

AVIAN POPULATION CHANGES IN A DEVELOPING URBAN AREA IN WESTERN AUSTRALIA OVER AN EIGHTEEN YEAR PERIOD

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Annual capture and recapture rates of a number of bird species obtained over an eighteen year period in an area cleared for urbanization, have shown changes in populations which are considered related to development in the area. The increase in the number of honeyeaters in particular, implies they have benefitted from the proliferation of nectar-producing native plants in some residential gardens. Other discrete changes in the avian population are also described.

INTRODUCTION

In 1982, a bird-banding project was commenced to gather morphometric data from avian species in the south of Western Australia. The continuation of this project to 2000 has provided unforeseen, though not entirely unexpected, information on local population trends over time.

Large areas of coastal Australia have undergone transition from remnant bushland to suburban development. Urbanization brings mixed blessings for birds. Clearing remnant bushland removes food resources, shelter and breeding sites. The provision of water, food and some vegetative cover in some residential gardens, particularly the establishment of nectar-producing plants to encourage honeyeaters, is certainly beneficial. Contrarily, bird-killing domestic animals are often introduced to the area and the use of chemicals for pest control can have deleterious effects on present and future generations of birds.

This study reports on changes in avian populations which have occurred over 18 years in a small, developing, coastal residential area in the extreme south of Western Australia.

STUDY AREA

Goode Beach (117°56'E, 35°05'S) is an isolated residential enclave of 160 subdivisions (each block approximately 0.1 h) on the southern shore of King George Sound and contiguous with the central northern boundary of the Torndirrup National Park, one of the southernmost national parks on the south coast of Western Australia.

In 1982, when this study commenced, only 26 blocks (16%) were developed, but by 2000, houses have been built on more than 70 per cent of the subdivisions.

Prior to development, the vegetation of Goode Beach resembled that found in the adjacent Torndirrup National Park, including thickets of Peppermint *Agonis reflexus*, mallee-type Jarrah *Eucalyptus marginata*, Marri *E. calophylla*, Karri, *E. diversicolor* and low- to medium-height heath interspersed with nectar-producing plants such as *Banksia*, *Adenanthos*, *Anigozanthos* and *Callistemon*. In January 1997 a wildfire burnt most of Torndirrup National Park adjacent to the study area (Smith 2001).

Due to the small size of the subdivisions, most were cleared entirely of vegetation before building commenced. Furthermore the need to maintain slashed firebreaks on undeveloped blocks

meant that much of the original vegetation was destroyed. As water conservation was a priority in the area, quick-growing native shrubs and trees which do not require much water were often selected for residential gardens. The bare or sparse nature of newly developed blocks, a feature of some gardens for several years early on, gave way to taller shrubs and trees (up to 10 m in height), in a relatively short time. Within two to four years after completion of each residence, several gardens grew flourishing stands of plants and small trees native to Western Australia. This provided on-going nectar sources throughout the year with, for example, *Callistemon*, *Grevillea*, *Kunzea* and *Melaleuca* species flowering during the winter and early summer and *Eucalyptus* species flowering during the summer and autumn. Furthermore, water was made freely available to the birds by many residents.

Study sites

GOODE BEACH. A major part of this study was conducted in the author's garden, hereafter referred to as Goode Beach, in one of the subdivisions. In 1982, upon completion of the house building, revegetation of the garden commenced, working outwards from the house. Native species were planted, including *Callistemon*, *Grevillea*, *Calothamnus*, *Kunzea* and several *Eucalyptus* species, including *E. lehmannii* which were resistant to "Dieback" (*Phytophthora* and *Armillaria* infections), whereas some other ornamental eucalypts succumbed. Some indigenous Marri and Jarrah saplings also survived.

The house was not fully occupied until 1986, but from 1982 was visited every four to six weeks for periods of several days at a time while retaining earthworks were completed. At each visit one 13 metre four shelf mist net (30 sq. m.) was erected next to the house. The net remained open all day, but was constantly monitored and closed at night or during inclement weather.

