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THE IMPACT OF URBAN DEVELOPMENT ON BIRD COMMUNITIES OF THREE VICTORIAN TOWNS — LILYDALE, COLDSTREAM AND MT EVELYN

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During 1982 an avifauna census was conducted in the outer Melbourne areas of Lilydale, Coldstream and Mt Evelyn, Victoria. Data were collected along foot transects at nine different sites. The sites were chosen to give a range of residential ages, from predeveloped (before housing development had started) through to some of the oldest residential areas in Lilydale which were in excess of 50 years of age. The objective was to examine how the bird populations may change over time in response to changing habitat. Introduced species such as Blackbird *Turdus merula*, Common Starling *Sturnus vulgaris*, and House Sparrow *Passer domesticus* appeared to be the most adaptable species as regards habitat use. Population density in developed areas was at times in excess of five times that of undeveloped sites, but the greatest species diversity was found in the undeveloped sites. Except for one site there appeared to be a steady increase in numbers of individuals, numbers of species, biomass, and population density with increasing age of residential areas. Comparisons were made between this and a similar study in Wagga Wagga, N.S.W. (Jones 1981).

INTRODUCTION

Habitats on the fringe of an expanding urban area and their dependant bird communities are dramatically altered as people move in. In most cases the patterns of establishing a new subdivision are similar. The original vegetation is stripped away to make way for street formation, cable and pipe laying and the establishment of house blocks. After the buildings are erected the yards are dug up for lawns and gardens. Residents introduce predators such as dogs and cats, which have perhaps never been experienced by the native birds. The habitat change could almost be described as catastrophic.

The vegetation slowly becomes established with seedling trees and shrubs growing to maturity. The habitat changes and is able to again offer greater variety for birds' use (Vale and Vale 1976). As the process takes many years it would be impractical to try and monitor the habitat changes and the resultant bird population changes in full. If a range of habitat ages within the city can be identified space can be substituted for time in order to obtain data on the change (Vale and Vale 1976).

Huhtalo and Jarvinen (1977) and Tomialoje (1970), in Europe and Guthrie (1974), Vale and Vale (1976), and Emlen (1974) in the United States used this approach to study urban bird communities.

Urban research such as this has important sociological and ecological implications but has received little attention in Australia except by Jones (1981, 1983) and Green (1981).

SITES AND THEIR SELECTION

Lilydale and the adjacent suburbs of Coldstream and Mt Evelyn are situated approximately 35 km east of the City of Melbourne. This section of the Yarra Valley at the northern end of the Dandenong Ranges is about 100 m a.s.l. The average annual rainfall is 906 mm, falling evenly throughout the year with October slightly above average.

Of the nine transect sites chosen in the study area (Table 1) two undeveloped sites were selected in local bushland. M. Aveling's *Lilydale the Billanook Country* was used to define the original vegetation makeup. Sites that agreed with these descriptions and appeared unaltered were used.

Six developed sites were selected on the basis of their age. Dates of subdivision and certificates of occupancy were investigated from the Lilydale Shire records and used as the primary indicators. Selection also involved finding a street with an age and habitat structure similar for all houses (Jones 1981). In the newer areas it was relatively easy to find a street where all houses were of similar age as they were occupied in only a short time. The older areas were much more difficult. Settlement was spaced out over many years so it was difficult to find a street where all the houses were of similar age and gardens of similar vegetative makeup. A transect through the city's central business district was also made for comparison.

TABLE 1

Sites chosen for avifauna census 1982.

Sites	Age years	Site No.
Undeveloped Sites		
Bush transect off Reserves Rd. Mt. Evelyn	–	1
Disused railway line Mt. Evelyn	–	2
Developed Sites		
Lauriston Dve, Coldstream	0-5	3
Melrose Ave, Coldstream	5-10	4
Beresford Rd, Lilydale	10-20	5
Burton Rd, and Tugun Rd, Lilydale	20-30	6
Belle Vue St, Lilydale	30-50	7
Castella St, Lilydale	50+	8
Main St, Lilydale Central business district	–	9

Site Descriptions

The terrain of Lilydale and its surrounds is described by Aveling (1972) as "undulating rising to steep". The original vegetation type was dry sclerophyll forest with marshy river flats to the north and wet sclerophyll forest to the south and east (Aveling 1972). In the foothills where Lilydale now stands the trees were predominantly eucalypts, banksias and casuarinas, while further into the mountains large stands of Mountain Ash *Eucalyptus regnans* were found.

