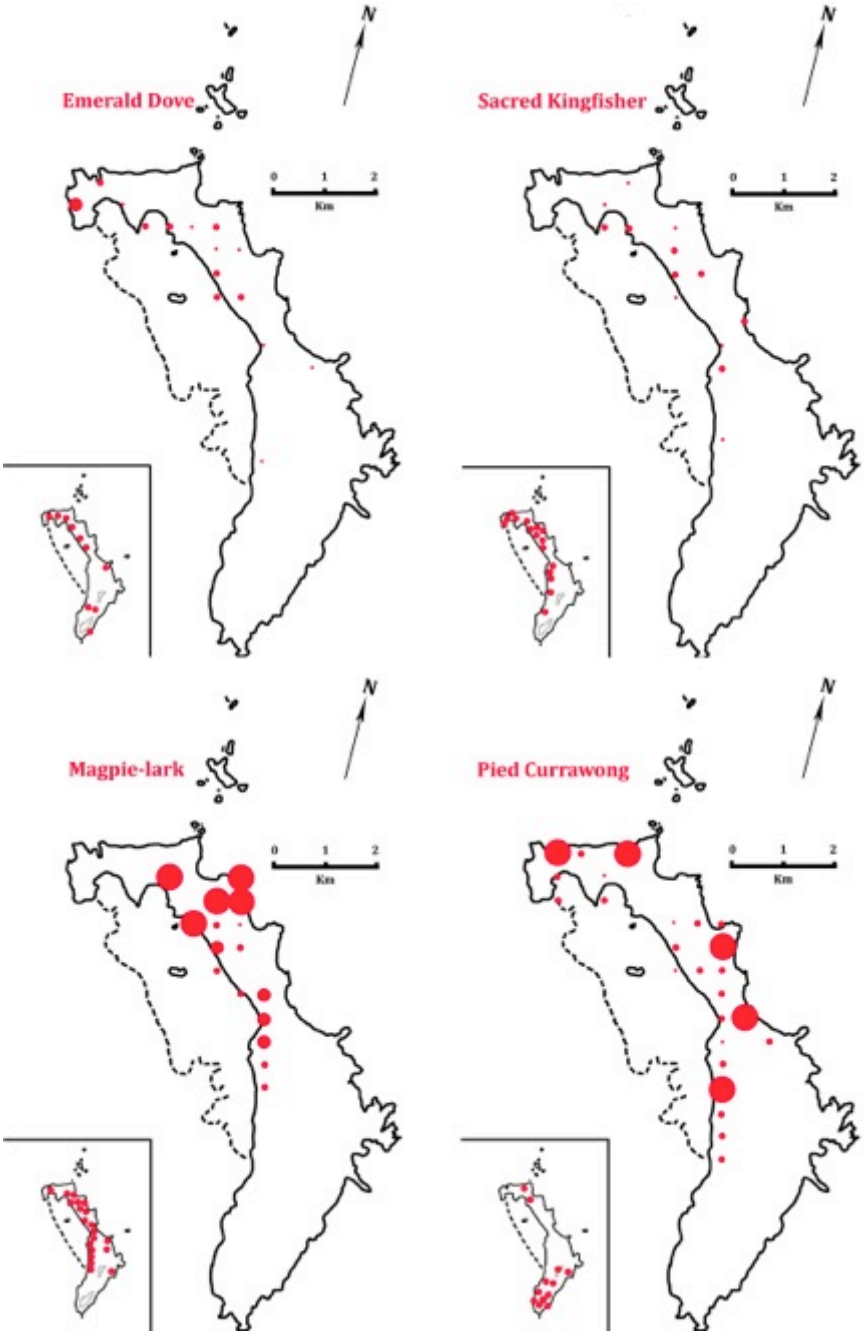


Figure 8. Distribution of Emerald Dove, Sacred Kingfisher, Magpie-lark and Pied Currawong, March 2007, across northern LHI, by frequency of occurrence at count sites