By 1992, the vigorous growth of vegetation necessitated a change of net site: three new sites were selected, all within 30 metres of the house, using nets of length either 9 metres (20 sq. m.) or 13 metres. Nets remained open from dawn to dusk to achieve maximum trapping effort within a defined area of approximately 0.2 hectares.

METHODS

Birds were caught in mist nets at Goode Beach from 1982 to 2000. Birds retrieved from mist nets were individually banded with metal bands, and standard measurements were taken for a concomitant study on the demographics of the local avian population.

TABLE 1

Annual net area available in Goode Beach with average net areas from 1983 to 1987 and 1992 to 2000.

Period	Number of nets and area of each (m ²)	Days open per year	Total net area per year (m ²)	Average net area for period (m ²)
1983	1 × 30	31	930	1 308
1984	"	48	1 440	
1985	"	51	1 530	
1986	"	50	1 500	
1987	"	38	1 140	
1992	2 × 30	30	1 800	1 935
1993	2 × 20	42	1 680	
1994	1 × 20; 1 × 30	39	1 950	
1995	2 × 30	29	1 740	
1996	1 × 20; 1 × 30	40	2 000	
1997	1 × 20; 1 × 30	40	2 000	
1998	2 × 30	31	1 860	
1999	3 × 20	39	2 340	
2000	1 × 20; 1 × 30	41	2 050	

As netting was sporadic from 1988 to 1991, results of mist net captures were presented for those caught from 1982 to 1987 and from 1992 to 2000. Annual capture rates were calculated from July of one year to June of the following year.

Netting commenced in December 1982, so the first year's records, to the end of June 1983, represented only six months. During that period the net was erected and opened on 31 days.

To facilitate subsequent comparisons, Table 1 shows the number of nets and area of each in square metres; also the number of

days they were open each year. From these two figures has been calculated the annual total net area available in square metres. No netting was carried out during period of absences from April to June in 1987, 1992, 1995 and 1998.

From 1992 onwards two external sites, Hilltop and Roadside (see Appendix 1) within one kilometre of Goode Beach, were operated sporadically to confirm which bird species were present within the Torndirrup National Park in the vicinity of Goode Beach, but this was not intended to provide comparable figures. A major wildfire burnt both sites in 1997.