Site 1 extended down a steep bush hillside into a gully containing the Olinda Creek. *Eucalyptus macrorhyncha* was prominent in the site. Site 2, along a disused railway, contained *E. obliqua.* Sites 3 and 4 (the newer subdivisions) were planted mostly with native varieties and had developing lawns. Exotic plants were more common in gardens of site 5 where the nature strip's trees were *Melaleuca stypholoides* and *Callistemon salignus.* Sites 6 and 7 had a greater proportion of exotic plants in the gardens and 6 had *E. crenulata* and *Prunus cerasifera* in the nature strip. The road and pavement area of site 8 were dominated by the English Elm *Ulmus procera* and English Oak *Quercus robur.* Only the road, pavement and buildings were included in the transect of site 9. The median strip in the centre of the road containing exotic trees and gardens of native shrubs was not included.

The increasing popularity of native plants could be seen in the gardens of the newer sites and the recent nature strip planting programmes. As the sites aged, the density of vegetation tended to increase as did the proportion of exotic plants.

METHODS

A foot transect was used to census each of the nine sites. The transect was approximately 350 m in length. Walking at an easy pace, stopping only to confirm a sighting, the census was made first down one side of the street then back along the other. The transect was covered in about ten minutes. The census strip was approximately 40 m wide, this being from the centre of the road to a line formed by the back of the house. At this width all substrates could be seen by the observer from the footpath (Jones 1981). Only birds within this strip were counted.

TABLE 2

Bird species observed at nine sites in Lilydale, Coldstream and Mt. Evelyn, Victoria.

Species	Site 1	2	3	4	5	6	7	8	9
Little Falcon *Falco longipennis*							X	X	
Brown Falcon *Falco berigora*								X	
Domestic Pigeon *Columba livia*					X				
Spotted Turtle-Dove *Streptopelia chinensis*	X		X	X	X	X	X	X	X
Common Bronzewing *Phaps chalcoptera*	X	X							
Yellow-tailed Black Cockatoo *Calyptorhynchus funereus*	X								
Gang-gang Cockatoo *Callocephalon fimbriatum*	X	X					X		
Galah *Cacatua roseicapilla*				X	X		X		
Sulphur-crested Cockatoo *Cacatua galerita*	X								
Crimson Rosella *Platycercus elegans*	X	X				X	X		
Eastern Rosella *Platycercus eximius*	X	X		X	X	X	X	X	X
Pallid Cuckoo *Cuculus pallidus*			X	X		X		X	
Fan-tailed Cuckoo *Cuculus pyrrhophanus*	X	X							
Horsfield's Bronze-cuckoo *Chrysococcyx basilis*			X	X			X		
Laughing Kookaburra *Dacelo novaeguineae*	X	X							
Sacred Kingfisher *Halcyon sancta*	X								
Welcome Swallow *Hirundo neoxena*	X		X	X	X	X			X
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	X	X							
Blackbird *Turdus merula**	X*	X*	X	X*	X*	X*	X*	X*	X
Song Thrush *Turdus philomelos*					X		X	X	
Rose Robin *Petroica rosea*	X								
Scarlet Robin *Petroica multicolor*	X	X							
Eastern Yellow Robin *Eopsaltria australis*	X	X							
Crested Shrike-tit *Falcunculus frontatus*	X	X							
Golden Whistler *Pachycephala pectoralis*	X	X							
Rufous Whistler *Pachycephala rufiventris*	X	X							
Grey Shrike-thrush *Colluricincla harmonica*	X	X	X						
Leaden Flycatcher *Myiagra rubecula*				X					
Satin Flycatcher *Myiagra cyanoleuca*	X	X							
Rufous Fantail *Rhipidura rufifrons*	X								
Grey Fantail *Rhipidura fuliginosa*	X	X							
Willie Wagtail *Rhipidura leucophrys*			X	X					
Eastern Whipbird *Psophodes olivaceus*	X								
Superb Blue Wren *Malurus cyaneus*	X	X							
White-browed Scrubwren *Sericornis frontalis*	X	X							
Brown Thornbill *Acanthiza pusilla*	X	X							
Yellow Thornbill *Acanthiza nana*		X			X	X	X		
Striated Thornbill *Acanthiza lineata*	X	X			X	X	X	X	
Varied Sittella *Daphoenositta chrysoptera*	X	X							
White-throated Treecreeper *Climacteris leucophaea*	X	X							
Red-browed Treecreeper *Climacteris erythrops*	X								
Red Wattlebird *Anthochaera carunculata*	X	X	X	X	X	X	X	X	
Yellow-faced Honeyeater *Lichenostomus chrysops*	X	X							
White-eared Honeyeater *Lichenostomus leucotis*	X	X							
White-plumed Honeyeater *Lichenostomus penicillatus*		X		X	X		X	X	X
White-naped Honeyeater *Melithreptus lunatus*	X								
New Holland Honeyeater *Phylidonyris novaehollandiae*			X	X	X	X	X	X	
Eastern Spinebill *Acanthorhynchus tenuirostris*	X	X					X	X	X
Spotted Pardalote *Pardalotus punctatus*	X	X							
Striated Pardalote *Pardalotus striatus*			X						
Silvereye *Zosterops lateralis*	X	X			X	X	X	X	
European Goldfinch *Carduelis carduelis*			X	X	X	X	X	X	
European Greenfinch *Carduelis chloris*							X	X	X
House Sparrow *Passer domesticus**			X*	X*	X*	X	X*	X*	X*
Eurasian Tree Sparrow *Passer montanus*			X	X	X				

