A STATISTICAL ANALYSIS OF TRENDS IN OCCUPANCY RATES OF WOODLAND BIRDS IN THE ACT DECEMBER 1998 TO DECEMBER 2005



Prepared for Canberra Ornithologists Group (COG)

by

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1. BACKGROUND

The Woodland Project undertaken by the Canberra Ornithologists Group commenced in 1998. The report 'A Statistical Analysis of Trends in Detection Rates of Woodland Birds in the ACT, 1998 to 2004' published in 2006, gives a comprehensive background to the Project, and longitudinal trends for a range of bird species (Cunningham & Rowell 2006).

A further analysis of Project data has been undertaken, including data collected during 2005. Statistician Ross Cunningham has carried out a statistical analysis of data on 64 species in the Woodland data set that appear in more than 1% of the surveys undertaken between December 1998 and December 2005, using the same statistical methods for the 1998 to 2004 analysis. Data for a further 6 species which occurred in less than 1% of surveys was also analysed, as these included several species of interest.

The analyses have been undertaken using data from a period that begins and ends with the same season, that is, from December 1998 to December 2005. This was suggested by Cunningham and Rowell (2006), to possibly reduce the effect of strong seasonal variation, evident in detection rates of some species, on the estimated linear trend.

Methods used are as described in Cunningham and Rowell (2006).

In the previous data analysis, Cunningham and Rowell (2006) used the term 'detection' for describing the recording of a bird's presence, and all graphs showed the 'probability of detection'. In line with more recent literature, the term 'occupancy' is used in this report. The 'probability of occupancy' is the likelihood that the species is present; the assumption being that the detection of a species, given it is present, is high and the same for all species.

The Project monitoring areas are as listed at Table 1, p.6 in Cunningham and Rowell (2006). The two areas listed at the bottom of Table 6, Naas and Kama, were first surveyed during 2005, and these data are included in the latest analysis. Several species of interest occur regularly at those sites, including Brown Treecreeper, Varied Sittella, Diamond Firetail, Crested Shrike-tit and Jacky Winter.

It is noted that the spring of 2005 produced good rainfall in the Canberra region, after four years of below average annual rainfall. The 648mm rainfall for 2005 was above the long-term average (622mm), but notably the spring rains were very good (100mm in September followed by 145mm over October/November, (The Canberra Times, 15 January 2007). These are critical breeding months for many birds. This essentially adds a good breeding year to the previous data set, and illustrates some 'recovery' in 2005 by some species which had shown declining or uncertain trends to 2004.

Mulligan's Flat/Goorooyarroo North Data Analysis

In addition to the analysis of data from all Woodland Project areas, a comparison of longitudinal profiles for species has been undertaken for Mulligan's Flat (MUL) and Goorooyarroo North (GOO) data for the period December 1998 to December 2005, using the same criteria and methods.

This is the first occasion an analysis has been undertaken for individual areas in the Woodland Project. It was decided to undertake this to 'test the waters' in terms of comparing different areas. Mulligan's Flat and Goorooyarroo North were selected for this exercise, as they are large woodland areas adjacent to each other, with substantial data sets of surveys from 1998. While their histories are broadly similar, there are some differences, and there are some differences in topography. These reserves are also the subject of an ANU experimental research project on woodlands ecology.

It should be noted that Mulligan's Flat has 24 monitoring sites, some of which are in dry forest, whereas Goorooyarroo North has 9 monitoring sites, all in grassy woodland. However, for the purpose of this analysis, it was decided to include all the Mulligan's Flat data/sites.

A problem relating to analyzing individual area data is that the number of species which fits the criteria for analysis (occurring in more than 1% of surveys) is less, due to the smaller number of records.

Nonetheless, this analysis gives some interesting comparisons of some species in the two reserves (refer Table 3 and Appendix 4).

2. RESULTS

The summary statistics on longitudinal trends in occupancy rates for 61 species which occur in more than 1% of surveys, plus 6 less common species, is given in Appendix 1. The p-values provide a measure of the strength of evidence against a null hypothesis of no long-term linear trend. Three waterbirds (Australasian Grebe, Wood Duck, Pacific Black Duck) were removed from the analysis as they were mainly associated with small dams which occurred at some sites.

A summary table (Appendix 2) provides the trends and comments on the trends for each species. This updates a similar table for species (Table 6), in Cunningham and Rowell (2006), and follows the same order of species to enable easy comparison.