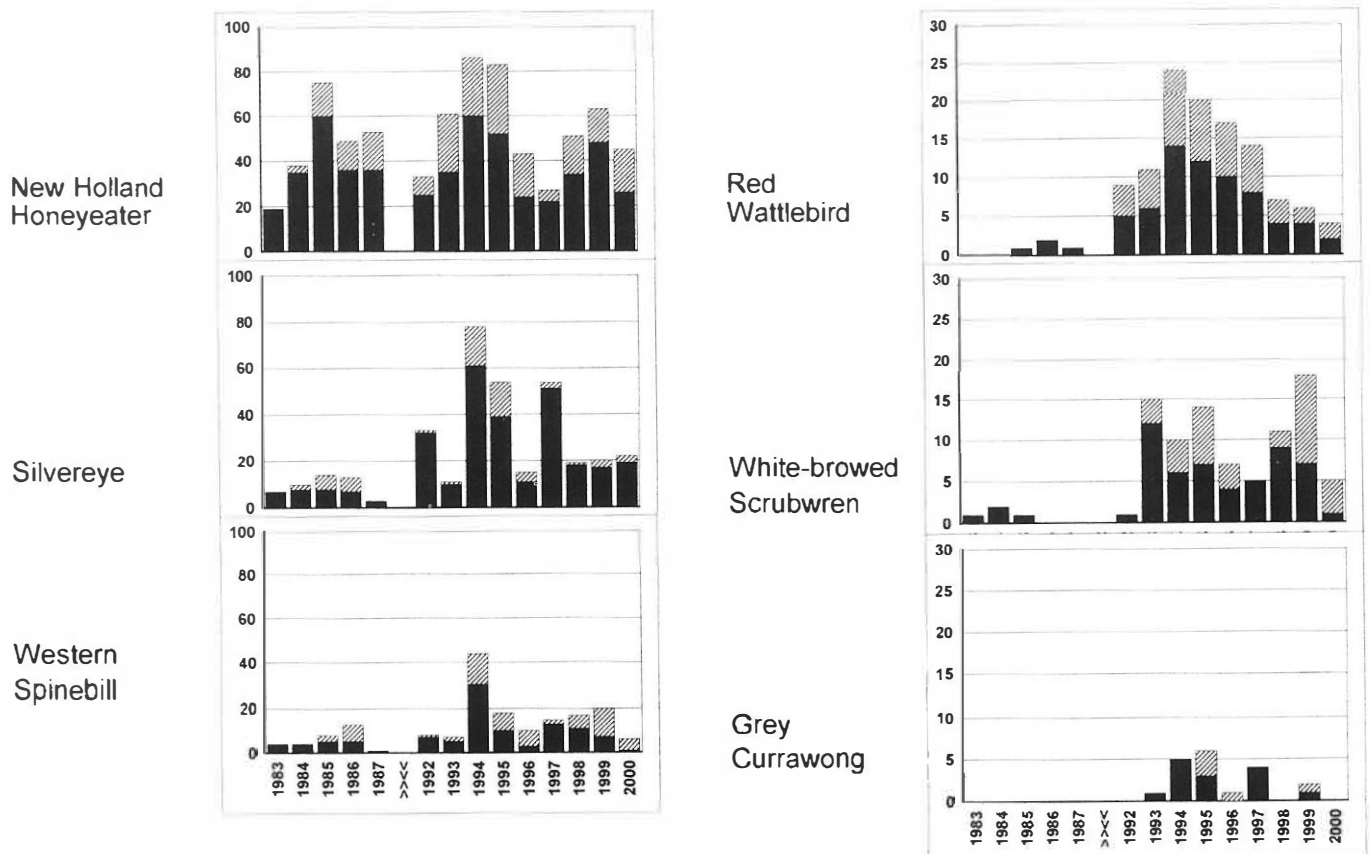


Figure 1. Annual captures (solid black) and recaptures (hatched) of six species: New Holland Honeyeater; Silvereye; Western Spinebill; Red Wattlebird; White-browed Scrubwren and Grey Currawong. (Note: The vertical scale of frequency differs between the first and last three species of birds).

RESULTS

Overall, 1 554 birds of 41 species were captured from December 1982 to 1987 and from 1992 to 2000. Those caught in Goode Beach were listed in Appendix 1, in descending order of abundance. Of these, 498 (32%) were recaptured. From December 1982 to June 1992, 516 birds of 26 species were caught at the one site in Goode Beach.

Capture data during 1982 to 1987 and 1992 to 2000 for the 15 species most frequently banded in Goode Beach, where more than ten individuals were banded (Appendix 1), are shown in descending order of abundance in Figure 1 and Table 2. The five most

abundant species and the predatory Grey Currawong *Strepera versicolor* (4 nectivores, 1 insectivore and 1 omnivore) are shown (Fig. 1) to demonstrate the variable capture patterns encountered. Annual totals of the remaining species (more than ten individuals banded) and recaptures are listed in Table 2. No pardalotes were recaptured, but banding and recapture rates and maximum longevity recorded for the 13 remaining species in Goode Beach are summarized in Table 3. Recapture rates varied from 6 per cent to 34 per cent. Six individuals of three species were recaptured nine or more times, whereas 21 individuals of five species were recaptured five or more times.

TABLE 2

The number of birds captured (B = Banded) and recaptured (R) at Goode Beach from 1983 to 1987 and from 1992 to 2000, in each case for year ending 30 June. Data are for species where more than 10 individuals were banded. For the top five most frequently banded species and the Grey Currawong, see also Figure 1.