TABLE 2 Continued

Species	Site 1	2	3	4	5	6	7	8	9
Red-browed Firetail *Emblema temporalis*	X	X							
Common Starling *Sturnus vulgaris**			X*	X*	X*	X*	X*	X*	X*
Common Mynah *Acridotheres tristis**		X*	X*	X*	X*	X*	X*	X*	X*
Australian Magpie Lark *Grallina cyanoleuca*		X	X	X	X	X	X	X	X
White-browed Woodswallow *Artamus superciliosus*			X						
Grey Butcherbird *Cracticus torquatus*	X	X		X				X	
Australian Magpie *Gymnorhina tibicen*		X	X	X	X	X		X	X
Pied Currawong *Strepera graculina*	X					X	X		
Grey Currawong *Strepera versicolor*		X							
Little Raven *Corvus mellori*	X		X	X	X	X		X	X
Total number of species recorded at each site	42	36	19	21	21	19	23	22	13

*Species making up 5% of total site population/and sites so affected.

Aerial species such as the Welcome Swallow were included if they were obviously within the strip. Birds merely flying over were not counted.

Building placement on the blocks was quite uniform throughout all the residential sites so the strip width was readily maintained. At the non-residential sites the same width was maintained and borders were established before censusing began.

Censusing began in January, 1982, when seven counts were made. Five were taken in each of the following months till December. Whenever possible the census was taken between dawn and 0930 hours to minimise the influence of human activity. No censuses were made during rain or strong wind but a variety of other weather conditions were encounted.

Information taken included: name of the species, number of each species and location occupied within the strip. The possible locations were: buildings and fences; poles and wires; ground; lower-story vegetation (0-3 m); middle-story vegetation (3-10 m); upper-story vegetation (10+m); and aerial.

Data on population density were calculated by dividing the area of each site in hectares into the daily mean number of individuals. With each transect being approximately 350 m long and 43 m deep the area of each was very near 1.5 ha.

To assess the actual biomass being supported by each site, estimates of the mass of each species were calculated and used to convert the daily population numbers into biomass equivalents (Jones 1981).

Sources for these data were research articles: (Rowley 1965, 1967, Horey and Walton 1971, Lane 1976, Liddy 1977, Park 1981) and Macdonald (1982). The most important single source was the bird skin collection in the National Museum of Victoria. Following Jones (1979) I accepted some biomass data from very small samples and others from crude estimates based on body measurements. The accuracy of some of these figures varied but it is unlikely to have any significant influence on the results.

Species diversity was calculated for each site by using Macarthur's Diversity Index $H^1 = \Sigma$ pi log pi (Macarthur 1957). The equitability of species, or the proportion that each species contributes to the total population of birds was also examined. Equitability was measured for each site by the Eveness Index

$$e = \frac{H^1}{\log S}$$ (Odum 1971).

RESULTS

Species Distribution

A total of 65 species was observed in all nine sites (Table 2). Only one species, the Blackbird, appeared in all sites; in others, namely sites 6, 7 and 8, it makes up close to 40% of their populations. A second exotic species, the Common Starling, was present in seven sites and held a "dominant" position in the suburban bird population. Huhtalo and Jarvinen (1977) defined a dominant species as one which made up over 5% of the total bird population. House Sparrows were observed in six out of seven developed

sites but were not present in either of the pre-developed sites. They were recorded in large numbers in sites 5 and 9, and in site 8 they made up over 30% of the bird population. Another exotic recorded in all of the seven developed sites was the Common Mynah.

