

Probability of persistence of indigenous animal species in the Port Phillip and Westernport region

**A report prepared for the Port Phillip and Westernport Catchment
Management Authority**

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1. Introduction

The world's human population has passed a significant milestone where the proportion of people living in urban areas now exceeds that living in rural areas (McDonald *et al.*, 2008), and it is predicted that by 2030 there will be almost 2 billion more urban residents globally (UNPD, 2005). Much of the world's biological diversity is already threatened by the transformation of natural ecosystems into human-dominated landscapes, and further urbanisation will likely have significant effects on the natural environment. This threat is exacerbated by the spatial congruence between people and biodiversity, as humans tend to settle in areas of high productivity which are associated with levels of high species-richness (Luck, 2007a, b). As human population density increases, so does the negative impact on environments, as measured by the density of invasive or exotic species (Thompson & Jones, 1999; McKinney, 2001: 2002) and the risk of species endangerment or extinction (Kerr & Currie, 1995; Woodroffe, 2000; Brashares *et al.*, 2001; Parks & Harcourt, 2002; McKee *et al.*, 2004). This process results in biotic homogenisation that threatens to reduce the biological uniqueness of local ecosystems (Lockwood & McKinney 2001; McKinney, 2002: 2006).

The global trend in urban population growth is set to continue in Australia, where the human population is already highly urbanised. For example, 73% of the population of Victoria resides within its capital city, Melbourne (Department of Infrastructure, 2002). Melbourne's population has grown from around 10,000 inhabitants in 1840 to approximately 3.5 million residents today, and is expected to reach 4 million by 2021 (Harvey, 1982; State of Victoria, 2000: 2002). With population growth comes urban expansion, and Melbourne's urban area increased from approximately 98,000 ha in the 1960's to over 202,600 ha by 1990 (McDonnell & Holland, 2008). To illustrate the impact of this rapidly expanding human population has had on the continent's biota: since the year 1600 approximately one-third of all documented mammal extinctions worldwide have occurred in Australia (Maxwell *et al.*, 1996). Such species losses are largely attributed to the introduction of exotic species, habitat loss or modification, and altered fire regimes since European settlement (Recher & Lim, 1990). As the population of Australian cities grow and urban areas expand, natural habitat will continue to be lost, fragmented or modified, thereby reducing overall indigenous biodiversity.

Urban development and growth in Australia has occurred recently relative to cities elsewhere in the world. This provides a unique opportunity to determine how human population expansion has affected native fauna. Indeed, on no other continent are the pervasive effects of human settlement on the diversity of vertebrate fauna as readily observed as they are in Australia. Our ability to document the pre-urbanisation levels of biodiversity in older settlements across Europe, Asia or Africa are limited by the absence of detailed information on the historical distribution and abundance of species. Yet spatially referenced biological records of wildlife sightings and museum entries have been collated and stored within faunal atlases, such as the 'Atlas of Victorian Wildlife', since initial European settlement of several Australian cities. Most questions relating to fauna conservation, protection and management can only be answered by first answering questions about species distributions, and faunal atlases provide an indispensable and relatively inexpensive means of assessing large-scale trends in a species' range through time and space (Donald & Fuller, 1998). Quantitative methods that infer the probability a species is extant have been developed with museum or atlas data to assess the conservation status and identify declining species (Solow, 1993a, b; Burgman *et al.*, 1995; McCarthy, 1998; Solow and Roberts, 2003). These methods have recently been used to infer the persistence of a species in areas impacted by urbanisation (van der Ree 2004; van der Ree & McCarthy 2005; Hamer & McDonnell *in prep.*).

State of Environment (SoE) reporting aims to monitor the condition and trend of a suite of environmental indicators within the region of the Port Phillip and Westernport Catchment Management Authority (PPWCMA), but until now, a separate assessment of fauna has not been made. Yet this information is a crucial pre-requisite to sustaining native biota in expanding urban centres, making it possible to identify areas where species have been retained, as well as those where they have been lost. Such data can be used to assess a species' conservation status and hence identify the most effective conservation priorities. Examining the probability that species known to have been present within the PPWCMA region at European settlement remain extant provides us with a measure of faunal health, given by the proportion of these species which still exist in the area. This report uses data from the 'Atlas of Victorian Wildlife' to estimate the probability of persistence of taxonomic groups of terrestrial vertebrate fauna (fish, amphibians, reptiles, birds and mammals) in each of the 7 land Reporting Areas in the region. Each Reporting Area is then assigned a score based on an overall assessment of its faunal condition. Descriptive assessments are made of the two marine Reporting Areas for which only avifaunal data are relevant.

2. Evaluation method

2.1 Faunal Records

Records of vertebrate fauna within the PPWCMA region were obtained from the Atlas of Victorian Wildlife (AVW). The AVW is administered by the State Government of Victoria's Department of Sustainability and Environment (DSE) and is a database of animal sightings and museum records within the State of Victoria. Sightings are submitted to the AVW by a range of people with varying expertise, from sightings made by qualified biologists during systematic fauna surveys, to members of the general public who make incidental sightings (van der Ree and McCarthy, 2005). Consequently, the amount of data contained within each record varies, but typically includes species, date and location. The location of each sighting is recorded at the highest possible resolution, down to an accuracy of 100 m where possible. All records are reviewed by an expert prior to entry into the database. AVW data were supplemented with records from the following additional data sources, each of which were gathered during systematic surveys made trained volunteers or qualified biologists: Melbourne Water Frog Census data, Melbourne Water Fish Census data, and the data from the Atlas of Australian Birds (co-ordinated by Birds Australia).

Records were extracted from their respective data sources in August 2008, but data were then filtered to ensure a minimum standard for all records. As some Reporting Areas had incomplete data for certain taxa in more recent years, cut-off dates were determined to standardise the reporting period of each taxonomic group across all Reporting Areas: 2005 for amphibians and reptiles, and 2006 for fish, birds and mammals. Records where species identification was tentative (e.g. identified only to genus level) or date of observation was missing were deleted from the dataset before analysis, as were any duplicate records. Multiple sightings of a species at a single site on the same day were recorded as a single sighting in order to eliminate non-independence in the dataset before analysis (McCarthy, 1998). Other records that were omitted from analysis were those where the location was obviously incorrect (e.g. terrestrial species occurring in marine environments), and those of non-native species that were introduced after initial European settlement (e.g. cats *Felis catus*). Dingoes (*Canis familiaris*) were also excluded from the analyses due to the potential for hybridisation with domestic dogs making it difficult to distinguish between the two (van der Ree, 2004). Records where subspecies were identified were grouped as a single species. In marine Reporting Areas (Port Phillip Bay and Westernport Bay), records of marine mammals, reptiles and fish were excluded from the analysis, meaning only information about avian species was included. Finally, all records were assigned to a single Reporting Area after their location co-ordinates had been mapped using GIS (*ArcView 3.2, Environmental Systems Research Institute, Inc. 1999*).

2.2 Quantitative methods to infer species persistence

Several different methods have been used to infer species persistence (Solow 1993; Burgman *et al.* 1995, McCarthy, 1998; Solow and Roberts, 2003), and each method is sensitive to different characteristics of the collection record (van der Ree and McCarthy, 2005). For example McCarthy's (1998) modified version of Solow's (1993) original formulae takes into account changes in collection effort, which may vary over time. These methods are essentially forms of time series analysis run on species' presence or absence data, which are sensitive to runs of absences of sightings in collection records. The basic idea in each of these methods being that confidence in the continued existence of a species is greater the more recently it has been sighted, or conversely, species are less likely to be extant if they have not been observed for an extended duration at the end of the observation period. However, the probabilities returned by these equations do not provide the probability that the species is extant (van der Ree & McCarthy, 2005), but rather the probability that a run of species absences at the end of an observation period would occur by chance alone. Small *P*-values suggest that the observed run of absences at the end of a recording period are unlikely to occur if the species is still extant, implying a decline in the range of a species (McCarthy, 1998).

For the purpose of the SoE report, the probability of a species being extant is more readily interpreted measure than the probability that absences did not occur by chance, for which a Bayesian formulation of Solow's (1993) equation is required (van der Ree & McCarthy, 2005). The posterior probability of the species being extant was calculated as:

$$p = \frac{1}{1 + [(T/t)^{N-1} - 1]/(N-1)}$$

Where N is the number of times the species was recorded between time 0 and time T , and t is the time when the species was last recorded. The prior probability of the species being extant in the last year of recording for each taxonomic group was assumed to be 0.5. This prior probability is the probability of the species being extant in the last year of recording prior to considering the sighting data. P -values resulting from this formula lie between 0 and 1.0, where $P = 1.0$ demonstrates that the species was certainly still extant at the end of the recording period.

2.3 Reporting Area Rating

The Bayesian formula above was used to investigate the probability that each faunal species known to have occurred within the Reporting Area at the time of European settlement in 1835 were extant at the end of the recording period. The probability of persistence was calculated for every faunal species within each Reporting Area for which there were sufficient data to perform calculations; this required a minimum of three or more independent observations per Reporting Area. Species with fewer records than this were assigned as "inadequate records". Inadequate records may result from a species having a cryptic nature, making it difficult to survey, or because the species was transiently passing through the area and is not normally resident within the Reporting Area. However, in a large number of cases inadequate records were likely to have occurred because the species has gone extinct, or become so rare as to make detection unlikely.

The results for each species were then grouped taxonomically (as fish, amphibians, reptiles, birds or mammals) and by Reporting Area, allowing for different aspects of interpretation of results. Each species was allocated to a probability class for extantness, ≥ 0.95 , $0.75 - 0.94$, $0.50 - 0.74$, < 0.50 and 'inadequate records'.

A species in the highest category for example, meant that that species was almost certain to still be extant within that Reporting Area, whereas there was a greater chance that a species < 0.50 probability category would be extinct rather than extant. The proportion of species within each of these grade bands is presented both by taxonomic group and by Reporting Area.

To generate a single rating of faunal health for each Reporting Area, the number of species that are most likely to be extant within that Reporting Area (i.e. those ≥ 0.75) are given as a proportion of the number of species that have ever been recorded within that Reporting Area (including those species with inadequate records):

A = 91 – 100%
 B = 81- 90%
 C = 71 - 80%
 D = 61 - 70%
 E = $\leq 60\%$

For example, a Reporting Area with an overall grade A has retained many of the native species that have ever been recorded there, whereas a Reporting Area with a grade of E has retained a relatively low proportion of its indigenous species.

3. Results

3.1 Results by taxonomic group

3.1.1 Fish

A total of 4,364 records from thirty-four species of indigenous freshwater fish were recorded within the region between 1930 and 2006. A full list showing the persistence probability for all fish (and other taxonomic groups) in each Reporting Area is provided within the accompanying Appendices. With a total of 29 species ever recorded, Urban Melbourne shows the highest diversity of fish species, and yet only 31% of species were almost certainly still extant, and almost a quarter of species had less than a 50% probability of still being extant (Table 1). Moorabool, Melton, Wyndham & Greater Geelong displayed the greatest species retention as all species for which there were sufficient data (almost 80% of fish species ever recorded in the Reporting Area) were certain to still be extant. Mornington Peninsula had the lowest proportion of species which were certain to still be extant, and also had the greatest proportion of species for which there were inadequate records, which could indicate high levels of local species extinctions. There is a certain degree of variability in species persistence between Reporting Areas. Reporting Areas in which fish appear to be doing best, in terms of the proportion of species with a greater than 75% probability of being extant, are Moorabool, Melton, Wyndham & Greater Geelong and Casey, Cardinia & Baw Baw, whereas the Reporting Areas in which fish species are least likely to still be extant are Bass Coast, South Gippsland & Islands Coast and Macedon Ranges, Hume, Mitchell & Whittlesea.

Table 1: The proportion of indigenous freshwater fish species within each probability grade of species persistence, the total number of species recorded and the rating for each Reporting Area.

Reporting Area	≥0.95	0.75-0.94	0.5-0.74	<0.50	'inadequate records'	Total spp.	Rating
Bass Coast, South Gippsland & Islands	43	0	14	14	29	7	E
Casey, Cardinia & Baw Baw	56	13	6	13	13	16	D
Macedon Ranges, Hume, Mitchell & Whittlesea	53	0	0	20	27	15	E
Moorabool, Melton, Wyndham & Greater Geelong	79	0	0	0	21	19	C
Mornington Peninsula	29	29	0	0	43	14	E
Urban Melbourne	31	21	14	24	10	29	E
Yarra Ranges & Nillumbik	53	0	13	20	13	15	E

3.1.2 Amphibians

Between the years 1856 and 2005 a total of 10,552 amphibian sightings were recorded within the region, from seventeen indigenous species (Table 2). Again, Urban Melbourne appeared to have the greatest species richness, with sixteen of the seventeen species present, almost 90% of which were certain to still be extant. Indeed the probability of species being extant was high for amphibians in all Reporting Areas; for example, all of the ten species of frog that have ever been recorded in the Bass Coast, South Gippsland & Islands Reporting Area had a greater than 75% chance of still being extant. In the Reporting Areas in which amphibians appeared to be fairing poorest, Macedon Ranges, Hume, Mitchell & Whittlesea and Casey, Cardinia & Baw Baw, approximately two thirds of species still had a greater than 75% probability of persistence.