Graphs showing the data with various representations of trends are given in Appendix 3 and Appendix 4. Appendix 3 has the trends for all areas and Appendix 4 has the trends for Mulligan's Flat and Goorooyarroo North data. All graphs include a marker for the January 2003 bushfires.

All Woodland Project Areas

A summary of those species where the data shows a significant change ($p \leq 0.05$) in occupancy rate is given in Table 1.

Table 1. Species showing a significant change ($p \leq 0.05$) in occupancy rate between December 1998 and December 2005

Species	p-value	Change in occupancy rate (%)
INCREASE		
Crested Pigeon	0.03	15
Sulphur-crested Cockatoo	0.01	9
Galah	0.02	7
Weebill	0.00	14
Speckled Warbler	0.01	15
Noisy Miner	0.00	17
White-winged Chough	0.01	15
Australian Raven	0.02	10
DECREASE		
Pallid Cuckoo	0.03	23
Shining Bronze-Cuckoo	0.00	27
Tree Martin	0.05	12
Grey Fantail	0.00	9
Scarlet Robin	0.01	12
Hooded Robin	0.01	24
Black-faced Cuckoo-shrike	0.00	12
White-throated Gerygone	0.02	10
Superb Fairy-wren	0.00	14
White-plumed Honeyeater	0.03	11
Noisy Friarbird	0.00	13
Grey Currawong	0.00	15
Common Myna	0.02	13
Common Starling	0.00	20

The analysis of data from September 1998 to June 2004 in Cunningham and Rowell (2006) listed 20 species showing trends of significance ($p \leq 0.05$) (Tables 4 and 5, pp.12-13). The addition of data to the end of 2005 has altered the trends for some of these species.

Table 2 shows these species and the trend after the analysis of data to December 2005.

Table 2. Species listed in Cunningham and Rowell (2006) as increasing or decreasing, and comparison with trend after analysis of data to December 2005

Unclear = non-significant, p>0.05

Species	Sept. 1998-June 2004		Dec. 1998-Dec. 2005	
	Trend	p-value	Trend	p-value
Eastern Rosella	Decrease	0.01	Unclear	
Red-rumped Parrot	Decrease	0.03	Unclear	
Tree Martin	Decrease	0.00	Decrease	0.05
Grey Fantail	Decrease	0.02	Decrease	0.00
Willie Wagtail	Decrease	0.00	Unclear	
Golden Whistler	Increase	0.00	Unclear	
Black-faced Cuckoo-shrike	Decrease	0.00	Decrease	0.00
Speckled Warbler	Increase	0.00	Increase	0.01
Superb Fairy-wren	Decrease	0.03	Decrease	0.00
Dusky Woodswallow	Decrease	0.05	Unclear	
Mistletoebird	Decrease	0.04	Unclear	
Yellow-faced Honeyeater	Increase	0.01	Unclear	
White-plumed Honeyeater	Decrease	0.00	Decrease	0.03
Noisy Friarbird	Decrease	0.00	Decrease	0.00
Olive-backed Oriole	Decrease	0.03	Unclear	
Grey Currawong	Decrease	0.01	Decrease	0.00
Striated Pardalote	Decrease	0.04	Unclear	
Common Myna	Decrease	0.03	Decrease	0.02
Common Starling	Decrease	0.00	Decrease	0.00

The change in trends for some species may be the result of several factors:

a) The current analysis used data that started and finished in the same season (summer) thus reducing the strong seasonal effect on probability of occupancy.

b) The good spring rains in 2005 may have resulted in successful breeding, increasing the occupancy rate of some species which had several previous poor breeding seasons. This could affect both the resident species (eg. Eastern Rosella, Red-rumped Parrot) and migrants (eg. Dusky Woodswallow, Mistletoebird, Olive-backed Oriole).

c) The occupancy rate of migratory species could be affected by climate or habitat factors outside the region (eg. Golden Whistler and Yellow-faced Honeyeater which breed in the mountains).

For these and other reasons, inferences relating to long term trends based on simple linear effects should be made with caution. The longer the dataset, the more meaningful the trends become, and it is suggested that, to be able to say anything useful about long term trends, survey data should be long term, at least 10 years or more.

Mulligan's Flat/Goorooyarroo North

Twenty-six species were recorded in 1% or more of surveys at both Mulligan's Flat and Goorooyarroo North. In this analysis, a number of species showed differences in trends between the two areas. Table 3 lists those species where the significance level of the difference in slope of the linear fit between the two areas is $p \leq 0.10$, and gives an indication of the trend.