Of the native species the Striated Thornbill had the highest population count but reached only 4.6% of the total bird population. Other native species that had relatively high population counts were the Red Wattlebird, occurring in eight of the nine sites, the Silvereye, six, and the Australian Magpie Lark, eight.

The number of individuals increased as the sites aged and did not peak until after the 50 year mark (site 8). At this site the bird, particularly exotics, used the man-made structures for shelter, resting and feeding. Daily counts reached as high as 98.6 individuals. Jones (1981) had similar results and found that the maturation of a residential habitat is accompanied by an increasing number of birds.

Population Density

Population density figures (Table 3) for the the developed sites were up to five times greater than for the predeveloped. This was mainly due to large concentrations of exotic species.

Density figures for predeveloped areas were very low, but there were many more species present. Most occured in numbers that were less than 1% of the population.

The highest species' densities were achieved by House Sparrows in site 8 at 37.3 per hectare and Common Starling in site 8 at 29.3 per hectare. These same two species also had the highest densities at sites 3, 4, 5 and 9. Of native species Striated Thornbills had the highest density of 6.9 per hectare in site 2.

Species Diversity

The highest values for diversity and equitability (Table 3) were found in the pre-developed sites 1 and 2. In the developed sites values gradually increased and peaked at site 7 (30-50 years) and then fell away again. While site 8 had a greater population density and much higher population biomass, the diversity and equitability figures were lower because three or four exotic species dominated the site. The lowest values were found in the most altered site, the central business district, site 9.

Population Biomass

Seasonal influences were quite apparent with biomass levels usually falling away i nthe winter. Four exotic species dominated the biomass levels in the developed sites. In site 8, Common Starlings, Common Mynahs and House Sparrows made up 75% of the entire population. For the majority of other species present individual biomass levels were less than 5% of the total.

Several species showed an obvious disparity between the numbers observed and their biomass,

TABLE 3

Population numbers, mean density, diversity index and equitability at nine sites.

	Site Number								
	1	2	3	4	5	6	7	8	9
Number of individuals	191	202	205	285	417	183	374	994	489
Daily mean No. individuals	13.4	14.2	14.4	20.0	29.2	12.9	26.3	70.0	34.4
Mean density*	8.9	9.5	9.6	13.3	19.5	8.6	17.5	46.7	22.9
Diversity (H^1)†	2.50	2.51	1.87	1.65	1.64	1.69	2.05	1.44	1.16
Equitability†	0.76	0.81	0.66	0.65	0.62	0.69	0.77	0.55	0.54

*Area of each transect is 1.5 ha.
†For Diversity Index see MacArthur (1957) and Equitability see Odum (1971).

as a portion of the overall total. In the pre-developed sites Striated Thornbills had the largest populations but their mass by comparison was so small they had very little influence in a biomass figure. On the other hand, in site 9, Little Ravens made up 0.4% of the population numbers, but made up 15.4% of the total biomass.

Figure 1, indicating the proportion of exotic and native species' biomass, shows clearly the increase in the exotic species as the developed sites aged. The native species' biomass varied from site to site and from season to season but there was no significant indication of increase as the site aged.

DISCUSSION

Bird censusing in a developed area can be used to monitor the impact of man on his environment (Huhtalo and Jarvinen 1977). Data from this study suggest that the impact of initial development on the bird population was extreme with a loss of up to 70% of the species from the original population. As the developed sites aged species numbers slowly built up. The first species to move into the newly developed areas in numbers were exotics such as Common Starling and Common Mynah and the native Australian Magpie. These ground-feeding species were able to use the open areas of new lawns and vacant blocks. Lower strata feeders such as White-plumed Honeyeaters and Red Wattlebirds did not appear until garden vegetation (preferably native) grew enough to offer them suitable protection. Exotic species such as House Sparrow and Common Starling were recorded in large numbers in the older developed sites. They appeared better able to use the deciduous trees and man made structures that dominated these sites. The exotics were readily recorded in all