Table 2: The proportion of indigenous amphibian species within each probability grade of species persistence, the total number of species recorded and the rating for each Reporting Area

Reporting Area	≥0.95	0.75-0.94	0.5-0.74	<0.50	'inadequate records'	Total spp.	Rating
Bass Coast, South Gippsland & Islands	90	10	0	0	0	10	A
Casey, Cardinia & Baw Baw	67	0	8	17	8	12	D
Macedon Ranges, Hume, Mitchell & Whittlesea	60	7	7	20	7	15	D
Moorabool, Melton, Wyndham & Greater Geelong	64	9	9	18	0	11	C
Mornington Peninsula	75	8	8	0	8	12	B
Urban Melbourne	88	0	0	0	13	16	B
Yarra Ranges & Nillumbik	69	8	8	15	0	13	C

3.1.3 Reptiles

Forty-two species of reptile were recorded in a total of 7,782 sightings between 1860 and 2005. Species diversity was comparatively even between Reporting Areas, with four of the seven Reporting Areas having between 33 and 38 species observed since recording began (Table 3). Only in one Reporting Area, the Bass Coast, South Gippsland & Islands, were more than half of species certain to still be extant at the end of the observation period. Yet three-quarters of species Mornington Peninsula have a greater than 75% probability of persistence. In contrast, a third or more species that were once present in five out of seven Reporting Areas now have either less than a 50% probability of persistence, or have inadequate records; the worst Reporting Areas for retaining reptile species were Moorabool, Melton, Wyndham & Greater Geelong and Macedon Ranges, Hume, Mitchell & Whittlesea .

Table 3: The proportion of indigenous reptile species within each probability grade of species persistence, the total number of species recorded and the rating for each Reporting Area

Reporting Area	≥0.95	0.75-0.94	0.5-0.74	<0.50	'inadequate records'	Total spp.	Rating
Bass Coast, South Gippsland & Islands	55	9	5	5	27	22	D
Casey, Cardinia & Baw Baw	32	20	12	20	16	25	E
Macedon Ranges, Hume, Mitchell & Whittlesea	21	21	9	36	12	33	E
Moorabool, Melton, Wyndham & Greater Geelong	21	9	18	42	9	33	E
Mornington Peninsula	36	40	8	4	12	25	C
Urban Melbourne	47	16	11	8	18	38	D
Yarra Ranges & Nillumbik	37	20	3	23	17	35	E

3.1.4 Birds

Three-hundred and ninety-six bird species were recorded in over 390,000 sightings within the region between 1800 and 2006 (Table 4). Birds were the only faunal group for which sightings were included from within both Port Phillip and Westernport Bays, which along with the Bass Coast, South Gippsland & Islands displayed the lowest levels of species retention, as between a half to two-thirds of species had either inadequate records or a less than 50% probability of persistence. All other Reporting Areas, with the exception of the Mornington Peninsula, had a greater than 75% probability of retaining three-quarters of species. All Reporting Areas had a similar number of species present, with an average of 262 (SD \pm 33) species per Reporting Area, with the highest species diversity within Urban Melbourne, and the lowest in the Bass Coast, South Gippsland & Islands.

Table 4: The proportion of indigenous bird species within each probability grade of species persistence, the total number of species recorded and the rating for each Reporting Area

Reporting Area	≥ 0.95	0.75-0.94	0.5-0.74	< 0.50	'inadequate records'	Total spp.	Rating
Bass Coast, South Gippsland & Islands	18	5	12	40	25	229	E
Casey, Cardinia & Baw Baw	67	8	3	5	18	249	C
Macedon Ranges, Hume, Mitchell & Whittlesea	66	10	3	3	18	238	C
Moorabool, Melton, Wyndham & Greater Geelong	73	7	3	6	11	305	C
Mornington Peninsula	54	15	6	4	20	248	D
Urban Melbourne	68	10	3	4	14	327	C
Yarra Ranges & Nillumbik	66	15	4	6	9	241	B
Western Port Bay	15	20	14	33	18	256	E
Port Phillip Bay	17	23	15	18	28	281	E

3.1.5 Mammals

Forty-nine species of indigenous mammal were recorded in 12,745 sightings between 1839 and 2006 within the region (Table 2). Species diversity was highest in Yarra Ranges & Nillumbik and lowest on the Mornington Peninsula. Whilst there is variability between Reporting Areas, mammal species in general do not appear to be being retained successfully in most Reporting Areas (Fig. 2). Two-thirds of mammals in Bass Coast, South Gippsland & Islands have a less than 50% probability of being extant or inadequate records. On the Mornington Peninsula, almost 50% of species are more likely to be extinct than extant, or have inadequate records. Mammals in Yarra Ranges & Nillumbik and Casey, Cardinia and Baw Baw Reporting Areas are retained comparatively more effectively, with around 60% of species in each Reporting Area showing a greater than 75% probability of persistence.

Table 5: The proportion of indigenous land mammal species within each probability grade of species persistence, the total number of species recorded and the rating for each Reporting Area

Reporting Area	≥ 0.95	0.75-0.94	0.5-0.74	< 0.50	'inadequate records'	Total spp.	Rating
Bass Coast, South Gippsland & Islands	7	22	4	30	37	27	E
Casey, Cardinia & Baw Baw	31	28	10	18	13	39	E
Macedon Ranges, Hume, Mitchell & Whittlesea	16	32	16	14	22	37	E
Moorabool, Melton, Wyndham & Greater Geelong	44	0	21	21	15	34	E
Mornington Peninsula	22	17	13	22	26	23	E
Urban Melbourne	38	13	3	26	21	39	E
Yarra Ranges & Nillumbik	45	17	7	21	10	42	D

3.1.6 Summary of taxonomic results

The overall patterns observed in the results suggest that some taxonomic groups, such as amphibians and to a certain extent birds, display relatively consistent results across Reporting Areas. Yet for other taxonomic groups, particularly reptiles and mammals, species persistence is markedly different between Reporting Areas. The results of species groups across all Reporting Areas in which they are found can provide an indication of which taxa are being more successfully retained than others (Table 6). Amphibians appear to be doing the best, having both the highest proportion of species that are certain to be extant as well as the lowest proportion of species that are more likely to be extinct than extant, and the lowest proportion of species with inadequate records. Fish and birds are closely matched in second and third place; both groups are certain to retain around 50% of species that have been present within the region, though each may lose around 10% of species. The faunal groups which appear to be the most heavily affected since human settlement are mammals and reptiles. Only around one third of species in each of these two groups are certain to persist, whereas approximately one fifth of species stand a high likelihood of becoming extinct.

Table 6: The mean proportion of species (\pm SD) within each probability grade across all Reporting Areas.

Species Group	$\geq 0.95\%$	0.75-0.94	0.5-0.74	< 0.50	'inadequate records'
Fish	49.2 \pm 17.1	8.8 \pm 11.9	6.8 \pm 6.9	13.0 \pm 9.7	22.2 \pm 11.6
Amphibians	73.1 \pm 11.6	6.0 \pm 4.2	5.7 \pm 4.0	10.0 \pm 9.5	5.1 \pm 5.1
Reptiles	35.6 \pm 12.4	19.3 \pm 10.4	9.3 \pm 5.1	19.7 \pm 15.4	16.0 \pm 6.0
Birds	49.4 \pm 25.1	12.5 \pm 5.9	7.0 \pm 5.2	13.1 \pm 13.9	18.0 \pm 6.2
Mammals	29.1 \pm 14.5	18.5 \pm 10.7	10.5 \pm 6.6	21.5 \pm 5.2	20.3 \pm 9.3

3.2 Results by Reporting Area

3.2.1 Bass Coast, South Gippsland & Islands

Amphibians are the most successful faunal group within the Bass Coast, South Gippsland & Islands Reporting Area: 90% of amphibian species are almost certain to be extant, and all other amphibian species have a greater than 75% probability of being extant (Table 7). Reptiles are also doing well in this Reporting Area, more successfully being retained than in any other Reporting Area; over 50% of species are certain to be extant, and only 5% of species with a less than 50% probability of persistence. However, both birds and mammals are showing poor levels of species persistence, as in each of these taxa around two-thirds of species have a greater probability of going extinct than remaining extant, or have inadequate records.

Table 7: The proportion of species within each taxonomic group falling within each probability grade and the total number of species in each taxa for the Bass Coast, South Gippsland & Islands, plus the total number of species for the entire CMA region.

Species Group	≥0.95%	0.75-0.94	0.5-0.74	<0.50	'inadequate records'	Total no. of species in Reporting Area.	Total no. species in CMA region
Fish	43	0	14	14	29	7	34
Amphibians	90	10	0	0	0	10	17
Reptiles	55	9	5	5	27	22	42
Birds	18	5	12	40	25	227	393
Mammals	7	22	4	30	37	27	49

3.2.2 Casey, Cardinia & Baw Baw

Birds, amphibians and fish species are all showing high levels of persistence in the Casey, Cardinia and Baw Baw Reporting Area with each taxa retaining from a half to two-thirds of native species (Table 8). However, both reptile and mammal groups are at greater risk of species decline in this Reporting Area as around a third of species in each of these groups has a less than 50% probability of persistence or inadequate records for analysis.

Table 8: The proportion of species within each taxonomic group falling within each probability grade and the total number of species in each taxa for Casey, Cardinia and Baw Baw, plus the total number of species for the entire CMA region.

Species Group	≥0.95%	0.75-0.94	0.5-0.74	<0.50	'inadequate records'	Total no. of species in Reporting Area.	Total no. species in CMA region
Fish	56	13	6	13	13	16	34
Amphibians	67	0	8	17	8	12	17
Reptiles	32	20	12	20	16	25	42
Birds	67	8	3	5	18	248	393
Mammals	31	28	10	18	13	39	49

3.2.3 Macedon Ranges, Hume, Mitchell & Whittlesea

The pattern in the Macedon Ranges, Hume, Mitchell & Whittlesea is very similar to that in Casey, Cardinia and Baw Baw; bird and amphibian species are showing high levels of persistence, with both taxa retaining from a half to two-thirds of native species (Table 9). However, in Macedon Ranges, Hume, Mitchell & Whittlesea, fish, reptile and mammal species are at greater risk than they are in Casey, Cardinia and Baw Baw; between a third and a half of species in these groups have less than 50% probability of persistence or have inadequate records. Reptiles and mammals are particularly at risk as less than quarter of species in each of these taxa are likely to be currently extant.

Table 9: The proportion of species within each taxonomic group falling within each probability grade and the total number of species in each taxa for Macedon Ranges, Hume, Mitchell & Whittlesea, plus the total number of species for the entire CMA region.

Species Group	≥0.95%	0.75-0.94	0.5-0.74	<0.50	'inadequate records'	Total no. of species in Reporting Area.	Total no. species in CMA region
Fish	53	0	0	20	27	15	34
Amphibians	60	7	7	20	7	15	17
Reptiles	21	21	9	36	12	33	42
Birds	66	10	3	3	18	238	393
Mammals	16	32	16	14	22	37	49

3.2.4 Moorabool, Melton, Wyndham & Greater Geelong

Fish species in Moorabool, Melton, Wyndham and Greater Geelong show the highest levels of persistence of any taxonomic group, more than three-quarters of species ever recorded are certain to still be extant (Table 10). The Reporting Area also shows high levels of species retention in the bird and amphibian taxonomic groups, with around two-thirds of species in each certain to still be extant. Mammal species show higher levels of persistence than they do elsewhere. Reptiles however are more at risk of species decline than any other, with 42% of species with a greater probability of going extinct than remaining extant in the Reporting Area.

Table 10: The proportion of species within each taxonomic group falling within each probability grade and the total number of species in each taxa for Moorabool, Melton, Wyndham and Greater Geelong, plus the total number of species for the entire CMA region

Species Group	≥0.95%	0.75-0.94	0.5-0.74	<0.50	'inadequate records'	Total no. of species in Reporting Area.	Total no. species in CMA region
Fish	79	0	0	0	21	19	34
Amphibians	64	9	9	18	0	11	17
Reptiles	21	9	18	42	9	33	42
Birds	73	7	3	6	11	303	393
Mammals	44	0	21	21	15	34	49

3.2.5 Mornington Peninsula

Amphibians are again showing high levels of persistence on the Mornington Peninsula (Table 11); however bird species are persisting less successfully here than elsewhere. Only a half of species are certain to persist as opposed to the two-thirds of bird species observed in all other Reporting Areas, except Bass Coast, South Gippsland & Islands. Reptiles are showing higher levels of species persistence in Mornington Peninsula than in any other Reporting Area, with two-thirds of species showing a greater than 75% probability of being extant. Species persistence in fish and mammal groups is less positive. This is particularly so for mammals, which demonstrate the lowest proportions of species with a greater than 75% probability of persistence of any Reporting Area, except for Bass Coast, South Gippsland & Islands.

Table 11: The proportion of species within each taxonomic group falling within each probability grade and the total number of species in each taxa for Mornington Peninsula, plus the total number of species for the entire CMA region

Species Group	≥0.95%	0.75-0.94	0.5-0.74	<0.50	'inadequate records'	Total no. of species in Reporting Area.	Total no. species in CMA region
Fish	29	0	0	0	43	14	34
Amphibians	75	8	8	0	8	12	17
Reptiles	36	40	8	4	12	25	42
Birds	54	15	6	4	20	247	393
Mammals	22	17	13	22	26	23	49

3.2.6 Urban Melbourne

In terms of the proportion of species with a greater than 75% probability of persistence, Urban Melbourne appears to be doing better than most Reporting Areas, with half of species in all taxa meeting this criterion. Amphibians and birds species are again showing the highest probabilities of persistence and between around 40 to 50% of mammal and reptile species are certain to still be extant (Table 12). Fish species are showing comparatively high levels of decline compared with other Reporting Areas however and almost a quarter of fish species high a higher probability of going extinct than remaining extant.