The 26 species are listed in Appendix 1 and graphs of the longitudinal trends are included in Appendix 4.

Table 3. Species in Mulligan's Flat and Goorooyarroo North for which the significance level of the difference in slope of the linear fit between the two areas is $p \leq 0.10$

Species	p-value for difference in slope of linear fit	Trend for Mulligan's Flat	Trend for Gooroo Nth
Crimson Rosella	0.08	Slight decrease	Slight increase
Rufous Whistler	0.01	Stable	Steep decrease
Striated Thornbill	0.07	Stable	Steep increase
White-throated Treecreeper	0.08	Slight increase	Slight decrease
Striated Pardalote	0.07	Slight decrease	Slight increase
Red Wattlebird	0.02	Slight increase	Slight decrease
Noisy Friarbird	0.10	Stable	Decrease
White-winged Chough	0.06	Increase	Decrease

Reasons for the differences in trends of these species between the two areas are not immediately apparent and require a closer analysis of the data, particularly the habitat data.

3. DISCUSSION

As noted by Cunningham and Rowell (2006), a number of species of concern appear in low numbers in the Woodland Project and there is insufficient data to detect population trends in these species. These include:

- Diamond Firetail
- Jacky Winter
- Crested Shrike-tit
- Varied Sittella.

Cunningham and Rowell (2006) noted that more targeted surveys appeared to be needed for such species, and the wider COG data base might assist in adding more sites to the survey. Given that the Woodland Project is probably at its maximum in terms of the locations and sites which can be coordinated and monitored four times a year by volunteers with resources available, adding more sites to the Woodland Project would not appear to be feasible.

An attempt was made in the past to identify sites in the general COG database with threatened and declining species and to have COG members survey sites twice a year. However, this proved difficult to coordinate and sustain, and to ensure regular surveys occurred etc. It may be possible to undertake a comprehensive review of general COG data on some species, but this would probably need to be funded work. It should be noted that collection of general COG data is not necessarily systematic and may not provide adequate evidence of trends, vis a vis clear trends based on statistical analyses from systematic long-term surveys.

This is an important issue to resolve, as several species are thought to warrant listing as 'vulnerable' in the ACT, but obtaining clear, statistically based evidence of declines in abundance is proving problematic. Four species (Diamond Firetail, Dusky Woodswallow, Crested Shrike-tit and Flame Robin) are under a 'watching brief' category under the ACTs threatened species legislation, after being nominated (unsuccessfully) by COG around four years ago. Those nominations drew largely on information in the general COG database as well as anecdotal information.

Flame Robin is rarely recorded in the woodland areas (less than 10 records in the data set), as its core habitat is in the higher forests and ranges; for this species, analysis of records in the general COG database may prove more useful.

Despite an increase in sightings of Diamond Firetails in some burned and cleared areas post the January 2003 bushfires, there is a view that the Diamond Firetail is one species which should be listed as a 'vulnerable' species in the ACT (as it is in NSW), given its almost complete absence from the ACTs large woodland reserves and very low numbers in only a few known locations.

It is noted that new, more numerically stable statistical methods in current development which deal better with low species counts, have the potential to assist in determining clearer trends for threatened birds and other species of interest (R Cunningham pers comm.).

Of the threatened species listed in the ACT, Hooded Robin is obviously a species of ongoing concern, now showing a clearer decreasing linear trend, with a significant (24%) decrease in occupancy rate from 2004 to 2005. Very small groups of this species are found in only a few Woodland Project locations (Bounds J in press).

Although it is not on the ACT threatened list, Scarlet Robin is another species with a worrying linear trend, a steady decline from 1998 to 2004 and more sharper decline in 2005. Scarlet Robin was nominated (unsuccessfully) by COG for listing in the ACT around four years ago, and may warrant a review and re-nomination.

Other resident species showing significant decreasing linear trends are Superb Fairy-wren, White-plumed Honeyeater and Grey Currawong.

A more detailed species analysis and commentary is beyond the scope of the brief for this report. However, it is considered this should preferably wait until there is several more years of data, at least 10 years of data, which would be after the 2008 surveys. Alternatively, consideration could be given to doing this in conjunction with the next analysis in two years time, which would have nine years data to the end of 2007 (but not nine years data for all sites).