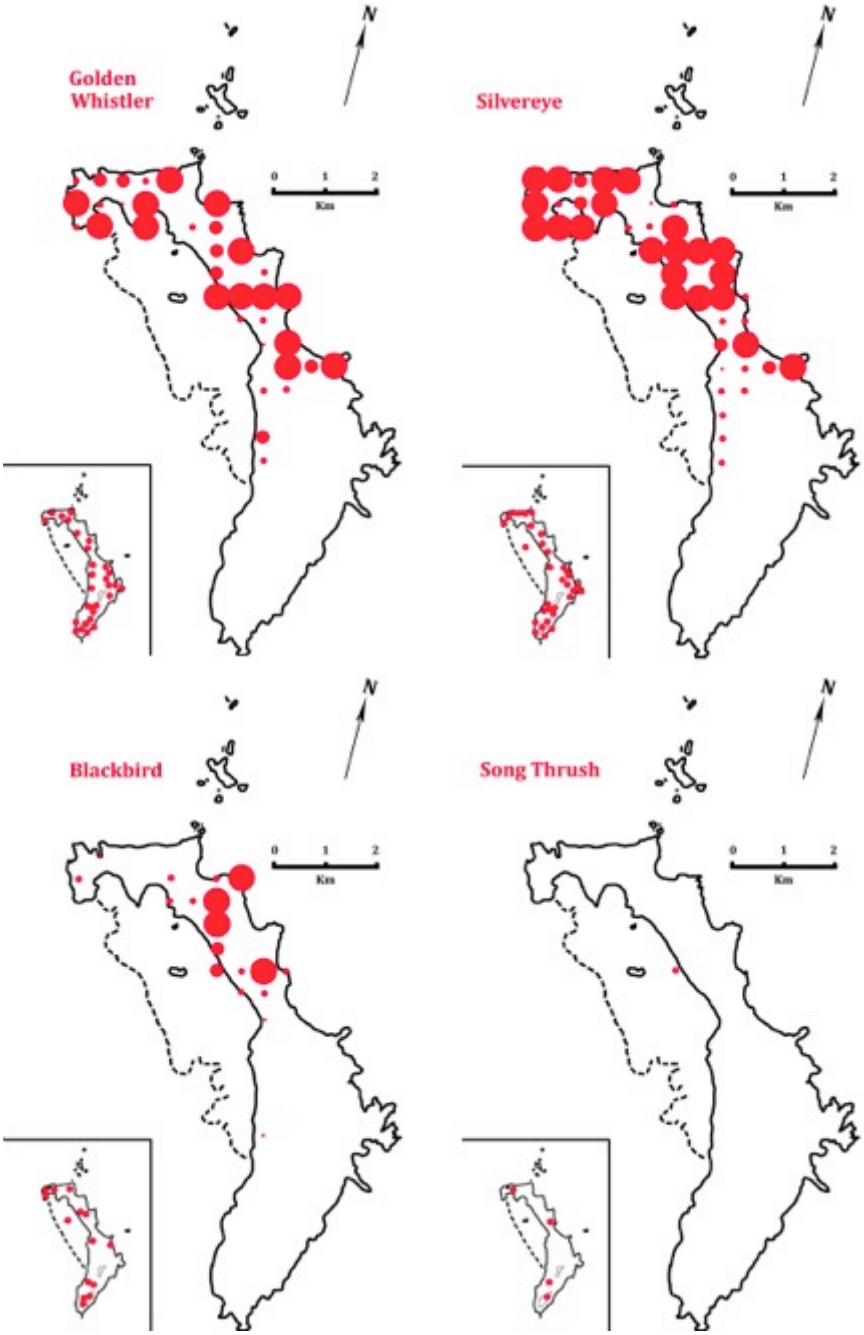


Figure 9. Distribution of Golden Whistler, Silvereye, Blackbird and Song Thrush, March 2007, across northern LHI, by frequency of occurrence at count sites

The most widespread species were Magpie-lark, Pied Currawong, Golden Whistler, Silvereye and Blackbird and their distribution was not very different when comparing data from 2007 with 2013. Magpie-larks avoid the mountain areas of the southern parts of the island but all the other species are widespread (see 1971–2 maps). The Silvereye is clearly the most widespread landbird on Lord Howe Island.

Again, the distribution patterns of Emerald Dove and Sacred Kingfisher differed little between the 2007 and 2013 maps. They are far less abundant landbirds, with the Sacred Kingfisher restricted to lowland areas, but not so the Emerald Dove (see 1971–2 maps).