Table 12: The proportion of species within each taxonomic group falling within each probability grade and the total number of species in each taxa for Urban Melbourne, plus the total number of species for the entire CMA region

Species Group	≥0.95%	0.75-0.94	0.5-0.74	<0.50	'inadequate records'	Total no. of species in Reporting Area.	Total no. species in CMA region
Fish	31	21	14	24	10	29	34
Amphibians	88	0	0	0	13	16	17
Reptiles	47	16	11	8	18	38	42
Birds	68	10	3	4	14	325	393
Mammals	38	13	3	0	46	39	49

3.2.7 Yarra Ranges & Nillumbik

Yarra Ranges & Nillumbik shows a better overall level of species retention across all taxa than any other Reporting Area; similar to what was previously observed in Urban Melbourne, half of species in all taxa show a greater than 75% probability of persistence. However a greater proportion of fish species are certain to still be extant than was seen in Urban Melbourne. Again, amphibian and bird species display the highest probabilities of persistence, and reptiles and mammals the lowest .

Species Group	≥0.95%	0.75-0.94	0.5-0.74	<0.50	'inadequate records'	Total no. of species in Reporting Area.	Total no. species in CMA region
Fish	53	0	13	20	13	15	34
Amphibians	69	8	8	15	0	13	17
Reptiles	37	20	3	23	17	35	42
Birds	66	15	4	6	9	241	393
Mammals	45	17	7	0	31	42	49

3.2.8 Summary of Reporting Area Results

The general pattern emerging from the Reporting Area results is that most amphibians and birds species are being retained, and in some cases are exceptionally successful, but reptile and mammal species have a less secure outlook. Table 14 summarises each Reporting Area in terms of their taxonomic strengths and weaknesses based on which taxa are showing particularly high or low probabilities of species persistence.

Table 14: The strengths and weaknesses of the seven terrestrial Reporting Areas in terms of taxonomic groups which are generally showing high or low probabilities of species persistence.

Reporting Area	Strengths	Weaknesses
Bass Coast, South Gippsland & Islands	Amphibians + Reptiles	Birds + Mammals
Casey, Cardinia & Baw Baw	Birds + Amphibians	Reptiles + Mammals
Macedon Ranges, Hume, Mitchell & Whittlesea	Birds + Amphibians	Reptiles + Mammals
Moorabool, Melton, Wyndham & Greater Geelong	Fish + Birds	Reptiles
Mornington Peninsula	Birds + Amphibians	Fish + Mammals
Urban Melbourne	Birds + Amphibians	Fish
Yarra Ranges & Nillumbik	Birds + Amphibians	Reptiles + Fish

3.2.9 Reporting Area Rating

A Reporting Area rating is a useful way of summarising trends across taxonomic groups (Table 15); generated from the proportion of species which are most likely to be extant (i.e. those with a probability of persistence greater than 75%) using the grade bands as before. However it must be remembered that this rating is by no means a definitive indicator of how all species are surviving within each Reporting Area, as the results presented above clearly demonstrate that even within the same Reporting Area, some taxa may be secure whilst others are declining.

Bass Coast, South Gippsland & Islands received the lowest score, largely attributable to the lack of persistence observed among bird species. Reporting Areas such as Urban Melbourne and Yarra Ranges & Nillumbik scored highest as they show the least variability between taxonomic groups, with mammals and

reptiles in particular demonstrating relatively higher levels of persistence. The score for Moorabool, Melton, Wyndham & Greater Geelong is increased through the successful retention of freshwater fish species, higher than any other Reporting Area.

Table 15: Rating for each of the seven terrestrial Reporting Areas.

Reporting Area	No. spp. \geq 75%	Total spp.	Proportion spp. \geq 75%	Rating
Bass Coast, South Gippsland & Islands	87	293	30%	E
Casey, Cardinia & Baw Baw	231	340	68%	D
Macedon Ranges, Hume, Mitchell & Whittlesea	231	338	68%	D
Moorabool, Melton, Wyndham & Greater Geelong	290	400	73%	C
Mornington Peninsula	212	321	66%	D
Urban Melbourne	327	447	73%	C
Yarra Ranges & Nillumbik	259	346	75%	C

4 Discussion

4.1 Limitations of data

This report is based on data contained within the AVW and several other biological records databases. The data contains biases that need to be considered before accepting apparent trends in the conservation status of species. Variations in the effort of record collecting within and between databases may confound analysis of trends in the distribution and abundance of species. For example, the annual recording rate of mammals within the AVW varied considerably between 1839 and 2006, with a major peak in the late 1980s, coinciding with a period of detailed fauna surveys conducted in the outer suburbs of Melbourne by the Arthur Rylah Institute for Environmental Research (van der Ree, 2004). In addition, records are entered into the different databases in a variety of ways; incidental sightings tend to form the bulk of AVW records, whereas fish data from the Melbourne Water Fish Census are from systematic surveys by qualified biologists, which are repeated at the same locations over various time periods. Records from organised surveys will be more regular than those submitted by chance-encounters from the general public, though may be less frequent across all Reporting Areas. Within the AVW data there may also be biases related to human population density; probability values for more sparsely populated rural areas may be more conservative because there is a greater chance that a species remains undetected. As the public becomes more aware about the conservation status of species, some more common species may be less frequently reported in favour of more 'novel' sightings. Following on from this, species surveys by zoological consultants may bias record collection towards species that are often associated with land ear-marked for development, or those that have protected status, as increasingly legislation demands priority species be targeted. The development and application of improved survey techniques used by consultants, researchers and enthusiastic volunteers may have biased sightings records as we are now able to detect species which would previously have been impossible. For example, ultrasonic call detectors for identifying species of insectivorous bats (*Microchiroptera*) have been developed since the 1970s, coinciding with an apparent range expansion of several bat species (van der Ree & McCarthy, 2005). As the formula used to infer persistence is inherently biased towards more recent records, several species that were recorded as highly likely to persist within a Reporting Area may have been based on a single isolated sighting recorded within the last year of the observation period. However, the inference that collection effort has become more frequent and effective in recent decades increases the likelihood that any documented range changes in the past few decades are real, and not a sampling effect. See van der Ree & McCarthy (2005) for more thorough discussion on the biases associated with the formulae used to infer species persistence.

It is impossible to be certain that the lack of a record of a species in these databases represents an actual absence on the ground (van der Ree, 2004), as the absence of a species cannot be 'proven'. It therefore remains possible that some species, particularly those that occur at very low densities, or are highly cryptic and elusive, may be wrongly determined to be absent. These species may persist in isolated, remnant vegetation that has escaped high-intensity disturbance (McKinney, 2002). Rediscovery of animals previously thought to be extinct has occurred frequently during the past few decades as the level of field research and

biological survey throughout Australia has increased along with the development of appropriate sampling procedures (Recher & Lim, 1990). However, while there is the potential for misclassifying the status of common but cryptic species, it is unlikely that a significant number of species classed as endangered will be found to be abundant (Recher & Lim, 1990). More frequently, rare fauna will not be listed as additional data are required before a decision can be reached about their status.

Not all species range contractions are the result of increased human activity, many species are on the periphery of their natural range in the greater Melbourne area, therefore it remains unclear whether fluctuations in species distribution are naturally occurring or caused by anthropogenic factors. The effect of natural range change precludes our ability to assess the impact of urbanisation as their historical distribution may have been unrelated to the expansion of human settlement. It also should be remembered that not all species that show a decline are at considerable conservation risk, as they may be still be abundant elsewhere in the greater geographic region, but restricted in distribution by climate or habitat (Recher & Lim, 1990).

4.2 Regional Factors Driving Taxonomic Declines

The impact of post-colonial human population growth and urban expansion on the probability of persistence of species within the region varies between taxonomic groups. Differences in the decline of vertebrate fauna across Australia can be attributed to settlement history related to the diversion of environmental resources to humans and introduced species (Burbidge & McKenzie, 1989), yet the loss of species cannot be attributed to a single cause (Recher & Lim, 1990). Declines in terrestrial vertebrate fauna have resulted from a combination of factors including habitat modification and fragmentation, over-exploitation, exotic diseases, the effects of pesticides, competition with introduced herbivores, and predation by foreign predators (Recher & Lim, 1990).

It should be noted that collection effort may be having some impact on the Reporting Area rankings, for example Urban Melbourne had the second highest proportion of species thought to remain extant (62%), despite having experienced the highest level of clearing, with only 5% of the original native vegetation remaining (PPWCMA 2007). Many of the other Reporting Areas have lost between 74 and 81% of their original native vegetation (PPWCMA 2007). Habitat loss and fragmentation throughout the entire CMA is expected to have been a large factor in species losses.

While several factors associated with urbanisation may be acting synergistically to cause species declines, it is possible to identify some of the main factors driving declines within each taxonomic group. Within all taxa however, there will be examples of 'urban avoiders', 'urban adapters' and 'urban exploiters' (*sensu* McKinney, 2002). Urban avoiders tend to have very specific life-requirements and so are sensitive to human-disturbance of natural habitats, and therefore are usually the first species to disappear in the proximity of humans. Urban adapters tend to be distributed at the fringes of urban areas, where their more generalist life-requirements enable them to attain densities much greater than in natural environments because of the abundance of human-subsidised foods and absence of their natural predators, which have been eliminated or deterred by human activities. Urban exploiters are often totally dependent of human resources; the combination between predator removal and abundant food subsidies allowing them to attain enormous population densities. The composition of species changes along the urban-rural gradient, with urban exploiters increasingly dominating animal communities towards the urban centre. This is confounded by the fact that many introduced species, which also increase with proximity to humans, are urban adapters or exploiters (McKinney, 2002).

One of the greatest impacts of human settlement in Australia on native fauna has been on mammals (Recher & Lim, 1990). Of these, it is small-to-medium sized ground-dwelling mammals that have been most affected in terms of range reduction and declining species abundance (Lunney & Leary 1988; Burbidge & McKenzie, 1989; Short & Smith 1994, van der Ree 2004, van der Ree & McCarthy, 2005). This is largely attributable to the conversion of Australia's natural habitats to pastoral and agricultural lands, and the over-exploitation of forests for timber products (Lunney & Leary, 1988; Recher & Lim, 1990; Bennett, 1990), as well as the introduction of exotic predators, such as cats *Felis catus* and fox *Vulpes vulpes* (Smith & Quin, 1995). Ecosystems have been altered by forest clearing, over-grazing, use of fertilisers and the introduction of 'weedy' plant species (Lunney & Leary, 1988). Not all mammal species have suffered the same impacts of human settlement however; species which occupy rugged or rocky terrain (e.g. rock wallabies *Petrogale*) and most large species (e.g. kangaroos *Macropus*) have been less adversely affected by human activity (Recher & Lim, 1990). Indeed, highly mobile species such as bats (e.g. the grey-headed flying fox *Pteropus poliocephalus*) appear to be favoured by urbanisation (van der Ree, 2004; van der Ree & McCarthy, 2005).

Whether the same relationship is true for all bats species, including the many insectivorous species, remains unclear given the ambiguity surrounding the effect of improved detection methods (van der Ree & McCarthy, 2005).

Whilst species of bird haven't suffered the same losses from the Australian continent observed in mammals, nearly 20% of bird species are listed as threatened or of 'special concern', implying that the impact of European settlement of bird fauna has been more significant than is generally acknowledged (Recher, 1999). Of bird species, ground-dwelling and ground-foraging species have been most affected (Recher & Lim, 1990). These species are particularly sensitive to the degradation of ground vegetation, over-grazing by livestock and introduced mammals, destruction of the litter layer through prescriptive burning, and soil-erosion; each of which removes cover for protection from predators, as well as diminishing the availability of nesting sites and food resources (Rech & Lim, 1990). Many bird species, such as scrub-birds *Atrichornis* and grass-wrens *Amytornis*, which were already highly restricted in their distribution by their specialised habitat requirements have been affected by changes to their habitats from altered fire regimes and from grazing by introduced herbivores (Recher & Lim, 1990). Other species have been highly affected by habitat clearing and fragmentation and the loss of old-growth forest through logging (Howe, 1984; Howe *et al.*, 1981; Loyn, 1985; Garnett 1992, Lunney *et al.*, 1997, Recher 1999, Gardner & Heinsohn, 2007).