For some species showing strong trends, the latest COG general data (2005/06) particularly from the Garden Bird Survey, appears to have similar patterns for some species, eg Noisy Friarbird, Noisy Miner. This may warrant further investigation if more detailed species analysis is undertaken.

4. RECOMMENDATIONS

1. The Woodland Project now has a good foundation data set and data should continue to be collected at existing Project locations on an ongoing basis; if continued into the longer term, this data set could be particularly important in determining changes due to factors such as climate change.

2. Given the year to year variations in trends which can occur for some species, analysis of Project data every two years would be more cost-effective, rather than annual analyses. A short report and summary table of trends could be produced two yearly, with consideration of a more detailed report and commentary at longer intervals, as funding and resources permit.

3. Further analysis of the Woodland data set for threatened and declining species of interest could be undertaken as soon as new statistical methods for dealing with species of low numbers are available.

5. REFERENCES

Cunningham, R.A. and Rowell, A. M. Statistical Analysis of Trends in Detection Rates of Woodland Birds in the ACT, 1998 to 2004 (2006).

[This report was published by COG in Canberra Bird Notes, Volume 31, Number 2, June 2006 (pages 73 to 110)]

The Canberra Times, 15 January 2007, page 4

Hooded Robin cover photo: Helen Fallow

Appendix 1 (Overall % change)

Based on the linear fit in the odds of occupancy for species which occur in more than 1% of surveys, and 6 less common species, adjusted for imbalance in survey effort between sites.
Associated approximate 95 % Confidence Intervals are given and the observed significance level (p-value). Bold figures are p≤ 0.05.
The significance level of the difference in slope of the linear fit between Gooroo North and Mulligan's Flat data is given for those species where p≤0.10. Where p>0.10, 'ns' is recorded.

BirdName	%Change in odds per year	Lower 95% Confidence Interval	Upper 95% Confidence Interval	Observed Significance Level of Linear Trend	Significance level of difference in slope betwenn Goo and Mull
Common Bronzewing	9.45	-4.00	24.78	0.17	
Crested Pigeon	15.04	0.86	31.22	**0.03**	
Nankeen Kestrel	-1.03	-18.51	20.19	0.91	
Sulphur-crested Cockatoo	9.31	1.96	17.19	**0.01**	ns
Galah	6.80	0.90	13.05	**0.02**	ns
Australian King-Parrot	1.40	-13.66	19.09	0.86	
Crimson Rosella	-2.00	-6.39	2.60	0.38	0.08
Eastern Rosella	-2.41	-7.54	3.00	0.37	ns
Red-rumped Parrot	0.77	-10.04	12.87	0.89	
Laughing Kookaburra	4.67	-6.13	16.71	0.40	
Pallid Cuckoo	-23.53	-40.33	-1.99	**0.03**	
Shining Bronze-cuckoo	-27.21	-40.23	11.35	**0.00**	
Welcome Swallow	-2.21	-19.33	18.54	0.82	
Tree Martin	-12.43	-23.65	0.45	**0.05**	
Grey Fantail	-9.23	-14.05	-4.15	**0.00**	ns
Willie Wagtail	-8.57	-18.62	2.72	0.12	
Leaden Flycatcher	-10.60	-21.96	2.41	0.10	
Scarlet Robin	-12.38	-20.55	-3.37	**0.01**	ns
Hooded Robin	-24.51	-39.95	-5.10	**0.01**	
Golden Whistler	7.49	-4.36	20.80	0.22	
Rufous Whistler	0.98	-5.76	8.21	0.78	0.01
Grey Shrike-thrush	-0.84	-11.55	11.16	0.88	
Magpie-lark	-5.96	-14.97	4.01	0.22	ns
Black-faced Cuckoo-shrike	-11.76	-17.69	-5.40	**0.00**	ns
White-winged Triller	1.40	-11.74	16.48	0.00	
White-throated Gerygone	-9.60	-17.35	-1.13	**0.02**	ns
Western Gerygone	3.74	-7.42	16.25	0.52	ns
Weebill	14.34	8.68	20.30	**0.00**	ns
Striated Thornbill	5.09	-2.17	12.89	0.17	0.07
Brown Thornbill	-9.88	-19.73	1.18	0.07	
Buff-rumped Thornbill	-5.24	-10.63	0.47	0.07	ns
Yellow-rumped Thornbill	1.31	-6.22	9.45	0.74	ns
Speckled Warbler	14.65	3.41	27.10	**0.01**	
Superb Fairy-wren	-13.91	-19.39	-8.05	**0.00**	