Swamphen, Buff-banded Rail and Masked Lapwing only occur on the island's lowlands. None of the three species was present in 1971–2. The maps indicate that the Buff-banded Rail and the Woodhen were sparsely distributed in 2007 and 2013. Both species were also far less frequently detected across the lowlands than most other landbirds.

The Woodhen in 1971–2 had a restricted distribution range (as it had been for many years), to the summit plateau of Mt Gower, with a single record from Mt Lidgbird. It is now patchily distributed across the lowlands with only a small number present in the northern hills at North Bay. Most Woodhens occur within the closely settled parts of the lowlands and particularly in the lowland forests at the southern end of the surveyed area. The least widespread landbird was the Song Thrush. This seems to have been always so with few seen in 2007 and as far back as 1971–2.

During the 2013 survey, 20 Woodhen and 10 Pied Currawong were held in captivity in a trial of methods needed for securing these species during the proposed rodent eradication.

Transect counts

The average duration of a transect walk was 16 minutes (range 9–30 minutes). This gave a total of 28 observations of the number of individuals of six species. Table 10 presents the raw mean number of individuals per species per transect walked and the frequency of a species recorded.

Table 10. Frequency and mean no. of individuals of six species, LHI core settlement transects, September 2013

Species	*Frequency*	*Mean*
Emerald Dove	14	0.8
Buff-banded Rail	18	1.7
Woodhen	4	0.2
Sacred Kingfisher	2	0.1
Blackbird	28	10.1
Song Thrush	7	0.5

There is a significant difference in observer walking speed (P< 0.001, see Figure 10) which may lead to differences in survey effort not related to the transect length. There is a faster speed on the second date compared with the first (3.0 compared with 3.4 km/hr, P<0.01).

The Blackbird was most frequently seen (on all occasions) and the most abundant species. The Buff-banded Rail, Emerald Dove and Song Thrush were the next most frequently recorded species and probably recorded sufficiently frequently to permit analysis. The other two species – Sacred Kingfisher and Woodhen – were recorded infrequently and formal analysis is probably not warranted.

Generalized linear mixed models were fitted to the four most abundant species. In all cases there were no significant influences due to the fixed effects, the direction of traversing the transect, the duration of the observation period or the length of the transect.

Table 11 presents the estimated mean number of the four most frequently seen individuals per transect. The estimates and confidence limits are based on the results of fitting a generalized linear mixed model.

Table 11. Estimated mean no. of the four most abundant species from transect counts, and 95% confidence limits

Species	*Mean*	*Lower limit*	*Upper limit*
Blackbird	9.88	7.78	12.41
Buff-banded rail	1.72	1.27	2.26
Emerald Dove	0.75	0.49	1.11
Song Thrush	0.50	0.28	0.83

The boxplot in Figure 10 shows the variation in speed walked by the seven observers. The bold horizontal line indicates the median speed walked. The box also outlines the 25% and 75% quantiles, with the whiskers representing the minimum and maximum respectively.

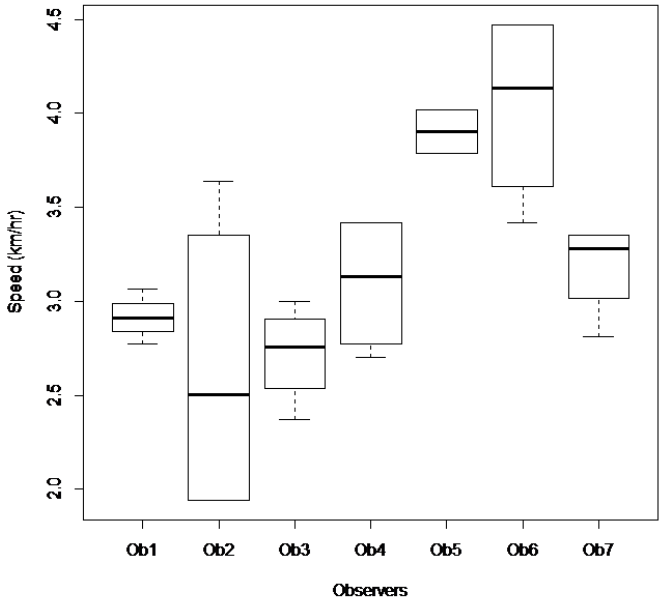


Figure 10. Boxplot showing variation in speed walked by the seven observers

Bird atlas data

Data submitted by early November 2013 to Birdlife Australia indicated that, by the end of September, 119 survey forms had been submitted by volunteers from the 24 survey sites. Between October and November 2012, 30 forms had been submitted. None were submitted between December 2012 and March 2013, with the remaining 89 submitted from 20 sites for the period from June onwards. The monitoring sites were officially launched in July 2013.