There is less evidence of change in the distribution and abundance of frogs in Australia than for birds and mammals (Recher & Lim, 1990). However, habitat loss, fragmentation and degradation, which often result from urbanisation, are among the greatest threats to amphibian populations (Stuart *et al.*, 2004; Beebee & Griffiths, 2005; Cushman, 2006). Many amphibian populations are patchily distributed at local scales, but may comprise larger networks of metapopulations at regional scales (Marsh & Trenham, 2001; Smith & Green, 2005). Yet the ability of amphibians to disperse can be significantly restricted in urban landscapes because of infrastructure such as roads, buildings and fences, reducing the ability of the population networks to function (Hamer & McDonnell, 2008). Waterbodies in proximity to humans are often limited in their suitability for amphibians for a variety of reasons (reviewed by Hamer & McDonnell, 2008), such as their being stocked with exotic fish, having inappropriate hydrological regimes, receiving contaminated runoff (i.e. fertilisers, sediment, pesticides, heavy metals), or having depleted vegetation. Overall, amphibian decline in an area is directly associated with changes in landscape structure that results in decreased wetland area and density, increased wetland isolation, and decreased wetland vegetation or forest cover (Lehtinen *et al.*, 1999; Rubbo & Kiesecker, 2005; Parris, 2006; Gagné & Fahrig, 2007).

On the whole, reptiles do not respond well to urbanisation, but the diversity of species within reptile taxa means that some species are affected by human-modified landscapes more than others (Hamer & McDonnell, *in prep.*). Generalist species with broad habitat requirements can persist in small habitat patches and corridors of native vegetation (Kitchener *et al.*, 1980; Recher *et al.*, 1987; Anderson & Burgin, 2002; Prosser *et al.*, 2006). However, species with more specific habitat requirements may be less likely to persist, especially in highly urbanised areas, because of habitat loss and fragmentation (Smith & Robertson, 1999; Robertson & Cooper, 2000). A reduction in the density of resources, such as hollow bearing trees, affects the persistence of species which depend on such resources (Hamer & McDonnell, *in prep.*). The wide-ranging movements of some species combined with the sun-basking habits of reptiles make them particularly susceptible to accidental or deliberate death by humans and traffic (White & Burgin, 2004). Species of snakes may be more likely to be adversely affected by direct human intervention through deliberate killing or removal of 'nuisance' individuals in urban areas (Butler *et al.*, 2005).

The major threats to fish biodiversity are intense and have been relatively well documented: overexploitation, flow modification, destruction of habitats, invasion by exotic species, and pollution (including eutrophication and sedimentation), all of which are interacting (Leveque *et al.*, 2008). One of the leading causes of species endangerment and extinction in freshwater systems is widely considered to be the introduction of invasive species (Claudi & Leach, 1999; Harrison & Stiassny, 1999; Sala *et al.*, 2000). Invasive species generally reduce native inland water species abundance through predation, hybridisation, parasitism, or competition and may alter community structure and ecosystem processes, such as nutrient cycling and energy flow or, in the case of invasive plants, the hydrologic regime of a particular inland water aquatic ecosystem (Arthington, 1991; Bunn *et al.*, 1997, 1998). For example, the introduction of salmonid species, particularly brown and rainbow trout, have resulted in major declines of *Galaxiidae* because of displacement or predation (McDowall 2006). Species such as tilapias have been intentionally dispersed worldwide for the biological control of aquatic weeds and insects, as baitfish for certain capture fisheries, for aquaria, and as a food fish (Canonico *et al.*, 2005). Whilst these fish are generally considered to be herbivorous, their capacity for reproduction combined with their feeding habits can result in the elimination of all submerged and floating aquatic macrophytes, which has been documented to coincide with significant declines in populations of four common and abundant species of native fish. (Crutchfield, 1995; Canonico *et al.*, 2005). Changes to hydrological patterns, altered flow and in-stream structures such as culverts have also had adverse affected

fish movement (Winter & Van Densen 2001; Stuart & Jones, 2006; MacDonald & Davies, 2007; Jones & Stuart, 2008), community structure (Bain *et al.*, 1988), and breeding behaviour (Hardie *et al.*, 2007).

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Appendix 1: Probability of persistence of fish species by Reporting Area

IR = insufficient records

Common Name	Scientific Name	Bass Coast, South Gippsland & Islands	Casey, Cardinia and Baw Baw	Macedon Ranges, Hume, Mitchell & Whittlesea	Moorabool, Melton, Wyndham and Greater Geelong	Mornington	Urban Melbourne	Yarra Ranges & Nillumbik
Australian Anchovy	<i>Engraulis australis</i>				1.00			
Australian Bass	<i>Macquaria novemaculeata</i>						1.00	
Australian Smelt	<i>Retropinna semoni</i>		0.96	1.00	1.00		0.86	1.00
Black Bream	<i>Acanthopagrus butcheri</i>				1.00		0.56	
Blue-spot Goby	<i>Pseudogobius olorum</i>				1.00			
Bridled Goby	<i>Arenigobius bifrenatus</i>		IR			IR	0.30	
Broad-finned Galaxias	<i>Galaxias brevipinnis</i>		0.69	IR	IR	0.91	0.80	1.00
Common Galaxias	<i>Galaxias maculatus</i>	1.00	1.00	1.00	1.00	0.94	1.00	1.00
Dwarf Galaxias	<i>Galaxiella pusilla</i>		0.98			0.96	0.93	
Estuary Perch	<i>Macquaria colonorum</i>	IR			IR		IR	IR
Flat-headed Gudgeon	<i>Philypnodon grandiceps</i>			1.00	1.00	0.97	1.00	
Freshwater Catfish	<i>Tandanus tandanus</i>						0.65	
Golden Perch	<i>Macquaria ambigua</i>						0.59	
Silver Perch	<i>Bidyanus bidyanus</i>						0.12	
Australian Grayling	<i>Prototroctes maraena</i>		0.14	IR			0.34	0.40
Long-finned Eel	<i>Anguilla reinhardtii</i>		1.00					
Macquarie Perch	<i>Macquaria australasica</i>			IR	IR		0.90	1.00
Mountain Galaxias	<i>Galaxias olidus</i>		0.96	1.00	1.00	IR	0.97	1.00
Murray Cod	<i>Maccullochella peelii peelii</i>			0.22			0.79	0.57
Pouched Lamprey	<i>Geotria australis</i>		0.30	1.00	IR		0.98	0.41
River Blackfish	<i>Gadopsis marmoratus</i>	IR	1.00	0.23	1.00	IR	0.78	1.00
Short-finned Eel	<i>Anguilla australis</i>	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Short-headed Lamprey	<i>Mordacia mordax</i>		1.00		1.00		0.98	0.07
Small-mouthed Hardyhead	<i>Atherinosoma microstoma</i>				1.00	IR	0.21	
Southern Pigmy Perch	<i>Nannoperca australis</i>	0.35	1.00	1.00	0.95	0.91	0.73	1.00
Spotted Galaxias	<i>Galaxias truttaceus</i>	0.70	0.92	IR	1.00	0.89	0.98	0.72
Tamar River Goby	<i>Afurcagobius tamarensis</i>		IR				0.43	
Australian Mudfish	<i>Neochanna cleaveri</i>						IR	
Silver Trevally	<i>Pseudocaranx dentex</i>					IR		
Trout Cod	<i>Maccullochella macquariensis</i>						IR	
Tupong	<i>Pseudaphritis urvillii</i>	1.00	0.88	1.00	1.00	0.95	1.00	IR

Western Carp Gudgeon	<i>Hypseleotris klunzingeri</i>				IR		
Yarra Pigmy Perch	<i>Nannoperca obscura</i>	0.23		1.00		0.11	
Yelloweye Mullet	<i>Aldrichetta forsteri</i>					0.50	

Appendix 2: Probability of persistence of amphibian species by Reporting Area IR = insufficient records

Common Name	Scientific Name	Bass Coast, South Gippsland & Islands	Casey, Cardinia and Baw Baw	Macedon Ranges, Hume, Mitchell & Whittlesea	Moorabool, Melton, Wyndham and Greater Geelong	Mornington	Urban Melbourne	Yarra Ranges & Nillumbik
Plains Froglet	<i>Crinia parinsignifera</i>			0.000				
Common Froglet	<i>Crinia signifera</i>	1.000	1.000	1.000	1.00	1.000	1.000	1.000
Victorian Smooth Froglet	<i>Geocrinia victoriana</i>	1.000	0.976	0.614	0.69	0.914	1.000	1.000
Southern Bullfrog (ssp. unknown)	<i>Limnodynastes dumerilii</i>	1.000	1.000	1.000	1.00	1.000	1.000	1.000
Striped Marsh Frog	<i>Limnodynastes peronii</i>	1.000	1.000	1.000	0.91	1.000	1.000	1.000
Spotted Marsh Frog (race unknown)	<i>Limnodynastes tasmaniensis</i>	1.000	1.000	1.000	1.00	1.000	1.000	1.000
Southern Brown Tree Frog	<i>Litoria ewingii</i>	1.000	1.000	1.000	0.95	1.000	1.000	1.000
Eastern Dwarf Tree Frog	<i>Litoria fallax</i>					NA	1.000	
Lesueur's Frog	<i>Litoria lesueuri</i>			0.829	0.00		NA	0.863
Plains Brown Tree Frog	<i>Litoria paraewingi</i>			NA			NA	
Peron's Tree Frog	<i>Litoria peronii</i>		NA	0.281		1.000	1.000	1.000
Growling Grass Frog	<i>Litoria raniformis</i>	0.550	1.000	1.000	1.00	1.000	1.000	1.000
Verreaux's Tree Frog	<i>Litoria verreauxii verreauxii</i>	1.000	1.000	1.000	1.00	1.000	1.000	1.000
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>		0.158	1.000	1.00		1.000	0.002
Haswell's Froglet	<i>Paracrinia haswelli</i>		0.667			1.000	1.000	
Brown Toadlet	<i>Pseudophryne bibronii</i>	1.000		1.000	0.02		1.000	0.733
Southern Toadlet	<i>Pseudophryne semimarmorata</i>	1.000	0.002	0.000		0.597	0.990	0.035

Appendix 3: Probability of persistence of reptile species by Reporting Area IR = insufficient records

Common Name	Scientific Name	Bass Coast, South Gippsland & Islands	Casey, Cardinia and Baw Baw	Macedon Ranges, Hume, Mitchell & Whittlesea	Moorabool, Melton, Wyndham and Greater Geelong	Mornington	Urban Melbourne	Yarra
Tree Dragon	<i>Amphibolurus muricatus</i>	IR	0.00	1.00	0.95	0.33	0.77	1.00

Highland Copperhead	<i>Austrelaps ramsayi</i>		IR					0.01
Lowland Copperhead	<i>Austrelaps superbus</i>	1.00	0.99	0.96	1.00	0.94	0.99	0.91
Eastern Three-lined Skink	<i>Bassiana duperreyi</i>	1.00	0.56	0.80	0.01	0.86	0.99	0.00
Common Long-necked Turtle	<i>Chelodina longicollis</i>	1.00	1.00	0.47	0.48	0.89	1.00	0.55
Marbled Gecko	<i>Christinus marmoratus</i>			0.57	0.73	IR	1.00	0.78
Large Striped Skink	<i>Ctenotus robustus</i>			1.00	0.39		1.00	IR
Striped Legless Lizard	<i>Delma impar</i>			0.03	0.98		1.00	
White-lipped Snake	<i>Drysdalia coronoides</i>	0.93	0.92	0.89	0.11	0.98	0.89	0.79
Swamp Skink	<i>Egernia coventryi</i>	0.50	0.77			0.80	0.87	0.95
Cunningham's Skink	<i>Egernia cunninghami</i>		IR	0.88	0.33		0.94	1.00
Black Rock Skink	<i>Egernia saxatilis intermedia</i>	IR	0.95	0.51	0.79		IR	0.99
White's Skink	<i>Egernia whitii</i>	1.00	0.66	0.83	0.11	0.98	0.77	0.84
Murray River Turtle	<i>Emydura macquarii</i>			IR			IR	
Southern Water Skink	<i>Eulamprus tympanum tympanum</i>	0.65	0.00	0.12	0.14	0.57	1.00	0.87
Delicate Skink	<i>Lampropholis delicata</i>	1.00	0.43	0.05		1.00	0.95	1.00
Garden Skink	<i>Lampropholis guichenoti</i>	1.00	1.00	0.10	0.95	1.00	1.00	0.97
Bougainville's Skink	<i>Lerista bougainvillii</i>		IR	1.00	0.00	IR	0.97	0.10
Broad-shelled Turtle	<i>Macrochelodina expansa</i>						IR	IR
McCoy's Skink	<i>Nannoscincus maccoyi</i>	0.89	0.89	0.81	0.56	1.00	1.00	0.00
Coventry's Skink	<i>Niveoscincus coventryi</i>		0.00	0.34	0.41		IR	0.01
Metallic Skink	<i>Niveoscincus metallicus</i>	1.00	0.44		0.05	0.91	IR	0.93
Tiger Snake	<i>Notechis scutatus</i>	1.00	0.96	0.01	1.00	0.89	1.00	1.00
Gippsland Water Dragon	<i>Physignathus lesueurii howittii</i>						0.68	IR
Bearded Dragon	<i>Pogona barbata</i>	IR		0.52	IR			
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>		0.97	0.00	0.51	IR	0.62	0.07
Southern Grass Skink	<i>Pseudemoia entrecasteauxii</i>	1.00		0.45	0.73	1.00	0.01	0.00
Tussock Skink	<i>Pseudemoia pagenstecheri</i>			0.93	0.97		1.00	IR
Glossy Grass Skink	<i>Pseudemoia rawlinsoni</i>	IR	0.56	0.03		0.92	0.59	0.92
Spencer's Skink	<i>Pseudemoia spenceri</i>		0.00	0.19	IR		IR	0.00
Eastern Brown Snake	<i>Pseudonaja textilis</i>	IR		1.00	0.98	1.00	1.00	1.00
Common Scaly-foot	<i>Pygopus lepidopodus</i>		IR			0.91	IR	
Gray's Blind Snake	<i>Ramphotyphlops nigrescens</i>							IR
Mountain Dragon	<i>Rankinia diemensis</i>			0.95	0.16			0.31
Eastern Small-eyed Snake	<i>Rhinoplocephalus nigrescens</i>		0.48	0.13	0.22	0.53	0.89	1.00
Weasel Skink	<i>Saproscincus mustelinus</i>	0.97	0.96	0.00	0.54	1.00	1.00	0.99
Little Whip Snake	<i>Suta flagellum</i>			1.00	0.95		1.00	0.22
Blotched Blue-tongued Lizard	<i>Tiliqua nigrolutea</i>	1.00	0.84	0.48	0.00	0.94	1.00	1.00
Stumpy-tailed Lizard	<i>Tiliqua rugosa</i>			IR	0.43		0.35	IR
Common Blue-tongued Lizard	<i>Tiliqua scincoides</i>	IR	1.00	1.00	0.79	1.00	1.00	1.00
Grassland Earless Dragon	<i>Tympanocryptis pinguicollis</i>			IR	0.55		0.08	
Lace Goanna	<i>Varanus varius</i>	1.00	0.87	IR	IR	0.77	0.58	1.00