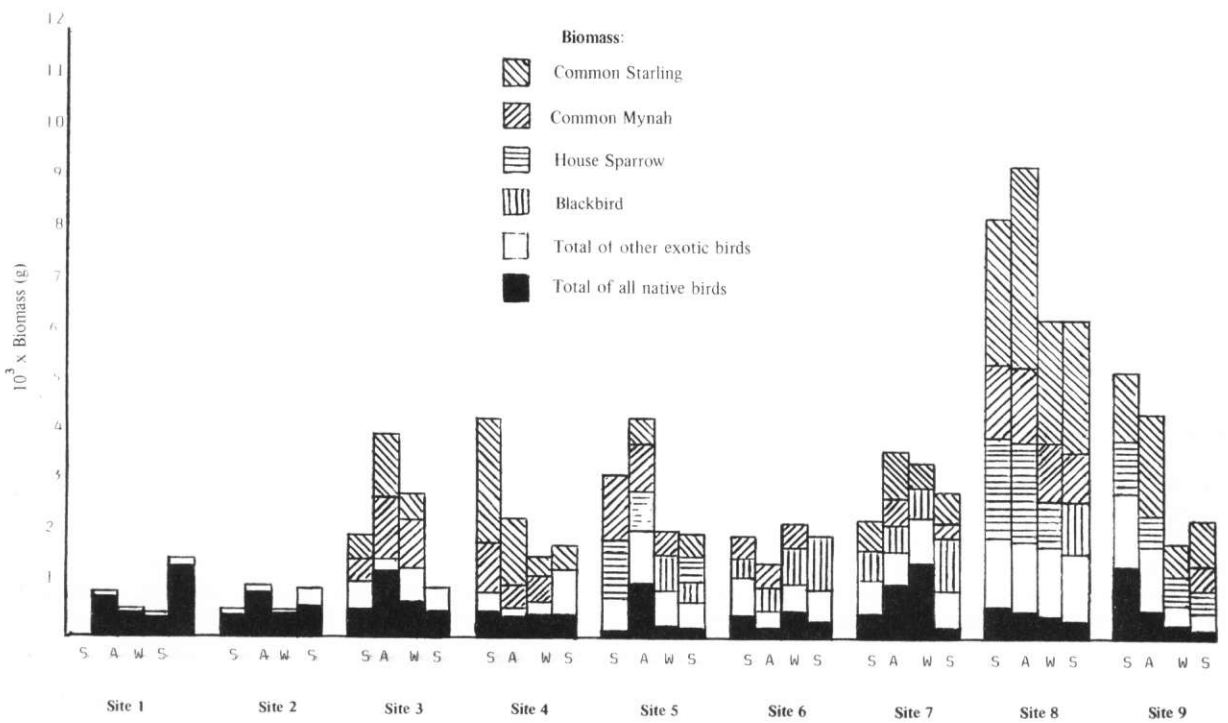

Figure 1. *Avifauna biomass at nine sites in Lilydale Shire, Victoria, for each season 1982. Dominated by four exotic species.*

locations in these sites while the native species were rarely recorded on any of the man made structures.

Across all the developed sites results in this study indicated that 29 species were lost completely from the original habitat. Species such as the White-browed Scrub Wren and Eastern Yellow Robin could not cope with the destruction of their habitat. In his study Jones (1981) found no rosellas or Red-rumped Parrots in developed areas and concluded that such areas lacked the necessary tree hollows for nesting sites. In this study both Crimson and Eastern Rosellas were found in developed sites. Their numbers increased during the winter months which indicated they may have been taking advantage of better feeding opportunities. During the winter there was a decline of species in the predeveloped sites and an increase in the developed sites 5 and 6 particularly. Biomass levels actually increased in site 6 during this time. This raises a question posed by Guthrie (1974): does suburban development allow a larger wintering population than natural habitat?

Previous studies have indicated that there is a decrease in species diversity and an increase in population density as an urban area ages (Tomialoje 1970, Emlen 1974, Guthrie 1974, Walcott 1974, Huhtalo and Jarvinen 1977, Jones 1981, 1983). The results of this study showed a slight increase in species diversity during the first forty years of development. When compared to that of the original habitat, species diversity had decreased.

Among some of the factors that I believe would depress the bird population in an urban area are items such as: increased levels of predation by introduced animals, disturbance by pedestrian and vehicular traffic which would limit access to vital resources such as foraging, watering, nesting and resting sites (Emlen 1974), and most importantly inter-specific competition. The most successful species found in the developed areas were the exotic species: Common Starling, House Sparrow, Common Mynah and Blackbird. They made up the largest increases in population and biomass as the developed sites aged. They had an advantage in being seed and insect eaters; the availability of water over long periods of the year gave a longer growth period to the plants and insects that supplied them with food. They are also regarded by Guthrie (1974) as "aggressive birds" when competing for nest and foraging sites.