Between October 2012 and September 2013, surveys had been conducted by six volunteer observers with one survey conducted by an observer whose identity was not recorded.

The 24 sites could be surveyed at any time of the day. Sixteen were surveyed by enumerating the abundance for each species over a 20-minute period within defined but variable areas or along set tracks of variable length. These sites are termed '20-minute search' sites. Three of these sites include a short track terminating in recording birds from a lookout point (sites LHI15, LHI16, LH19). The remaining eight sites, termed 'General area search' are designed to record species and their abundance over variable time periods, but all within the same day with varying but defined areas. The '20-minute search' sites are designed to monitor the bush birds, while the 'General area search' sites are designed to monitor waders and waterbird populations. For a detailed description of the Birdlife Australia monitoring sites see http://birdlife.org.au/documents/ATL-LHI-Lord_Howe_Bird_Monitoring_Site_Guide.pdf

In all cases, surveys appear to have been conducted by the recommended method except for site LHI10 where four surveys were conducted as a '20-minute search' rather than as a 'General area search'.

Acknowledgements

The survey was conducted under an arrangement between the Lord Howe Island Board and the Canberra Ornithologists Group. The report was compiled by Peter Fullagar and Chris Davey with statistical input from A O (Nick) Nicholls. Ian Hutton was responsible for the arrangements and logistical support on the island and provided invaluable input with his intimate knowledge of the flora and fauna of the island. The survey teams were Lia Battisson, Ian Hutton, Martyn Moffat, Mark Allen, Kathy Walter, John Goldie, Peter Fullagar and Chris Davey all, apart from Ian Hutton, members of the Canberra Ornithologists Group.

We thank Birdlife Australia for providing us with a copy of records collected between October 2013 and September 2014 from the 24 Bird Monitoring Sites on the island. Finally, we thank David Priddel and the Lord Howe Island Board for their support

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APPENDIXES

Appendix A. Location, vegetation code and group, habitat zone and number of surveys for each of the 96 survey sites, LHI

	Geolocation		*Vegetation code*	*Vegetation group*	*Habitat zone*	*No. of surveys*
Site number	*Latitude*	*Longitude*				
1	31 31 09.2	159 02 27.8	1	1	1	2
2	31 31 06.7	159 02 25.2	1	1	1	2
3	31 31 16.8	159 02 31.0	1	1	1	2
4	31 31 12.8	159 02 31.0	1	1	1	2
5	31 31 05.8	159 02 21.4	1	1	1	2
6	31 31 04.3	159 02 24.7	1	1	1	2
7	31 31 00.4	159 02 24.8	4	1	1	2
8	31 30 56.9	159 02 23.0	4	1	1	2
9	31 31 01.2	159 02 31.7	5	2	1	2
10	31 31 00.3	159 02 37.3	5	2	1	2
11	31 30 57.4	159 02 39.8	1	1	1	2
12	31 30 54.7	159 02 37.3	1	1	1	2
13	31 30 56.1	159 02 56.5	1	1	1	2
14	31 30 52.9	159 02 57.7	1	1	1	2
15	31 30 52.2	159 03 04.4	1	1	1	2
16	31 30 50.1	159 03 01.6	1	1	1	2
17	31 30 58.3	159 03 05.2	1	1	1	2
18	31 31 02.9	159 03 09.0	1	1	1	2
19	31 31 05.0	159 02 55.2	1	1	1	2
20	31 31 04.5	159 02 59.4	1	1	1	2
21	31 31 02.0	159 03 03.4	1	1	1	2
22	31 30 59.3	159 03 01.0	1	1	1	2
23	31 31 08.1	159 03 11.3	3	1	1	2
24	31 31 11.0	159 03 09.1	3	1	1	2
25	31 30 52.5	159 03 20.3	1	1	1	4
26	31 30 55.0	159 03 25.0	1	1	1	4
27	31 30 52.9	159 03 39.6	3	1	1	4
28	31 30 49.6	159 03 39.7	3	1	1	4
29	31 31 08.1	159 03 46.4	6	3	2	4
30	31 31 10.9	159 03 44.0	6	3	2	4
31	31 31 06.0	159 03 34.4	6	3	2	4
32	31 31 05.8	159 03 30.4	6	3	2	4
33	31 31 15.7	159 03 29.5	5	2	2	4