Appendix 4: Probability of persistence of bird species by Reporting Area

IR = insufficient records

Common Name	Scientific Name	Bass Coast, South Gippsland & Islands	Casey, Cardinia and Baw Baw	Macedon Ranges, Hume, Mitchell & Whittlesea	Moorabool, Melton, Wyndham and Greater Geelong	Mornington	Port Phillip	Urban Melbourne	Westernport	Yarra Ranges & Nillumbik
Antarctic Petrel	<i>Thalassoica antarctica</i>					0.51				
Antarctic Prion	<i>Pachyptila desolata</i>		IR			0.89	0.58	IR	0.37	
Arctic Jaeger	<i>Stercorarius parasiticus</i>	IR			1.00	IR	0.91	0.96	0.28	
Arctic Tern	<i>Sterna paradisaea</i>		IR		IR	IR	IR	0.47	0.47	
Asian Dowitcher	<i>Limnodromus semipalmatus</i>						IR		IR	
Australasian Bittern	<i>Botaurus poiciloptilus</i>	IR	0.96	0.88	1.00	0.85	0.49	1.00	IR	0.11
Australasian Figbird	<i>Sphecotheres viridis</i>		IR							
Australasian Gannet	<i>Morus serrator</i>	0.21			1.00	1.00	0.85	1.00	0.49	
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	0.68	1.00	1.00	1.00	1.00	0.97	1.00	0.91	1.00
Australasian Pipit	<i>Anthus novaeseelandiae</i>	IR	IR	0.84	0.67	0.51	0.88	IR	0.48	0.88
Australasian Shoveler	<i>Anas rhynchotis</i>	0.63	1.00	1.00	1.00	1.00	0.67	1.00	0.56	0.96
Australian Bustard	<i>Ardeotis australis</i>				IR					IR
Australian Hobby	<i>Falco longipennis</i>	IR	1.00	1.00	1.00	0.97	0.98	1.00	IR	0.99
Australian King-Parrot	<i>Alisterus scapularis</i>	IR	1.00	0.72	0.95	0.80	IR	1.00		1.00
Australian Magpie	<i>Gymnorhina tibicen</i>	1.00	1.00	1.00	1.00	1.00	0.32	1.00	0.66	1.00
Australian Owllet-nightjar	<i>Aegotheles cristatus</i>	IR	1.00	1.00	1.00			1.00	IR	1.00
Australian Painted Snipe	<i>Rostratula australis</i>			IR	0.14		IR	0.33	IR	
Australian Pelican	<i>Pelecanus conspicillatus</i>	0.03	1.00	1.00	1.00	1.00	0.98	1.00	0.01	1.00
Australian Pratincole	<i>Stiltia isabella</i>			IR	0.32		IR			
Australian Raven	<i>Corvus coronoides</i>	0.61	1.00	1.00	1.00	0.90	0.92	1.00	0.62	1.00
Australian Ringneck	<i>Barnardius zonarius zonarius</i>			IR	IR		0.17	0.17	IR	0.30
Australian Shelduck	<i>Tadorna tadornoides</i>	0.01	1.00	1.00	1.00	0.97	0.21	1.00	IR	0.97
Australian Spotted Crake	<i>Porzana fluminea</i>	IR	0.96	1.00	1.00	0.61	0.92	1.00	0.28	IR
Australian White Ibis	<i>Threskiornis molucca</i>	0.01	1.00	1.00	1.00	1.00	0.88	1.00	0.71	1.00
Australian Wood Duck	<i>Chenonetta jubata</i>	0.25	1.00	1.00	1.00	1.00	0.89	1.00	0.89	1.00
Azure Kingfisher	<i>Alcedo azurea</i>		0.97	IR	IR		IR	1.00	IR	0.94
Baillon's Crake	<i>Porzana pusilla</i>		1.00	1.00	0.96	1.00	0.92	1.00	1.00	0.95
Banded Lapwing	<i>Vanellus tricolor</i>	IR	1.00	0.97	1.00		0.11	1.00	0.54	0.65
Banded Stilt	<i>Cladorhynchus leucocephalus</i>				1.00		0.89	0.98		
Barking Owl	<i>Ninox connivens</i>	IR	0.97	0.87	0.95	IR		0.97	IR	0.95

Barn Owl	<i>Tyto alba</i>		1.00	IR	1.00	0.33		1.00		IR
Bar-tailed Godwit	<i>Limosa lapponica</i>	0.65			1.00		0.90	0.87	0.11	
Bassian Thrush	<i>Zoothera lunulata</i>	0.40	1.00	1.00	1.00	0.95	0.83	1.00	IR	1.00
Beautiful Firetail	<i>Stagonopleura bella</i>		0.93			IR	IR	IR		0.96
Bell Miner	<i>Manorina melanophrys</i>	IR	1.00	0.99	IR	1.00	IR	1.00		1.00
Black Falcon	<i>Falco subniger</i>	0.67	0.80	1.00	1.00	0.97	0.43	0.98	0.66	0.88
Black Honeyeater	<i>Sugamel niger</i>			IR				IR		
Black Kite	<i>Milvus migrans</i>		IR	1.00	1.00			0.92		0.96
Black Swan	<i>Cygnus atratus</i>	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.97	1.00
Black-breasted Buzzard	<i>Hamirostra melanosternon</i>				IR					
Black-browed Albatross	<i>Thalassarche melanophris</i>	IR			IR		0.20	IR	0.66	
Black-chinned Honeyeater	<i>Melithreptus gularis</i>				1.00			IR		IR
Black-eared Cuckoo	<i>Chrysococcyx osculans</i>		IR	0.97	0.98			0.99		IR
Black-faced Cormorant	<i>Phalacrocorax fuscescens</i>	0.86		IR	IR	0.73	0.96	IR	0.91	
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	0.94	1.00	1.00	1.00	1.00	0.83	1.00	0.82	1.00
Black-faced Monarch	<i>Monarcha melanopsis</i>					IR		IR		0.86
Black-faced Woodswallow	<i>Artamus cinereus</i>			IR						
Black-fronted Dotterel	<i>Elseyonis melanops</i>	0.75	1.00	1.00	1.00	1.00	0.66	1.00	0.10	0.99
Black-shouldered Kite	<i>Elanus axillaris</i>	0.08	1.00	1.00	1.00	1.00	0.06	1.00	0.72	0.97
Black-tailed Godwit	<i>Limosa limosa</i>		IR		1.00	IR	0.96	0.95	IR	
Black-tailed Native-hen	<i>Gallinula ventralis</i>	IR	IR	0.67	1.00		0.52	1.00		IR
Black-winged Petrel	<i>Pterodroma nigripennis</i>				IR					
Black-winged Stilt	<i>Himantopus himantopus</i>	0.16	0.30	1.00	1.00	0.97	0.97	1.00	IR	IR
Blue Petrel	<i>Halobaena caerulea</i>	IR				0.64	IR		0.14	
Blue-billed Duck	<i>Oxyura australis</i>	0.39	1.00	1.00	1.00	0.96	0.09	1.00	0.32	0.95
Blue-winged Parrot	<i>Neophema chrysostoma</i>	1.00	1.00	0.98	1.00	0.78	0.94	1.00	0.96	0.80
Bridled Tern	<i>Onychoprion anaethetus</i>							0.11		
Broad-billed Prion	<i>Pachyptila vittata</i>	IR								
Broad-billed Sandpiper	<i>Limicola falcinellus</i>		IR		0.48		IR	1.00	IR	
Brolga	<i>Grus rubicunda</i>			0.83	1.00		0.96	IR		
Brown Booby	<i>Sula leucogaster</i>						IR		IR	
Brown Falcon	<i>Falco berigora</i>	0.75	1.00	1.00	1.00	0.97	0.69	1.00	0.94	1.00
Brown Gerygone	<i>Gerygone mouki</i>		0.02							IR
Brown Goshawk	<i>Accipiter fasciatus</i>	0.85	1.00	1.00	1.00	1.00	0.68	1.00	0.94	0.97
Brown Quail	<i>Coturnix ypsilophora</i>	0.34	1.00	0.96	1.00	0.91	0.10	1.00	IR	0.92
Brown Songlark	<i>Cincloramphus cruralis</i>		0.85	1.00	1.00	0.59	0.82	1.00	0.25	0.49
Brown Thornbill	<i>Acanthiza pusilla</i>	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.70	1.00

Brown Treecreeper	<i>Climacteris picumnus</i>		IR	IR	1.00			1.00		0.38
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>	0.71	1.00	1.00	1.00	1.00	0.62	1.00	0.82	1.00
Brush Bronzewing	<i>Phaps elegans</i>		1.00		1.00	0.99	IR	1.00	0.30	1.00
Brush Cuckoo	<i>Cacomantis variolosus</i>		0.98	IR	0.89	0.98	IR	0.97		0.97
Budgerigar	<i>Melopsittacus undulatus</i>	IR		IR	IR			0.78		IR
Buff-banded Rail	<i>Gallirallus philippensis</i>	0.89	1.00	0.95	1.00	0.97	0.98	1.00	IR	0.86
Buff-breasted Sandpiper	<i>Tryngites subruficollis</i>						0.32	0.59		
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	0.74	0.99	1.00	1.00	0.23	IR	1.00	0.07	0.98
Bush Stone-curlew	<i>Burhinus grallarius</i>			0.14	0.06			0.96		IR
Cape Barren Goose	<i>Cereopsis novaehollandiae</i>	1.00	1.00	IR	1.00	1.00	0.96	1.00	0.66	
Cape Gannet	<i>Morus capensis</i>						0.04			
Cape Petrel	<i>Daption capense</i>	IR					IR	IR	IR	
Caspian Tern	<i>Hydroprogne caspia</i>	0.46	0.90	IR	1.00	0.97	0.33	1.00	IR	IR
Cattle Egret	<i>Ardea ibis</i>	0.75	1.00	1.00	1.00	1.00	0.53	1.00	0.27	0.95
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>					IR		IR		
Chestnut Teal	<i>Anas castanea</i>	0.95	1.00	1.00	1.00	1.00	0.96	1.00	0.85	1.00
Chestnut-breasted Mannikin	<i>Lonchura castaneothorax</i>		1.00					IR		IR
Chestnut-rumped Heathwren	<i>Calamanthus pyrrhopygius</i>		0.38		0.97			IR	IR	0.83
Chestnut-rumped Thornbill	<i>Acanthiza uropygialis</i>				0.89					
Cicadabird	<i>Coracina tenuirostris</i>									0.22
Clamorous Reed-Warbler	<i>Acrocephalus stentoreus</i>	1.00	1.00	1.00	1.00	1.00	IR	1.00	0.94	1.00
Cockatiel	<i>Nymphicus hollandicus</i>	IR	IR	0.98	0.95		IR	1.00	IR	0.55
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>	0.91	1.00	1.00	1.00	0.94	IR	1.00	0.70	1.00
Common Bronzewing	<i>Coracina tenuirostris</i>	IR	1.00	1.00	1.00	1.00	IR	1.00	0.05	1.00
Common Cicadabird	<i>Coracina tenuirostris</i>		0.22			0.29		IR		0.94
Common Diving-Petrel	<i>Pelecanoides urinatrix</i>	IR				0.44	0.85	IR	0.13	
Common Greenshank	<i>Tringa nebularia</i>	0.33	IR		1.00	0.32	0.99	1.00	0.89	
Common Koel	<i>Eydynamys scolopacea</i>							0.04		IR
Common Sandpiper	<i>Actitis hypoleucos</i>	0.80	0.64		0.92	0.36	1.00	1.00	0.64	
Common Tern	<i>Sterna hirundo</i>				1.00	0.47	0.59	1.00	0.77	
Crescent Honeyeater	<i>Phylidonyris pyrrhoptera</i>	0.87	0.98	0.96	1.00	1.00	IR	IR	0.20	1.00
Crested Bellbird	<i>Oreoica gutturalis</i>				0.98					
Crested Pigeon	<i>Ocyphaps lophotes</i>		1.00	1.00	1.00	1.00	1.00	1.00		0.94
Crested Shrike-tit	<i>Falcunculus frontatus</i>	1.00	1.00	0.99	1.00	1.00	IR	1.00	IR	0.97
Crested Tern	<i>Thalaseus bergii</i>	0.83	0.54		1.00	0.95	0.90	1.00	0.77	
Crimson Chat	<i>Epthianura tricolor</i>									IR
Crimson Rosella	<i>Platycercus elegans</i>	1.00	1.00	1.00	1.00	1.00	0.94	1.00	0.09	1.00