To further this study of the effects of urban development on bird populations, nesting and breeding records in both predeveloped and developed sites may be valuable (Batten 1972). Huhtalo and Jarvinen (1977) claimed that "... the proportion of birds nesting in buildings best describes the extent of the independent settling of wild species in human habitation."

As our cities become larger and accommodate more people there is a growing awareness of the ills of this overcrowding and a growing demand for ways to solve them. The native habitat with its flora and fauna is gaining popularity. Greenbelt legislation, the establishment of parks and reserves, work by environmental groups, and planting of native trees by city councils are all evidence of this interest. Much is being made of efforts to bring native birds back to city gardens. City councils in the United States are investigating ways to achieve this (e.g. Hooper *et al.* 1975, U.S.D.A. Forest Service 1977). Similar investigations by city and shire councils in Australia would be beneficial to future town planning.

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REFERENCES

Aveling, M. (1972), Lilydale the Billanook Country 1937-1972. Gray Hunt and Associates Pty. Ltd. Melbourne.

Batten, L. A. (1972), 'Breeding bird species in relation to increasing urbanisation', *Bird Study* 19: 157-166.

Emlen, J. T. (1974), 'An urban bird community in Tucson Arizona: derivation, structure, regulation', *Condor* 76: 184-197.

Green, R. (1981), Ecology of Native and Exotic Birds in the Suburban Habitat. Monash University Ph.D. Thesis unpublished.

Guthrie, D. A. (1974), 'Suburban bird populations in Southern California', *Amer. Midl. Nat.* 92: 461-466.

Hooper, R. C., E. F. Smith, H. S. Crawford and B. S. McGinnes (1975), 'Nesting bird populations in a new town', *Wildl. Soc. Bull.* 3: 111-118.

Horey, G. M. and S. J. Walton (1971), 'A banding project in the Brindabella Ranges Australian Capital Territory', *Aust. Bird Bander* 9: 27-33.

Huhtalo, H. and O. Jarvinen (1977), 'Quantitative composition of the urban bird community in Tornio, Northern Finland', *Bird Study* 24: 179-185.

Jones, D. N. (1979), Exotic Species in the Urban Bird Community of Wagga Wagga, New South Wales. Honours Thesis, New England University, New South Wales.

Jones, D. N. (1981), 'Temporal changes in the suburban avifauna of an inland city', *Aust. Wildl. Res.* 8: 109-119.

Jones, D. N. (1983), 'The suburban bird community of Townsville, a tropical city', *Emu* 83: 12-18.

Lane, S. G. (1976), 'Results from banding Southern Yellow Robins', *Aust. Bird Bander* 14: 63-66.

Liddy, J. (1977), 'A note on the female plumage of the Leaden Flycatcher', *Corella* 1: 73-76.

Macarthur, R. H. (1957), 'On the relative abundance of bird species', *Proc. Nat. Acad. Sci. U.S.A.* 43: 293-295.

Macdonald, J. D. (1982), Understanding Australian Birds. Their Biology Behaviour and Habits. A. H. and A. W. Reed, Sydney.

Odum, E. P. (1971), Fundamentals of Ecology. W. B. Saunders, Philadelphia.

Park, P. (1981), 'Results from a nesting study of welcome swallows in Southern Tasmania', *Corella* 5: 85-90.

Rowley, I. (1965), 'The life history of the Superb Blue Wren', *Emu* 64: 251-297.

Rowley, I. (1967), 'A fourth species of Australian corvid', *Emu* 66: 191-210.

Tomialoje, L. (1970), 'Quantitative studies of the synanthropic avifauna of Legnica and its environments', *Acta Ornithology* Warsaw 12: 209-290.

U.S.D.A. Forest Service. (1977), Determination of Habitat Requirements for Birds in Suburban Areas. U.S. Department of Agriculture Research Paper N.E. 357.

Vale, T. R. and G. R. Vale (1976), 'Suburban bird populations in West Central California', *J. Biogeog.* 3: 157-165.

Walcott, C. F. (1974), 'Changes in bird life in Cambridge Massachusetts from 1860 to 1964', *Auk* 91: 151-160.