		First period 1983 to 1987						Second period 1992 to 2000								Totals 1st/2nd Periods	
Species		1983	1984	1985	1986	1987	>><<	1992	1993	1994	1995	1996	1997	1998	1999	2000	
Golden Whistler	B		2	1	1			3	4	10	6	1	5	4	3	5	4/41
	R							1		2	4		1	1		1	
Spotted Pardalote	B	5	2	1		1		1	1	4		1		1	1	1	9/10
	R																
Brown Honeyeater	B		2	2	1	2				1	1	3	4		1	1	7/11
	R												1				
Grey Fantail	B	1			2			1		2	5	1	2	1	1		3/13
	R											2	1				
Red-winged Fairy-wren	B			2				1	7		4	1	1				2/14
	R								6	1	3						
Striated Pardalote	B		2	1	1			3			6		1				4/10
	R																
Inland Thornbill	B	1		1	1			2	3	1	2		3		1		3/12
	R								4		2	2					
Laughing Kookaburra	B	1		1	1					4	3		1	1	1		3/10
	R											1					
Red-eared Firetail	B	1		2				1	3	3			1		1		3/9
	R									1							
Total (all species)																	38/130

TABLE 3

Banding rates, in descending order of frequency, capture rates and longevity of 15 species caught in Goode Beach, for which more than 10 individuals were banded (frequently banded species). Maximum longevity is calculated from date of banding to date of last recapture.

Species	Number banded	Number of recaptures	Recapture rate (%)	Number of times recaptured (Number of individuals)														Maximum recorded longevity (y:mm)
				1	2	3	4	5	6	7	8	9	10	12	14			
New Holland Honeyeater	512	98	16	47	10	9	2	4	3	2		2		1	1	8.02		
Silvereye	291	60	14	31	5	3		2								6.06		
Western Spinebill	106	65	26	15	2	6	2	1	1			1				4.06		
Red Wattlebird	69	47	29	10	5	1	1	1	1			1				9.11		
White-browed Scrub-wren	56	34	34	10	4	4	1									2.07		
Golden Whistler	45	9	16	5	2											1.01		
Spotted Pardalote	19																	
Brown Honeyeater	18	1	6	1												1.08		
Grey Fantail	16	3	13	1	1											1.06		
Red-winged Fairy-wren	16	10	31	2	2		1									1.07		
Inland Thornbill	15	8	27	2	1		1									3.11		
Striated Pardalote	14																	
Grey Currawong	14	6	29	2	2											1.04		
Laughing Kookaburra	13	1	8	1												0.09		
Red-eared Firetail	12	1	8	1														

Of less significance are the 21 other species listed in Appendix 1 which were caught sporadically in Goode Beach, where fewer than ten individuals were banded mainly during the second period, although five species, namely Western Rosella *Platycercus icterotis*, Fan-tailed Cuckoo *Cacomantis flabelliformis*, White-breasted Robin *Eopsaltria georgiana*, White-naped Honeyeater *Melithreptus lunatus* and Red-eared Firetail *Stagonopleura oculata*, were captured sporadically in Goode Beach before 1992. Three species encountered during the first period have not been caught in Goode Beach since 1989, namely Western Thornbill *Acanthiza inornata*, Yellow-rumped Thornbill *Acanthiza chrysorrhoa* and Splendid Fairy-wren *Malurus splendens*, to which may be added the Scarlet Robin *Petroica multicolor*, not seen since 1985.

Several species (Appendix 1) were also caught at the two external sites, where nineteen species were banded at Hilltop or Roadside, until netting was curtailed by the 1997 fire. Four of these species, Tree Martin *Hirundo nigricans*, Black-faced Cuckoo-shrike *Coracina novaehollandiae*, Dusky Woodswallow *Artamus cyanopterus* and White-cheeked Honeyeater *Phylidonyris nigra* have never been captured in Goode Beach, though Tree Martins are regularly seen overhead.

DISCUSSION

Any long-term comparisons of avian populations sampled by mist netting in a developing locality can be criticized when mist-netting sites are altered after becoming unusable due to changes in the vertical profile or density of the vegetation. New flight lines invite the repositioning of nets. The total net area available during a period is, however, a measurable parameter, giving some idea of the amount of netting carried out.