BirdName	%Change in odds per year	Lower 95% Confidence Interval	Upper 95% Confidence Interval	Observed Significance Level of Linear Trend	Significance level of difference in slope betwenn Goo and Mull
Dusky Woodswallow	2.92	-11.71	19.97	0.71	
Varied Sittella	1.12	-14.99	20.27	0.90	
Brown Treecreeper	4.19	-14.27	26.62	0.67	
White-throated Treecreeper	-2.31	-9.32	5.25	0.53	0.08
Mistletoebird	-4.49	-12.37	4.09	0.29	ns
Spotted Pardalote	1.10	-5.20	7.82	0.73	ns
Striated Pardalote	3.57	-1.32	8.71	0.15	0.07
Silvereye	0.69	-9.73	12.31	0.90	
White-naped Honeyeater	-33.14	-48.47	-13.25	0.00	
Brown-headed Honeyeater	11.43	-1.46	26.00	0.08	ns
Eastern Spinebill	-9.47	-23.32	6.88	0.23	
Yellow-faced Honeyeater	5.49	-2.58	14.22	0.18	ns
White-eared Honeyeater	-7.66	-19.73	6.22	0.25	
White-plumed Honeyeater	-11.21	-20.32	-1.06	**0.03**	
Noisy Miner	17.39	7.18	28.58	**0.00**	ns
Red Wattlebird	-4.95	-11.27	1.81	0.14	0.02
Noisy Friarbird	-12.92	-19.01	-6.37	**0.00**	0.10
Red-browed Finch	-15.98	-33.28	5.80	0.13	
Olive-backed Oriole	-4.88	-16.96	8.95	0.46	
White-winged Chough	15.32	4.00	27.88	**0.01**	0.06
Pied Currawong	6.84	-0.66	14.92	0.07	
Grey Currawong	-22.12	-33.29	-9.07	**0.00**	
Grey Butcherbird	5.59	-9.00	22.53	0.46	
Australian Magpie	4.28	-0.68	9.49	0.09	ns
Australian Raven	9.74	1.29	18.89	**0.02**	
Common Myna	-12.83	-22.40	-2.08	**0.02**	
Common Starling	-20.21	-26.53	-13.36	**0.00**	
Less Common Birds					
Brown Goshawk	11.91	-11.78	41.96	0.34	
Gang-gang Cockatoo	14.53	-5.93	39.44	0.17	
Crested Shrike-tit	24.67	-12.09	76.81	0.21	
White-browed Scrubwren	-34.45	-53.22	-8.17	0.01	
Diamond Firetail	17.87	-9.21	53.02	0.21	
Double-barred Finch	21.35	-7.75	59.62	0.16	

Appendix 2 (Summary of trends)

Summary of trends for 61 species which occurred in more than 1% of surveys, and 6 less common species.

'Unclear' trend = non-significant trend or irregular occupancy rates.