Curlew Sandpiper	<i>Calidris ferruginea</i>	0.73	0.80		1.00		0.80	1.00	0.02	
Darter	<i>Anhinga novaehollandiae</i>	0.76	1.00	1.00	1.00	0.97		1.00	IR	0.93
Diamond Dove	<i>Geopelia cuneata</i>			IR	0.93	IR		0.95		
Diamond Firetail	<i>Stagonopleura guttata</i>			IR	1.00			IR		IR
Dollarbird	<i>Eurystomus orientalis</i>	IR	1.00	IR	0.76	IR		0.98		0.83
Double-banded Plover	<i>Charadrius bicinctus</i>	0.73	0.80	IR	1.00	0.70	0.82	1.00	0.86	
Dusky Moorhen	<i>Gallinula tenebrosa</i>	0.69	1.00	1.00	1.00	1.00	0.28	1.00	0.93	1.00
Dusky Woodswallow	<i>Artamus cyanopterus</i>	1.00	1.00	0.99	1.00	1.00	0.80	1.00	0.01	1.00
Eastern Curlew	<i>Numenius madagascariensis</i>	0.43	0.76		0.92	0.67	0.86	0.90	0.66	
Eastern Great Egret	<i>Ardea modesta</i>	0.71	0.68	0.97	0.85	0.80	1.00	0.97	IR	0.37
Eastern Koel	<i>Eudynamys orientalis</i>					IR		0.92		IR
Eastern Rosella	<i>Platycercus eximius</i>	0.90	1.00	1.00	1.00	1.00	0.95	1.00		1.00
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	1.00	1.00	1.00	1.00	1.00	0.76	1.00	0.05	1.00
Eastern Whipbird	<i>Psophodes olivaceus</i>	0.60	1.00	0.21				1.00		1.00
Eastern Yellow Robin	<i>Eopsaltria australis</i>	1.00	1.00	1.00	1.00	1.00	0.08	1.00	IR	1.00
Emerald Dove	<i>Chalcophaps indica</i>									IR
Emu	<i>Dromaius novaehollandiae</i>		0.67	IR				IR		0.86
Erect-crested Penguin	<i>Eudyptes sclateri</i>						IR			
Eurasian Coot	<i>Fulica atra</i>	0.50	1.00	1.00	1.00	1.00	0.55	1.00	0.92	1.00
Fairy Martin	<i>Hirundo ariel</i>	0.77	0.97	1.00	1.00	0.88	IR	1.00	0.01	0.87
Fairy Prion	<i>Pachyptila turtur</i>	IR				0.86	0.96	IR	0.33	
Fairy Tern	<i>Sternula nereis</i>	0.91			1.00	IR	0.89	0.63	0.84	
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	1.00	1.00	1.00	1.00	1.00	0.06	1.00	0.60	1.00
Fiordland Penguin	<i>Eudyptes pachyrhynchus</i>								IR	
Flame Robin	<i>Petroica phoenicea</i>	0.96	1.00	1.00	1.00	1.00	0.23	1.00	0.91	1.00
Flesh-footed Shearwater	<i>Ardenna carneipes</i>						IR		IR	
Fluttering Shearwater	<i>Puffinus gavia</i>				1.00	0.69	1.00	0.57	IR	
Forest Kingfisher	<i>Todiramphus macleayii</i>			IR				IR		
Fork-tailed Swift	<i>Apus pacificus</i>	IR	0.50	1.00	0.92	IR	0.83	0.99	0.31	0.94
Freckled Duck	<i>Stictonetta naevosa</i>	IR		IR	1.00	1.00	0.77	1.00		
Fuscous Honeyeater	<i>Lichenostomus fuscus</i>		1.00	0.96	0.93			IR		0.98
Galah	<i>Eolophus roseicapilla</i>	1.00	1.00	1.00	1.00	1.00	IR	1.00	0.97	1.00
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	1.00	1.00	1.00	1.00	0.59	0.30	1.00	IR	1.00
Garganey	<i>Anas querquedula</i>						IR			
Gilbert's Whistler	<i>Pachycephala inornata</i>			IR	0.21					
Glossy Ibis	<i>Plegadis falcinellus</i>	IR	IR	1.00	1.00	IR	0.66	1.00	IR	
Golden Whistler	<i>Pachycephala pectoralis</i>	1.00	1.00	1.00	1.00	1.00	0.07	1.00	IR	1.00

Golden-headed Cisticola	<i>Cisticola exilis</i>	0.96	1.00	1.00	1.00	0.77	IR	1.00	0.93	0.99
Gould's Petrel	<i>Pterodroma leucoptera</i>	IR								
Grass Owl	<i>Tyto longimembris</i>				1.00		IR			
Great Cormorant	<i>Phalacrocorax carbo</i>	0.53	1.00	1.00	1.00	1.00	0.82	1.00	0.96	0.95
Great Crested Grebe	<i>Podiceps cristatus</i>	0.78	0.66	1.00	1.00	1.00	0.94	1.00	0.39	0.82
Great Egret	<i>Ardea alba</i>	0.25	1.00	1.00	1.00	0.58	IR	1.00	IR	IR
Great Frigatebird	<i>Fregata minor</i>					IR	IR	IR		
Great Knot	<i>Calidris tenuirostris</i>	0.79	IR		1.00		0.02	IR	0.15	
Great Skua	<i>Stercorarius skua</i>					IR	0.39	0.35	0.54	
Greater Sand Plover	<i>Charadrius leschenaultii</i>	IR			0.26		0.98		0.64	
Great-winged Petrel	<i>Pterodroma macroptera</i>					0.56			0.09	
Grey Butcherbird	<i>Cracticus torquatus</i>	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.87	1.00
Grey Currawong	<i>Strepera versicolor</i>	0.91	1.00	1.00	1.00	1.00	IR	1.00	IR	1.00
Grey Falcon	<i>Falco hypoleucos</i>				IR					
Grey Fantail	<i>Rhipidura albiscarpa</i>	1.00	1.00	1.00	1.00	1.00	0.75	1.00	0.21	1.00
Grey Goshawk	<i>Accipiter novaehollandiae</i>		0.75	IR	1.00	IR	IR	1.00	IR	0.96
Grey Plover	<i>Pluvialis squatarola</i>	1.00			0.65	IR	0.68	0.59	0.08	
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	1.00	1.00	1.00	1.00	1.00	0.12	1.00	0.95	1.00
Grey Teal	<i>Anas gracilis</i>	0.72	1.00	1.00	1.00	1.00	0.10	1.00	0.82	0.06
Grey-backed Storm-Petrel	<i>Garrodia nereis</i>								IR	
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>		0.87	IR	0.67	0.87	0.78	0.92	IR	0.14
Grey-headed Albatross	<i>Thalassarche chrysostoma</i>	0.29							0.42	
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	IR	IR		0.90		0.26	IR	0.01	
Ground Parrot	<i>Pezoporus wallicus</i>						IR			
Gull-billed Tern	<i>Gelochelidon nilotica</i>	IR	0.09		0.04		IR	0.98	IR	
Hardhead	<i>Aythya australis</i>	0.77	1.00	1.00	1.00	1.00	0.44	1.00	0.39	1.00
	<i>Lichenostomus melanops</i>									
Helmeted Honeyeater	<i>cassidix</i>	0.50	0.72						IR	IR
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>	0.72	1.00	1.00	1.00	1.00	0.61	1.00	0.81	1.00
Hooded Plover	<i>Thinornis rubricollis</i>	0.98			IR	1.00	0.90	0.51	0.93	
Hooded Robin	<i>Melanodryas cucullata</i>	0.21	0.99	IR	0.90	IR	0.75	0.24	IR	0.53
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>	0.95	1.00	0.95	1.00	1.00	0.94	1.00	0.79	1.00
Hudsonian Godwit	<i>Limosa haemastica</i>				IR					
Hutton's Shearwater	<i>Puffinus huttoni</i>							IR	0.12	
Intermediate Egret	<i>Ardea intermedia</i>	IR	IR	0.97	1.00	0.93	0.86	1.00		
Jacky Winter	<i>Microeca fascinans</i>	0.25	0.93	0.79	1.00	0.94	IR	0.99	0.05	1.00
Kelp Gull	<i>Larus dominicanus</i>	IR			IR	0.78	0.40		0.68	
Kerguelen Petrel	<i>Lugensa brevirostris</i>	IR				IR	IR			

King Quail	<i>Coturnix chinensis</i>	0.97	0.07				IR	0.79	IR	0.06
Large-billed Scrubwren	<i>Sericornis magnirostris</i>	IR	0.96	0.09				0.98		1.00
Latham's Snipe	<i>Gallinago hardwickii</i>	0.59	1.00	1.00	1.00	1.00	0.61	1.00	0.38	0.98
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	1.00	1.00	1.00	1.00	1.00	0.48	1.00	0.88	1.00
Leaden Flycatcher	<i>Myiagra rubecula</i>		0.95	1.00	0.96	0.93	IR	0.98	IR	0.99
Lesser Frigatebird	<i>Fregata ariel</i>						IR			
Lesser Sand Plover	<i>Charadrius mongolus</i>	IR			0.64		0.93		0.91	
Lesser Yellowlegs	<i>Tringa flavipes</i>						IR			
Letter-winged Kite	<i>Elanus scriptus</i>		IR	IR	IR			IR	IR	IR
Lewin's Honeyeater	<i>Meliphaga lewinii</i>		1.00	0.67				IR		1.00
Lewin's Rail	<i>Lewinia pectoralis</i>	0.83	0.96	IR	1.00	0.99	0.86	1.00	1.00	1.00
Light-mantled Sooty Albatross	<i>Phoebastria palpebrata</i>							IR		
Little Bittern	<i>Ixobrychus minutus</i>		0.96				0.82	0.97		0.95
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	0.55	1.00	1.00	1.00	1.00	0.85	1.00	0.69	1.00
Little Button-quail	<i>Turnix velox</i>	IR		IR	0.94				IR	
Little Corella	<i>Cacatua sanguinea</i>	IR	1.00	1.00	0.96	0.93		1.00	IR	1.00
Little Crow	<i>Corvus bennetti</i>			IR				1.00		
Little Curlew	<i>Numenius minutus</i>		IR		IR		0.80	IR		
Little Eagle	<i>Hieraaetus morphnoides</i>	0.01	1.00	1.00	1.00	0.91	IR	1.00	0.35	0.81
Little Egret	<i>Egretta garzetta</i>	0.80	0.11	1.00	1.00		0.91	1.00	0.22	IR
Little Friarbird	<i>Philemon citreogularis</i>					IR		1.00		IR
Little Grassbird	<i>Megalurus gramineus</i>	0.83	1.00	1.00	1.00	0.91	1.00	1.00	0.55	0.92
Little Lorikeet	<i>Glossopsitta pusilla</i>		0.96	1.00	0.96	0.81	0.21	1.00	IR	0.99
Little Penguin	<i>Eudyptula minor</i>	0.30			0.12	1.00	0.86	0.99	0.92	
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>	1.00	1.00	1.00	1.00	1.00	0.83	1.00	0.14	0.64
Little Raven	<i>Corvus mellori</i>	0.87	1.00	1.00	1.00	1.00	0.40	1.00	0.66	1.00
Little Shearwater	<i>Puffinus assimilis</i>								IR	
Little Stint	<i>Calidris minuta</i>				1.00		IR			
Little Tern	<i>Sternula albifrons</i>	IR			1.00	IR	0.40	IR	0.58	
Little Wattlebird	<i>Anthochaera chrysoptera</i>	0.93	1.00	1.00	0.98	1.00	0.95	1.00	0.98	1.00
Long-billed Corella	<i>Cacatua tenuirostris</i>		1.00	1.00	1.00	0.99	IR	1.00	IR	1.00
Long-tailed Jaeger	<i>Stercorarius longicaudus</i>						IR		IR	
Long-toed Stint	<i>Calidris subminuta</i>				1.00		IR	0.76		
Magellanic Penguin	<i>Spheniscus magellanicus</i>								IR	
Magpie Goose	<i>Anseranas semipalmata</i>	0.99	IR		0.12	0.16	IR	1.00	IR	IR
Magpie-lark	<i>Grallina cyanoleuca</i>	0.88	1.00	1.00	1.00	1.00	0.63	1.00	0.86	1.00
Major Mitchell's Cockatoo	<i>Lophocroa leadbeateri</i>				IR			0.98		