34	31 31 18.7	159 03 30.1	5	2	2	4
35	31 31 23.8	159 03 44.6	5	2	2	4
36	31 31 21.3	159 03 47.0	5	2	2	4
37	31 31 09.8	159 04 04.7	1	1	2	4
38	31 31 07.1	159 04 09.1	1	1	2	4
39	31 31 08.9	159 04 19.2	10	2	2	4
40	31 31 12.1	159 04 16.3	10	2	2	4
41	31 31 17.1	159 04 18.9	6	3	2	4
42	31 31 21.3	159 04 18.9	6	3	2	4
43	31 31 19.1	159 04 01.0	5	2	2	4
44	31 31 22.4	159 03 59.4	5	2	2	4
45	31 31 29.0	159 04 06.3	5	2	2	4
46	31 31 32.2	159 04 10.4	5	2	2	4
47	31 31 33.6	159 03 51.2	5	2	2	4
48	31 31 28.1	159 03 50.3	5	2	2	4
49	31 31 32.1	159 04 21.7	5	2	2	2
50	31 31 35.6	159 04 23.8	5	2	2	2
51	31 31 42.3	159 04 39.5	5	2	3	2
52	31 31 40.1	159 04 44.2	5	2	3	2
53	31 31 51.2	159 04 33.4	1	1	3	2
54	31 31 53.3	159 04 36.4	1	1	3	2
55	31 31 52.2	159 04 22.9	6	3	2	4
56	31 31 53.9	159 04 18.5	6	3	2	4
57	31 31 58.8	159 04 10.6	1	1	2	4
58	31 31 55.4	159 04 07.2	1	1	2	4
59	31 31 48.6	159 04 04.5	1	1	2	4
60	31 31 45.4	159 04 01.5	1	1	2	4
61	31 32 07.3	159 04 20.4	1	1	3	4
62	31 32 07.6	159 04 23.4	1	1	3	4
63	31 32 21.0	159 04 29.5	1	1	4	4
64	31 32 24.7	159 04 34.6	1	1	4	4
65	31 32 18.5	159 04 40.1	6	3	4	4
66	31 32 20.2	159 04 45.1	6	3	4	4
67	31 31 59.9	159 04 37.7	3	1	3	4
68	31 32 03.4	159 04 38.6	3	1	3	4
69	31 32 07.8	159 04 49.6	3	1	3	4
70	31 32 10.8	159 04 53.1	2	1	3	4
71	31 32 17.2	159 04 50.3	7	3	3	4
72	31 32 32.4	159 04 59.4	7	3	5	4
73	31 33 05.1	159 04 32.3	6	3	4	2

74	31 33 03.1	159 04 37.5	6	3	4	2
75	31 33 09.8	159 04 58.1	9	2	5	2
76	31 33 09.4	159 04 54.4	9	2	5	2
77	31 33 19.0	159 04 43.9	1	1	5	2
78	31 33 23.4	159 04 40.5	1	1	5	2
79	31 33 30.9	159 04 36.9	5	2	5	4
80	31 33 34.5	159 04 35.8	5	2	5	4
81	31 33 43.6	159 04 34.2	5	2	5	4
82	31 33 40.6	159 04 35.3	5	2	5	4
83	31 33 58.0	159 04 32.9	5	2	5	4
84	31 34 03.2	159 04 31.5	5	2	5	4
85	31 32 33.6	159 04 40.9	6	3	4	4
86	31 32 33.2	159 04 45.6	6	3	4	4
87	31 32 46.7	159 04 40.5	8	3	4	4
88	31 32 43.4	159 04 41.5	8	3	4	4
89	31 32 52.0	159 04 42.0	1	1	4	4
90	31 32 55.1	159 04 39.7	1	1	4	4
91	31 32 37.4	159 04 54.2	1	1	5	2
92	31 32 37.7	159 04 57.7	1	1	5	2
93	31 32 42.3	159 05 06.2	1	1	5	2
94	31 32 43.9	159 05 10.7	1	1	5	2
95	31 32 49.3	159 05 26.8	1	1	5	2
96	31 32 52.7	159 05 27.4	1	1	5	2

Appendix B. Description of start point and turning point for all transects (A–G)

See Figure 2 for a map of the Lord Howe Island settlement area showing the seven transects. The protocol for these transect counts is also included here.