Leishman (2000) conducted a more comprehensive long-term study (21 years) in forest, yet acknowledged variations in the pattern of sampling. The nature of this study in Goode Beach only allows a robust form of analysis or at best a proportional comparison of the data available. The mean annual total net areas available within a limited location of 0.2 hectares (Table 1) were compared during the two periods, 1982 to 1987 and 1992 to 2000, and show that the amount of net area available through the years has not differed by more than a ratio of 1:1.5. Thus, even adjusting for this ratio, the individuals of most species shown (Fig. 1, Table 2) were more frequently encountered in the period 1992 to 2000. An exception is the New Holland Honeyeater *Phylidonyris novaehollandiae*, which was present in Torndirrup National Park and in the Goode Beach area at the start of this study. This is the only species where the average numbers banded per year during 1983 to 1987 and 1992 to 2000 are similar (Fig. 1). Excluding the half year 1983, the numbers of New Holland Honeyeaters captured annually during 1984 to 1987 fall within the range for 1992 to 2000, indicating that the annual netting rates were similar. Fluctuations in numbers trapped may normally occur due to variations in climate, flowering phenology or variations in trapping efficiency.

However six other species, Silvereye *Zosterops lateralis*, Red Wattlebird *Anthochaera carunculata*, White-browed Scrubwren *Sericornis frontalis*, Golden Whistler

Pacycephala pectoralis, Inland Thornbill *Acanthiza apicalis* and Red-winged Fairy-wren *Malurus elegans* (Fig. 1, Table 2), showed an overall three- to ten-fold increase during the period 1992 to 2000.

Three of the four most frequently banded species (Fig. 1) were honeyeaters and the fourth, Silvereye, was a recognized nectar feeder. The low proportion of Silvereye recaptures in some years would suggest that part of their population was nomadic. In 1994, the peak captures recorded in Figure 1 can be attributed to the fact that the indigenous Marri or Red Gum, several of which were retained as saplings in my garden, grew rapidly and flowered very successfully in that year.

The only other species of smaller honeyeater to contest the early monopoly held by the New Holland Honeyeater, the Western Spinebill *Acanthorhynchus superciliosus*, was also present, but in fewer numbers, in Goode Beach in 1983. Their agility and habit of diving into cover when attacked allowed them to exploit the same food sources as the New Holland Honeyeater, but particularly those grevilleas with a prostrate habit.

Red Wattlebirds became the dominant species of larger honeyeater when trees had grown to a height of five metres which was sufficiently high for them to nest in. *Eucalyptus lehmannii*, a tree which grows along the south coast of Western Australia, and was introduced to Goode Beach, bears large flowers from mid-winter to late summer and was particularly favoured by Red Wattlebirds as a food source and nesting site. By 1995 two other pairs of Red Wattlebirds had breeding territories encroaching on the territory of the resident pair in my 0.2 hectare garden.

It could well be that the aggressiveness of the New Holland Honeyeater and Red Wattlebirds led to the disappearance of smaller species like the Scarlet Robin, Splendid Fairy-wren and Yellow-rumped Thornbill, though the latter, which prefers open ground, may have moved elsewhere as the ground cover developed.

The proliferation of wattlebirds in particular was bound to attract predators to reap a harvest of nestlings. Grey Currawongs have always been sporadically present in the Torndirrup National Park, yet in Goode Beach their regular presence was noted only from 1993. In the spring of 1995, 17 adult Red Wattlebirds, representing at least five breeding pairs, were seen harrying a Grey Currawong which was removing a well-feathered Red Wattlebird pullus from its nest. Yet Tawny Frogmouths *Podargus strigoides*, which have nested for several years close to my house Figures 2–5 (Smith 1997, 2001) have gained some protection from the resident Red Wattlebirds.

It is not easy to explain why two other honeyeaters, the White-cheeked Honeyeater (Appendix 1) and the more elusive Tawny-crowned Honeyeater *Phylidonyris melanops*, have never been recorded or netted in Goode Beach, though both species occur nearby and breed (Smith 1991) and 44 White-cheeked Honeyeaters were banded at Roadside. The vegetation requirements of these two species differ but it could also be argued that the White-cheeked Honeyeater is not as aggressive as the more dominant New Holland Honeyeater.

Few White-browed Scrubwrens (Fig. 1) were netted during 1983 to 1987, likely due to the absence of thick bushy cover in the gardens at that time. Once gardens became established they were captured regularly during 1992 to 2000, with recaptures in most years. The remaining species listed in Table 2, in particular the Golden Whistler, show a similar but not so distinct pattern of capture between the two time periods, that could be attributed to the same explanation.