Mallee Ringneck	<i>Barnardius zonarius barnardi</i>				IR			0.68		
Malleefowl	<i>Leipoa ocellata</i>				IR					
Marsh Sandpiper	<i>Tringa stagnatilis</i>	IR	IR		1.00	IR	0.24	1.00	IR	
Masked Lapwing	<i>Vanellus miles</i>	0.02	1.00	1.00	1.00	1.00	1.00	1.00	0.17	1.00
Masked Owl	<i>Tyto novaehollandiae</i>		0.47	IR	0.87			0.91		0.40
Masked Woodswallow	<i>Artamus personatus</i>	IR	0.96	1.00	0.01	0.78		IR		0.33
Mistletoebird	<i>Dicaeum hirundinaceum</i>	0.94	1.00	0.96	1.00	1.00	0.69	1.00	0.72	1.00
Mottled Petrel	<i>Pterodroma inexpectata</i>						IR			
Musk Duck	<i>Biziura lobata</i>	0.93	0.85	1.00	1.00	1.00	0.95	1.00	IR	IR
Musk Lorikeet	<i>Glossopsitta concinna</i>		1.00	1.00	0.98	1.00	0.94	1.00	IR	1.00
Nankeen Kestrel	<i>Falco cenchroides</i>	0.94	1.00	1.00	1.00	1.00	0.59	1.00	0.35	0.99
Nankeen Night Heron	<i>Nycticorax caledonicus</i>	IR	0.89	1.00	0.99	0.95	0.54	1.00	0.45	0.97
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	1.00	1.00	1.00	1.00	1.00	0.93	1.00	0.90	1.00
Noisy Friarbird	<i>Philemon corniculatus</i>		IR	IR				1.00		0.75
Noisy Miner	<i>Manorina melanocephala</i>	0.95	1.00	1.00	0.99	1.00	0.53	1.00	0.92	1.00
Northern Giant-Petrel	<i>Macronectes halli</i>				IR		IR	IR	0.45	
Northern Shoveler	<i>Anas clypeata</i>				0.08			IR		
Olive Whistler	<i>Pachycephala olivacea</i>	0.56	0.98	IR	1.00	IR		0.99	IR	1.00
Olive-backed Oriole	<i>Oriolus sagittatus</i>	0.95	1.00	1.00	1.00	0.99	0.80	1.00	IR	0.98
Orange-bellied Parrot	<i>Neophema chrysogaster</i>	IR	IR		1.00	IR	1.00	0.86	0.21	
Oriental Plover	<i>Charadrius veredus</i>						IR			
Oriental Pratincole	<i>Glareola maldivarum</i>		IR		0.91					
Osprey	<i>Pandion cristatus</i>	IR			0.25	IR				
Pacific Barn Owl	<i>Tyto javanica</i>	0.69	0.98	0.72	0.98	0.89	0.74	0.96	0.92	0.66
Pacific Black Duck	<i>Anas superciliosa</i>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00
Pacific Golden Plover	<i>Pluvialis fulva</i>	IR	IR		1.00		0.98	0.98	0.23	
Pacific Gull	<i>Larus pacificus pacificus</i>	0.96	1.00		1.00	0.54	0.98	1.00	1.00	
Painted Button-quail	<i>Turnix varia</i>	0.89	0.99	0.94	0.99	0.81	IR	0.99		0.73
Painted Honeyeater	<i>Grantiella picta</i>		0.96		IR			IR		
Painted Snipe	<i>Rostratula benghalensis</i>							0.01		
Pale-headed Rosella	<i>Platycercus adscitus</i>							0.83		
Pallid Cuckoo	<i>Cuculus pallidus</i>	0.78	1.00	1.00	1.00	0.99	0.49	1.00	0.72	0.88
Peaceful Dove	<i>Geopelia striata</i>			IR	0.95			0.98		1.00
Pectoral Sandpiper	<i>Calidris melanotos</i>	IR			1.00		0.09	1.00		
Peregrine Falcon	<i>Falco peregrinus</i>	1.00	1.00	1.00	1.00	1.00	0.89	1.00	0.95	1.00
Pied Butcherbird	<i>Cracticus nigrogularis</i>					IR				
Pied Cormorant	<i>Phalacrocorax varius</i>	0.97	1.00	0.97	1.00	1.00	0.94	1.00	0.91	0.85

Pied Currawong	<i>Strepera graculina</i>	0.14	1.00	1.00	1.00	0.98	IR	1.00		1.00
Pied Oystercatcher	<i>Haematopus longirostris</i>	0.76	IR		1.00	0.85	1.00	1.00	1.00	
Pilotbird	<i>Pycnoptilus floccosus</i>		0.99					IR		0.79
Pink Robin	<i>Petroica rodinogaster</i>	0.72	0.99	0.91	0.99	0.94	IR	0.92	IR	0.80
	<i>Malacorhynchus</i>									
Pink-eared Duck	<i>membranaceus</i>	0.60	0.94	1.00	1.00	IR	0.92	1.00	0.31	0.77
Plains-wanderer	<i>Pedionomus torquatus</i>		IR	0.94	0.98		IR	0.65		IR
Plumed Whistling-Duck	<i>Dendrocygna eytoni</i>							0.69		IR
Pomarine Jaeger	<i>Stercorarius pomarinus</i>				IR	IR	IR		IR	
Powerful Owl	<i>Ninox strenua</i>	1.00	1.00	0.85	0.95	0.68		1.00	IR	1.00
Purple Swamphen	<i>Porphyrio porphyrio</i>	1.00	1.00	1.00	1.00	1.00	0.74	1.00	0.84	1.00
Purple-crowned Lorikeet	<i>Glossopsitta porphyrocephala</i>			1.00	1.00	IR	IR	0.99		0.58
Rainbow Bee-eater	<i>Merops ornatus</i>		IR	0.93	1.00	IR	IR	0.97		0.79
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>		1.00	1.00	0.99	1.00	0.96	1.00	IR	1.00
Red Knot	<i>Calidris canutus</i>	0.26	IR		1.00		0.71	0.87	0.04	
Red Wattlebird	<i>Anthochaera carunculata</i>	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.85	1.00
Red-backed Kingfisher	<i>Todiramphus pyrrhopygia</i>				IR			0.76		IR
Red-browed Finch	<i>Neochmia temporalis</i>	1.00	1.00	1.00	1.00	1.00	0.90	1.00	0.48	1.00
Red-browed Treecreeper	<i>Climacteris erythrops</i>		1.00	0.76	1.00			IR		1.00
Red-capped Plover	<i>Charadrius ruficapillus</i>	0.21		IR	1.00	1.00	0.99	1.00	0.93	
Red-capped Robin	<i>Petroica goodenovii</i>			1.00	1.00			0.94		0.87
Red-chested Button-quail	<i>Turnix pyrrhotorax</i>			IR	0.98			IR		IR
Red-kneed Dotterel	<i>Erythronyx cinctus</i>	0.73	IR	1.00	1.00	0.63	0.92	1.00	IR	0.68
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>	IR			1.00		0.95	1.00	0.09	
Red-necked Phalarope	<i>Phalaropus lobatus</i>				1.00		IR	1.00		
Red-necked Stint	<i>Calidris ruficollis</i>	0.51	IR	IR	1.00	0.91	0.86	1.00	0.39	
Red-rumped Parrot	<i>Psephotus haematonotus</i>		0.91	1.00	1.00	0.95	0.74	1.00	IR	1.00
Regent Honeyeater	<i>Anthochaera phrygia</i>			0.58	0.55			IR		0.88
Regent Parrot	<i>Polytelis anthopeplus</i>							IR		
Restless Flycatcher	<i>Myiagra inquieta</i>		1.00	0.95	1.00	IR	IR	0.66	0.41	1.00
Richard's Pipit	<i>Anthus novaeseelandiae</i>	0.29	1.00	1.00	1.00	0.81	IR	1.00		1.00
Rockhopper Penguin	<i>Eudyptes chrysocome</i>					IR			IR	
Rose Robin	<i>Petroica rosea</i>	IR	1.00	0.81	0.94	0.89	IR	0.99	0.31	1.00
Royal Albatross	<i>Diomedea epomophora</i>								0.03	
Royal Spoonbill	<i>Platalea regia</i>	0.14	1.00	1.00	1.00	1.00	0.77	1.00	0.51	0.97
Ruddy Turnstone	<i>Arenaria interpres</i>	0.38			1.00	IR	1.00	0.42	0.59	
Ruff	<i>Philomachus pugnax</i>				0.35	IR	IR	0.87		
Rufous Fantail	<i>Rhipidura rufifrons</i>	0.95	1.00	0.95	1.00	1.00	0.71	1.00	0.42	1.00

Rufous Songlark	<i>Cincloramphus mathewsi</i>		IR	0.88	0.96	0.11	IR	IR	IR	0.90
Rufous Whistler	<i>Pachycephala rufiventris</i>	1.00	1.00	1.00	1.00	1.00	0.29	1.00	0.13	1.00
Sacred Kingfisher	<i>Todiramphus sanctus</i>	IR	1.00	1.00	1.00	0.98	0.70	1.00	0.03	1.00
Salvin's Prion	<i>Pachyptila salvini</i>	IR				IR	0.73	0.02	0.12	
Sanderling	<i>Calidris alba</i>	0.66			IR	IR	0.74	0.91	0.42	
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>	IR	0.99	0.63	IR			IR	IR	1.00
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	0.78	1.00	0.26	0.96	1.00	IR	1.00	0.17	1.00
Scaly-breasted Lorikeet	<i>Trichoglossus chlorolepidotus</i>		IR	0.90	IR	0.58	0.79	1.00		IR
Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>		IR			IR		IR		0.94
Scarlet Robin	<i>Petroica boodang</i>	1.00	1.00	1.00	1.00	0.99	0.28	1.00	0.64	1.00
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	0.96	0.08	0.74	1.00		1.00	1.00	0.60	
Shining Bronze-Cuckoo	<i>Chrysococcyx lucidus</i>	0.86	1.00	1.00	1.00	1.00	0.44	1.00	0.69	1.00
Short-tailed Shearwater	<i>Ardenna tenuirostris</i>	0.89	IR		0.74	1.00	0.94	0.96	0.90	
Shy Albatross	<i>Thalassarche cauta</i>	0.24				IR	0.50		0.86	
	<i>Chroicocephalus</i>									
Silver Gull	<i>novaehollandiae</i>	0.94	1.00	1.00	1.00	1.00	0.97	1.00	0.99	0.94
Silvereye	<i>Zosterops lateralis</i>	0.96	1.00	1.00	1.00	1.00	0.93	1.00	0.39	1.00
Singing Bushlark	<i>Mirafra javanica</i>	IR	IR	0.42	1.00	IR	0.66	IR		IR
Singing Honeyeater	<i>Lichenostomus virescens</i>			IR	1.00	1.00	0.95	1.00	0.85	IR
Slender-billed Prion	<i>Pachyptila belcheri</i>					0.33	0.67	IR	0.08	
Snow Petrel	<i>Pagodroma nivea</i>					IR				
Sooty Albatross	<i>Phoebastria fusca</i>								IR	
Sooty Owl	<i>Tyto tenebricosa</i>		0.91					0.56		1.00
Sooty Oystercatcher	<i>Haematopus fuliginosus</i>	0.81			1.00	1.00	0.96	0.07	0.94	
Sooty Shearwater	<i>Ardenna grisea</i>					IR	IR		IR	
Southern Boobook	<i>Ninox novaeseelandiae</i>	0.94	1.00	0.98	0.99	0.95	0.65	0.99	0.12	1.00
Southern Emu-wren	<i>Stipiturus malachurus</i>	1.00	1.00			0.12	0.12	IR	IR	1.00
Southern Fulmar	<i>Fulmarus glacialis</i>	IR				IR	0.89	IR	0.75	
Southern Giant-Petrel	<i>Macronectes giganteus</i>	IR			0.30	IR	0.42		IR	
Southern Whiteface	<i>Aphelocephala leucopsis</i>			0.89	1.00	IR				IR
Spangled Drongo	<i>Dicrurus bracteatus</i>	IR			IR			IR	IR	
Speckled Warbler	<i>Pyrrholaemus sagittatus</i>			0.90	1.00	IR	IR	IR		0.93
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>		0.85	0.97	1.00	1.00	0.95	1.00	0.32	IR
Splendid Fairy-wren	<i>Malurus splendens</i>							1.00		
Spotless Crane	<i>Porzana tabuensis</i>	IR	1.00	1.00	0.92	0.95	IR	1.00	1.00	IR
Spotted Harrier	<i>Circus assimilis</i>	IR	IR	0.91	0.65	IR	IR	1.00	IR	IR
Spotted Pardalote	<i>Pardalotus punctatus</i>	1.00	1.00	1.00	1.00	1.00	0.72	1.00	0.20	1.00
Spotted Quail-thrush	<i>Cinclosoma punctatum</i>		1.00	1.00	1.00	IR	IR	0.11	IR	0.97