Description of each transect location

A. Intersection of Neds Beach Road and Lagoon Road to the bridge at Old Settlement Creek.
B. Intersection of Neds Beach Road and Lagoon Road to Neds Beach bathing huts.
C. Intersection of Anderson Road and Neds Beach Road to the corner at the top of Middle Beach Road.
D. Intersection of Anderson Road and Muttonbird Drive up to and along Skyline Drive down McGees Parade to the intersection with Anderson Road.
E. Intersection of Middle Beach Road and Lagoon Road up Middle Beach Road to Anderson Road turning right (S) and down Anderson Road to Bowker Avenue walking track (which is a little difficult to see but is on the W or right hand side of the road and marked by a small triangular trail marker).
F. Intersection of Middle Beach Road and Lagoon Road to the gate at the corner of the airfield at Windy Point.
G. Intersection of Ned's Beach Road with Lagoon Road to the intersection of Middle Beach Road and Lagoon Road (beside the LHI Museum).

Protocol for transect counts

1. Count only the six species of birds (Buff-banded Rail, Woodhen, Sacred Kingfisher, Emerald Dove, Blackbird and Song Thrush). Include all seen or heard on a slow walk from the defined start point to the defined finish point (outward count) and, as a new count, on the return walk to the start point (return count). Keep these two counts separate.

2. Count in the evening not before 1700 in September – later in mid-summer.

3. Indicate which transect you have counted and include your name and the date.

4. Record the start and finish time for your outward count and your return count.

5. Count all individuals you detect both sides of the road. There is no particular limit on distance but it would be reasonable not to include calls from birds or sightings that are, say, more than 25 metres from the roadside. Do not worry that you might count the same individual or individuals that could have been be seen on another transect at the transect intersections. Just include them as part of your transect count, if you spot them.

Appendix C. Bird species recorded in 96 survey sites, LHI, 2013

Species nomenclature and names follow those recommended by the latest IOC listing (see Gill and Wright, 2006, revised 2013 as version 3.5). For some species we use a simplified alternative in this report.

Name used in this report	*IOC recommended name, if different*	*Scientific name*	*Subspecies*
Feral Duck[1]		*Anas platyrhynchos*	
White-faced Heron		*Egretta novaehollandae*	
Woodhen	Lord Howe Woodhen	*Gallirallus sylvestris*	
Buff-banded Rail		*Gallirallus philippensis*	
Swamphen	Purple Swamphen	*Porphyrio porphyrio*	
Masked Lapwing		*Vanellus miles*	*novaehollandiae*
Pacific Golden Plover		*Pluvialis fulva*	
Bar-tailed Godwit		*Limosa lapponica*	
White Tern		*Gygis alba*	*candida*
Sooty Tern		*Onychprion fuscatus*	*kermadeci*
Feral Pigeon		*Columba livia*	
Emerald Dove	Pacific Emerald Dove	*Chalcophaps longirostris*	*rogersi*
Sacred Kingfisher		*Todiramphus sanctus*	*vagans*
Pied Currawong		*Strepera graculina*	*crissalis*[2]
Golden Whistler	Australian Golden Whistler	*Pachycephala pectoralis*	*contempta*[2]
Magpie-lark		*Grallina cyanoleuca*	
Welcome Swallow		*Hirundo neoxena*	
Tree Martin		*Hirundo nigricans*	
Silvereye		*Zosterops lateralis*	*tephropleurus*[2]
Starling	Common Starling	*Sturnus vulgaris*	
Blackbird	Common Blackbird	*Turdus merula*	
Song Thrush		*Turdus philomelos*	

Note:

1. Includes hybrids with Pacific Black Duck, *Anas superciliosa*
2. Endemic subspecies