Species such as bronzewings, parrots, Laughing Kookaburra *Dacelo novaeguineae* and Australian Magpie *Gymnorhina tibicen*, benefit from human contact because of the provision of water or food, but in this study the species which benefited most were the honeyeaters. This is substantiated (Table 3) by the high proportion of recaptured birds, which in some cases were recaptured several times.

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APPENDIX 1

Species banded and recaptured at Goode Beach, Hilltop and Roadside.

	Number Banded	Number Recaptured		Number Banded	Number Recaptured
Most frequently captured birds (>10) at Goode Beach			Common Bronzewing <i>Phaps chalcoptera</i>	5	
New Holland Honeyeater	512	198	Fan-tailed Cuckoo <i>Cacomantis flabelliformis</i>	5	
<i>Phylidonyris novaehollandiae</i>			White-breasted Robin <i>Eopsaltria georgiana</i>	5	
Silvcreye <i>Zosterops lateralis</i>	291	60	Western Rosella <i>Platycercus icterotis</i>	4	
Western Spinebill	106	65	Western Thornbill <i>Acanthiza inornata</i>	3	
<i>Acanthorhynchus superciliosus</i>			Grey Shrike-thrush <i>Colluricincla harmonica</i>	3	1
Red Wattlebird <i>Anthochaera carunculata</i>	69	47	Magpie-lark <i>Grallina cyanleuca</i>	3	
White-browed Scrubwren	56	34	Shining Bronze-Cuckoo <i>Chrysococcyx lucidus</i>	2	
<i>Sericornis frontalis</i>			Grey Butcherbird <i>Cracticus torquatus</i>	2	
Golden Whistler <i>Pachycephala pectoralis</i>	45	9	Splendid Fairy-wren <i>Malurus splendens</i>	1	
Spotted Pardalote <i>Pardalotus punctatus</i>	19		Brush Bronzewing <i>Phaps elegans</i>	1	
Brown Honeyeater <i>Lichmera indistincta</i>	18	1	Collared Sparrowhawk	1	
Grey Fantail <i>Rhipidura fuliginosa</i>	16	3	<i>Accipiter cirrhocephalus</i>		
Red-winged Fairy-wren <i>Malurus elegans</i>	16	10	Red-capped Parrot <i>Purpureicephalus spurius</i>	1	
Inland Thornbill <i>Acanthiza apicalis</i>	15	8	Willie Wagtail <i>Rhipidura leucophrys</i>	1	
Striated Pardalote <i>Pardalotus striatus</i>	14		Western Gerygone <i>Gerygone fusca</i>	1	
Grey Currawong <i>Strepera versicolor</i>	14	6	Southern Emu-wren <i>Stipiturus malachurus</i>	1	
Laughing Kookaburra <i>Dacelo novaeguineae</i>	13	1			
Red-cared Firetail <i>Stagonopleura oculata</i>	12	1	Species banded at Hilltop or Roadside but NOT at Goode Beach		
Other species banded (<10) at Goode Beach			Tree Martin <i>Hirundo nigricans</i>	10	
Australian Magpie <i>Gymnorhina tibicen</i>	7	1	Black-faced Cuckoo-shrike	2	
Tawny Frogmouth <i>Podargus strigoides</i>	6		<i>Coracina novaehollandiae</i>		
White-naped Honeyeater <i>Meliphreptus lunatus</i>	6	2	Dusky Woodswallow <i>Artamus cyanopterus</i>	2	
Little (Western) Wattlebird	6		White-cheeked Honeyeater	44	
<i>Anthochaera chrysoptera</i>			<i>Phylidonyris nigra</i>		
Yellow-rumped Thornbill	5				
<i>Acanthiza chrysorrhoa</i>					

Figures 2–5. Tawny Frogmouths nesting at Goode Beach, near Albany, Western Australia. All photographs were taken by Victor Smith.



Figure 2. Female Tawny Frogmouth feeding a week-old nestling while male with dark crown awaits his turn (1999).



Figure 3. Male brooding nestling with female bringing food (1999).



Figure 4. Female Tawny Frogmouth sitting (2001).



Figure 5. Male Tawny Frogmouth sitting (2001).