Square-tailed Kite	<i>Lophoictinia isura</i>		IR	IR	0.04			IR	IR	IR
Star Finch	<i>Neochmia ruficauda</i>									IR
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	0.77	1.00	1.00	1.00	1.00	0.98	1.00	0.74	1.00
Striated Fieldwren	<i>Calamanthus fuliginosus</i>		1.00	IR	1.00	0.38	IR	1.00		0.17
Striated Pardalote	<i>Pardalotus striatus</i>	0.88	1.00	1.00	1.00	1.00	0.60	1.00	0.75	1.00
Striated Thornbill	<i>Acanthiza lineata</i>	1.00	1.00	1.00	1.00	1.00	0.36	1.00	IR	1.00
Striped Honeyeater	<i>Plectorhyncha lanceolata</i>							IR		
Stubble Quail	<i>Coturnix pectoralis</i>	0.94	1.00	0.97	1.00	0.88	0.91	1.00	0.11	0.99
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	1.00	1.00	1.00	1.00	1.00	0.02	1.00	0.13	1.00
Superb Fairy-wren	<i>Malurus cyaneus</i>	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.93	1.00
Superb Fruit-Dove	<i>Ptilinopus superbus</i>							IR		
Superb Lyrebird	<i>Menura novaehollandiae</i>	0.01	1.00	0.93				0.93		1.00
Superb Parrot	<i>Polytelis swainsonii</i>			IR	0.95			0.25		
Swamp Harrier	<i>Circus approximans</i>	0.45	1.00	1.00	1.00	1.00	0.99	1.00	0.92	0.96
Swift Parrot	<i>Lathamus discolor</i>	0.37	0.71	0.57	1.00	0.99	IR	0.99		0.95
Tawny Frogmouth	<i>Podargus strigoides</i>	0.93	1.00	1.00	1.00	0.99	0.86	1.00	0.30	1.00
Tawny-crowned Honeyeater	<i>Phylidonyris melanops</i>	IR	1.00	IR	0.96	IR		IR		IR
Terek Sandpiper	<i>Xenus cinereus</i>	0.71	0.05		0.75		0.59	0.91	0.01	
Tree Martin	<i>Hirundo nigricans</i>	0.82	1.00	1.00	1.00	1.00	0.30	1.00	IR	1.00
Turquoise Parrot	<i>Neophema pulchella</i>		IR					IR		IR
Varied Sittella	<i>Daphoenositta chrysoptera</i>	0.82	1.00	0.90	1.00	1.00	IR	1.00	0.02	1.00
Wandering Albatross	<i>Diomedea exulans</i>					0.55	0.40	IR	IR	
Wedge-tailed Eagle	<i>Aquila audax</i>	0.85	1.00	1.00	1.00	1.00	0.33	1.00	0.02	1.00
Wedge-tailed Shearwater	<i>Ardenna pacifica</i>						IR		IR	
Weebill	<i>Smicromnis brevirostris</i>		0.63	1.00	1.00	IR	IR	1.00		0.01
Welcome Swallow	<i>Hirundo neoxena</i>	0.83	1.00	1.00	1.00	1.00	0.65	1.00	0.99	1.00
Western Gerygone	<i>Gerygone fusca</i>			IR	IR			0.82		IR
Whimbrel	<i>Numenius phaeopus</i>	0.12	IR		IR		0.52		0.03	
Whiskered Tern	<i>Chlidonias hybridus</i>	IR	IR	1.00	1.00	0.96	0.82	1.00	0.42	IR
Whistling Kite	<i>Haliastur sphenurus</i>	0.92	1.00	1.00	1.00	0.84	1.00	1.00	0.90	1.00
White-backed Swallow	<i>Cheramoeca leucosternus</i>		IR	0.40	0.78		IR	IR	IR	
White-bellied Cuckoo-Shrike	<i>Coracina papuensis</i>		IR	IR	1.00		IR	IR		1.00
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	1.00	0.37	1.00	1.00	0.89	0.97	0.93	0.93	1.00
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>				IR			IR		IR
White-browed Babbler	<i>Pomatostomus superciliosus</i>			IR	0.19					
White-browed Scrubwren	<i>Sericornis frontalis</i>	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.95	#DIV/0!
White-browed Treecreeper	<i>Climacteris affinis</i>		1.00							

White-browed Woodswallow	<i>Artamus superciliosus</i>	IR	1.00	1.00	0.96	IR	IR	1.00	0.46	0.95
White-cheeked Honeyeater	<i>Phylidonyris nigra</i>				IR					
White-eared Honeyeater	<i>Lichenostomus leucotis</i>	1.00	1.00	1.00	1.00	1.00	0.90	1.00	0.96	1.00
White-faced Heron	<i>Egretta novaehollandiae</i>	0.04	1.00	1.00	1.00	1.00	0.98	1.00	0.83	1.00
White-faced Storm-Petrel	<i>Pelagodroma marina</i>				IR		0.01	IR	IR	
White-fronted Chat	<i>Epthianura albifrons</i>	0.78	1.00	0.94	1.00	0.99	1.00	1.00	0.75	IR
White-fronted Honeyeater	<i>Phylidonyris albifrons</i>							IR		
White-fronted Tern	<i>Sterna striata</i>	IR			IR	0.89	0.86	0.08	0.73	
White-headed Petrel	<i>Pterodroma lessonii</i>					0.64	IR	0.12	0.24	
White-headed Pigeon	<i>Columba leucomela</i>					1.00		IR		0.78
White-naped Honeyeater	<i>Melithreptus lunatus</i>	1.00	1.00	1.00	1.00	1.00	0.72	1.00	0.62	1.00
White-necked Heron	<i>Ardea pacifica</i>	0.83	1.00	1.00	1.00	0.97	0.37	1.00	0.92	1.00
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	0.94	1.00	1.00	1.00	1.00	0.46	1.00	0.84	1.00
White-throated Gerygone	<i>Gerygone olivacea</i>		IR	1.00	0.95			IR		0.95
White-throated Needletail	<i>Hirundapus caudacutus</i>	0.44	1.00	0.98	0.98	0.98	0.73	1.00	0.03	0.98
White-throated Nightjar	<i>Eurostopodus mystacalis</i>		0.90	0.83	0.93			IR		0.92
White-throated Treecreeper	<i>Cormobates leucophaeus</i>	1.00	1.00	1.00	1.00	1.00	IR	1.00	0.11	1.00
White-winged Black Tern	<i>Chlidonias leucopterus</i>				1.00		0.85	1.00		
White-winged Chough	<i>Corcorax melanorhamphos</i>		IR	1.00	1.00			1.00		1.00
White-winged Triller	<i>Lalage sueurii</i>	0.08	1.00	1.00	1.00	0.97	0.73	1.00	IR	0.81
Willie Wagtail	<i>Rhipidura leucophrys</i>	0.88	1.00	1.00	1.00	1.00	0.50	1.00	0.54	1.00
Wilson's Phalarope	<i>Steganopus tricolor</i>						IR			
Wonga Pigeon	<i>Leucosarcia melanoleuca</i>		1.00	IR		IR			IR	1.00
Wood Sandpiper	<i>Tringa glareola</i>	IR		IR	1.00		0.55	1.00		
Yellow Thornbill	<i>Acanthiza nana</i>	0.94	1.00	1.00	1.00	0.97	IR	1.00	0.26	0.94
Yellow Wagtail	<i>Motacilla flava</i>				IR			1.00		
Yellow Wattlebird	<i>Anthochaera paradoxa</i>					IR				
Yellow-billed Spoonbill	<i>Platalea flavipes</i>	0.77	1.00	1.00	1.00	0.94	0.93	1.00	0.91	0.97
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	1.00	1.00	1.00	1.00	1.00	IR	1.00	0.72	1.00
Yellow-nosed Albatross	<i>Thalassarche chlororhynchos</i>						IR		IR	
Yellow-plumed Honeyeater	<i>Lichenostomus ornatus</i>				IR			1.00		
Yellow-rumped Pardalote	<i>Pardalotus xanthopygus punctatus</i>				IR			IR		
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	0.94	1.00	1.00	1.00	1.00	0.92	1.00	0.68	1.00
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	1.00	1.00	1.00	1.00	1.00	IR	1.00	0.56	1.00
Yellow-tufted Honeyeater	<i>Lichenostomus melanops</i>	IR	0.83	0.96	0.97	IR	IR	IR		IR
Zebra Finch	<i>Taeniopygia guttata</i>		IR	1.00	1.00		IR	IR		IR

Appendix 5: Probability of persistence of mammal species by Reporting Area

IR = insufficient records

Common Name	Scientific Name	Bass Coast, South Gippsland & Islands	Casey, Cardinia and Baw Baw	Macedon Ranges, Hume, Mitchell & Whittlesea	Moorabool, Melton, Wyndham and Greater Geelong	Mornington	Urban Melbourne	Yarra Ranges & Nillumbik
Platypus	<i>Ornithorhynchus anatinus</i>	IR	0.83	0.55	1.00		0.83	0.05
Feathertail Glider	<i>Acrobates pygmaeus</i>	IR	0.74	0.85	0.99	0.62	0.00	0.86
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	IR	0.92		0.71	IR	0.58	0.91
Leadbeater's Possum	<i>Gymnobelideus leadbeateri</i>	IR	0.99					0.07
Greater Glider	<i>Petauroides volans</i>		0.99	0.86	0.99			0.67
Yellow-bellied Glider	<i>Petaurus australis</i>	IR	0.95					0.96
Sugar Glider	<i>Petaurus breviceps</i>	0.81	0.99	0.79	0.35	0.00	0.95	1.00
Koala	<i>Phascolarctos cinereus</i>	0.21	0.97	0.95	1.00	1.00	0.39	0.99
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	0.89	0.97	0.03	0.99	0.01	1.00	0.97
Mountain Brushtail Possum	<i>Trichosurus cunninghami</i>	IR	0.90	0.59	0.97		IR	0.98
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	0.43	0.94	0.96	1.00	0.87	1.00	0.23
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	0.32	0.98	1.00	1.00	0.99	0.99	1.00
Black Wallaby	<i>Wallabia bicolor</i>	1.00	0.96	0.95	1.00	1.00	1.00	1.00
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	0.07	0.92	0.77	0.95	0.55	0.00	0.63
Little Red Flying-fox	<i>Pteropus scapulatus</i>			IR			IR	
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	0.08	0.71	0.69	0.18	0.30	1.00	0.97
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	IR	1.00	0.80	0.57		1.00	1.00
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>		IR		IR			0.00
Common Bent-wing Bat	<i>Miniopterus schreibersii</i> (group)		IR	1.00	0.60	IR	0.31	0.04
Southern Freetail Bat (long penis)	<i>Mormopterus</i> sp. 1			IR				0.85
Southern Myotis	<i>Myotis macropus</i>			IR			IR	0.45
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>	0.04	0.02	0.57	0.32	0.94	0.89	0.89
Gould's Long-eared Bat	<i>Nyctophilus gouldi</i>		0.46	IR	0.73			0.96
Eastern Horseshoe Bat	<i>Rhinolophus megaphyllus</i>							IR
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>						0.95	
Inland Broad-nosed Bat	<i>Scotorepens balstoni</i>			IR				
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>						IR	IR
White-striped Freetail Bat	<i>Tadarida australis</i>		0.88	0.75	0.98		1.00	0.52
Large Forest Bat	<i>Vespadelus darlingtoni</i>	0.80	0.29	0.12	0.02	IR	0.47	1.00
Southern Forest Bat	<i>Vespadelus regulus</i>		0.86	0.88	0.54	IR	0.78	0.04
Little Forest Bat	<i>Vespadelus vulturnus</i>	0.00	0.22		0.61	0.05	1.00	1.00
Agile Antechinus	<i>Antechinus agilis</i>	0.37	0.99	0.34	0.02	0.98	0.08	0.97
Swamp Antechinus	<i>Antechinus minimus</i>	IR	IR					

Dusky Antechinus	<i>Antechinus swainsonii</i>		0.54	0.92	0.49	0.87	0.25	0.92
Eastern Bettong	<i>Bettongia gaimardi</i>			IR			IR	IR
Spot-tailed Quoll	<i>Dasyurus maculatus</i>		0.97	0.88	IR		IR	0.93
Eastern Quoll	<i>Dasyurus viverrinus</i>		IR	0.18			0.03	IR
Water Rat	<i>Hydromys chrysogaster</i>	0.03	0.83	0.91	1.00	IR	1.00	1.00
Southern Brown Bandicoot	<i>Isoodon obesulus obesulus</i>	0.69	1.00	IR	IR	0.19	0.93	0.97
Broad-toothed Rat	<i>Mastacomys fuscus mordicus</i>		0.38				IR	0.00
Eastern Barred Bandicoot	<i>Perameles gunnii</i>			0.71	0.47		IR	
Long-nosed Bandicoot	<i>Perameles nasuta</i>	IR	0.75	0.47		0.75	0.09	0.79
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>		IR	0.99	0.99		1.00	1.00
Long-nosed Potoroo	<i>Potorous tridactylus</i>	0.83						
Smoky Mouse	<i>Pseudomys fumeus</i>							0.14
New Holland Mouse	<i>Pseudomys novaehollandiae</i>		0.06			0.00	0.03	
Bush Rat	<i>Rattus fuscipes</i>	0.00	0.48	0.00	0.00	IR	0.85	1.00
Swamp Rat	<i>Rattus lutreolus</i>	0.89	0.88		IR	0.11	0.97	0.02
Fat-tailed Dunnart	<i>Sminthopsis crassicaudata</i>			0.88	0.96		0.21	
White-footed Dunnart	<i>Sminthopsis leucopus</i>					0.00		0.21
Common Dunnart	<i>Sminthopsis murina</i>			IR	IR			0.00
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	0.97	0.94	0.98	0.67	1.00	1.00	1.00
Rufous-bellied Pademelon	<i>Thylogale billardieri</i>	IR						
Common Wombat	<i>Vombatus ursinus</i>	0.95	0.97	0.57	0.99	0.69	0.99	1.00