Species	**Trends in occupancy rate** **Bold** = ACT threatened species **#** = species on ACT 'watching brief' (nominated by COG for 'vulnerable' status but not accepted for threatened species listing)	**Linear Trend**
Common Bronzewing	Low occupancy rate; fairly steady with increase in 2003-4 and decrease in 2005.	Unclear
Crested Pigeon	Occupancy rate fairly steady, increase in 2004, followed by slight decrease in 2005	Increase
Nankeen Kestrel	Low occupancy rate, lowest in 2002-4 followed by increase in 2005.	Unclear
Sulphur-crested Cockatoo	Occupancy rate high and steady, decrease in autumn-winter 2004, sharp increase in 2005.	Increase
Galah	High occupancy rate; decrease from 1998-2001, increase during 2002-2005, highest in 2004.	Increase
Australian King-Parrot	Typically forest-dwelling. Low occupancy rate, steady 1999-2002, increase in 2003 post-fire, sharp decrease 2004-5	Unclear
Crimson Rosella	Very high occupancy rate, overall steady trend.	Stable
Eastern Rosella	High occupancy rate, slight decline 1998-2003, then increase to highest rate in 2005.	Unclear
Red-rumped Parrot	Low occupancy rate, decrease from 1998-2002, increase from 2003 to highest level in 2005.	Unclear
Laughing Kookaburra	Occupancy rate high in 1999-2000, declining to 2001 then steady increase. Occupancy peaks in winter and summer.	Unclear
Pallid Cuckoo	Spring-summer migrant. Highest occupancy rates in spring 2001 and 2002, low in spring 2003/04, very low in 2005.	Decrease
Shining Bronze-cuckoo	Spring-summer migrant. Highest rate in spring 2000, almost total absence in 2002/03, very low 2004, increase in 2005	Decrease
Welcome Swallow	Low, variable occupancy rate.	Unclear
Tree Martin	Spring-summer migrant. Highest occupancy rate in summer 1999 and 2001, slight decline since 2001 to lowest in 2003.	Decrease
Grey Fantail	Spring-summer migrant with high occupancy rate, highest in 2001, lowest in 2004 with slight increase over this in 2005.	Decrease
Willie Wagtail	Moderate occupancy rate, decrease from 1998-2003, then increase to highest level in 2005.	Unclear
Leaden Flycatcher	Spring-summer migrant, moderate occupancy rate, fairly steady overall, lowest rates in 2003 and 2005	Stable
Scarlet Robin	Moderate occupancy rate, highest in winter, steady decline from 1998-2004 with sharp decline in 2005.	Decrease
Hooded Robin	**Low, irregular occupancy rate. Highest in 1999, lowest in 2004-5.**	**Decrease**
Golden Whistler	Altitudinal migrant, peaks in autumn-winter. Increase in occupancy in winters 2000-3, then steep decline 2004-5.	Unclear
Rufous Whistler	Spring-summer migrant with high and relatively steady occupancy rate.	Stable
Grey Shrike-thrush	Variable occupancy rate, steep increase from 1999-2002, then decrease to 2004 and increase again in 2005.	Unclear
Magpie-lark	Moderate, relatively steady occupancy rate.	Stable
Black-faced Cuckoo-shrike	Mostly a spring-summer migrant. High occupancy rate, decrease from 1998-2003 with slight increase to 2005.	Decrease
White-winged Triller	**Spring-summer migrant. Low occupancy rate, highest in first summer of surveys 1998/99, sharp decrease to lowest rate in 2000/01 with gentle increase thereafter.**	**Unclear**

Species	**Trends in occupancy rate** **Bold** = ACT threatened species # = species on ACT 'watching brief' (nominated by COG for 'vulnerable' status but not accepted for threatened species listing)	**Linear Trend**
White-throated Gerygone	Spring-summer migrant. Moderate occupancy rate, highest in summer 1999, variable but generally decreasing since.	Decrease
Western Gerygone	Mostly a spring-summer migrant. Variable occupancy rate, peaks in 1999, 2002, 2005, highest in summer 2005.	Unclear
Weebill	High occupancy rate, steady from 1999-2003, then sharp increase 2004-05.	Increase
Striated Thornbill	Moderate, somewhat variable occupancy rate with peaks in spring and autumn, highest rate in 2005.	Stable
Brown Thornbill	Low to moderate occupancy rate, peaks in winter. Steady decline from highest rate in 2000.	Unclear
Buff-rumped Thornbill	High occupancy rate, steady decline from highest rate in 1999 to lowest in 2004, with slight increase in 2005.	Unclear
Yellow-rumped Thornbill	Moderate occupancy rate, increase from low level in 1999, steady from 2001-4 then decrease in 2005.	Unclear
Speckled Warbler	Low occupancy rate with peaks in summer and winter. Increase from lowest rate in 1999 to highest in 2003, with slight decrease since.	Increase
Superb Fairy-wren	High occupancy rate. Steady decline from highest levels in 1999-2000 to lowest in 2004. Slight increase in 2005.	Decrease
Dusky Woodswallow #	Spring-summer migrant, low occupancy rate since a peak in 1999, lowest rate in 2003/04, but has evened out since. More data needed to clarify trend.	Unclear
Varied Sittella	**Low variable occupancy rate, lowest in 1999, highest in 2004.**	**Unclear**
Brown Treecreeper	**Low variable occupancy rate, highest in 1999, steep decrease the following year, increasing to peak at end 2002. Overall, fairly steady since 2001, but long-term trend unclear due to very low numbers.**	**Unclear**
White-throated Treecreeper	Moderate occupancy rate, lowest in 1999, sharp increase in 2000, steady decrease since.	Unclear
Mistletoebird	Spring-summer migrant. Moderate to high occupancy rate. Lowest rate in 2002, highest in 2005.	Unclear
Spotted Pardalote	Moderate occupancy rate, winter/spring peaks. Steady decline from 1999-2003, then sharp increase to highest level in 2005 (post-fire recovery?).	Unclear
Striated Pardalote	Partial altitudinal migrant. High occupancy rate, spring and autumn peaks. Lowest levels in 2003 after fires, increasing to highest rate in 2005.	Unclear
Silvereye	Partial passage migrant, peaks during autumn and spring. Low occupancy rate, highest in 2001, gentle decline to 2005.	Unclear
White-naped Honeyeater	Typically forest-dwelling, passage migrant in woodlands, peaks in autumn and spring. Irregular occupancy rate, highest in 2002 and 2003.	Unclear
Brown-headed Honeyeater	Low occupancy rate, irregular, non-seasonal. Sharp increase in summer 2005.	Unclear
Eastern Spinebill	Low occupancy rate, irregular. Highest rate in autumn 2004 followed by sharp decline to lowest level in 2005.	Unclear
Yellow-faced Honeyeater	Passage migrant in woodlands, peaks in autumn and spring. Moderate occupancy rate, highest in spring 2002/3, decline since.	Unclear
White-eared Honeyeater	Altitudinal migrant, peaks in winter. Moderate but irregular occupancy rate, highest in 1999 & 2003, lowest in 2005.	Unclear
White-plumed Honeyeater	Moderate occupancy rate, peaks in winter and summer. Gentle decline from 1999-2004, slight increase in 2005.	Decrease
Noisy Miner	Moderate occupancy rate, non-seasonal, steady until sharp increase in 2005.	Increase
Red Wattlebird	Moderate occupancy rate, highest in 1999, steep decrease to 2001 then fairly steady to 2005.	Unclear

Species	**Trends in occupancy rate** **Bold** = ACT threatened species # = species on ACT 'watching brief' (nominated by COG for 'vulnerable' status but not accepted for threatened species listing)	**Linear Trend**
Noisy Friarbird	Spring-summer migrant. High occupancy rate, highest in 1999-2000, steady decline since with slight peak in 2004.	Decrease
Red-browed Finch	Low irregular occupancy rate. Highest rate in autumn 2002, virtually absent in 2005.	Unclear
Olive-backed Oriole	Spring-summer migrant. Irregular occupancy rate, highest in 1999-2000, lowest 2003, increase again 2004/5.	Unclear
White-winged Chough	Low to moderate occupancy rate, peaks in spring. Increase from lowest level in 2000 to highest rate in 2005.	Increase
Pied Currawong	Moderate occupancy rate, steady after sharp decrease from highest level in 1999.	Stable
Grey Currawong	Low occupancy rate, autumn-winter peaks. Steady decline from highest level in 1999 to lowest in 2004, slight increase in 2005	Decrease
Grey Butcherbird	Low occupancy rate, peaks in autumn. Lowest rate in 1999, steep increase to 2001, slight decrease to 2005.	Unclear
Australian Magpie	Occupancy rate high and steady.	Stable
Australian Raven	Moderate occupancy rate, peaks in autumn. Steady increase from 1999 to highest level in 2005.	Increase
Common Myna	Moderate occupancy rate, peaks in spring-summer. Steady decrease from 2000-4 with sharp increase in spring 2005.	Decrease
Common Starling	High occupancy rate, peaks in spring. Steady decrease from 2000-3 with sharp increase in 2004-5.	Decrease
Less Common Species	**All have low occupancy rates**	
Brown Goshawk	Peaks in spring. General increase from very low level in 1999 to highest in 2004-5.	Unclear
Gang gang Cockatoo	Typically forest-dwelling. Sharp peak in 1999 then low steady rate since.	Unclear
Crested Shrike-tit #	Irregular occupancy rate. Peaks mostly spring/summer. Lowest rates 2000 and 2001, highest 1999, 2002/03, 2004. More data needed to clarify trend.	Unclear
White-browed Scrubwren	Highest occupancy rate at start of surveys in 1999, steady decline to almost complete absence in 2005.	Decrease
Diamond Firetail #	Irregular occupancy rate, with summer-autumn peaks. Sharp decrease from summer 2003, then steep increase to highest peak autumn 2005 (post fire effects?).	Unclear
Double-barred Finch	Irregular occupancy rate, peaks in summer and winter. Highest level in winter 2005	Unclear