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The birds of Perth's urban parks : Factors influencing their distribution and community attitudes towards them

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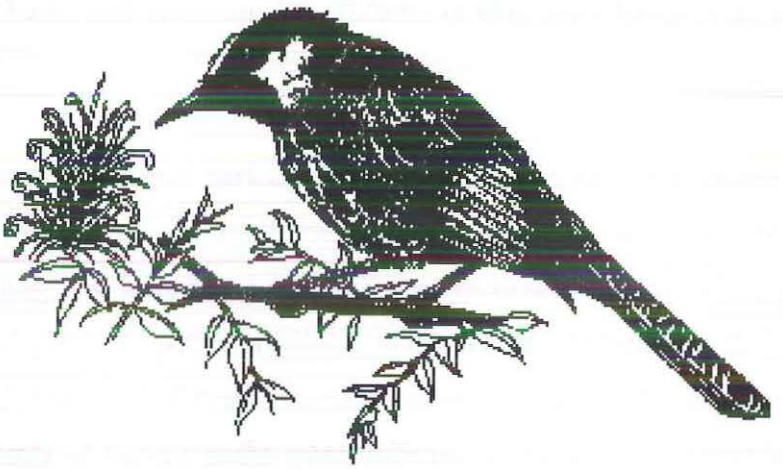
BY

Jodi S. Mansell



A Thesis Submitted in Partial Fulfillment of the Requirements for the Award of an Honours Degree of Bachelor of Science in Environmental Management

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ABSTRACT

Birds add colour, movement and sound to the landscape while posing few nuisance problems. They are some of the most obvious wildlife components of urban areas and, as such, provide a precious link between humans and nature, in an otherwise altered environment. Knowledge of the general responses of bird populations to urbanisation and an understanding of their habitat requirements is necessary to ensure the continuation of birdlife in urban areas. Most of the literature on urban birds around the world has concentrated on birds in streets and remnant patches. Urban parks provide much potential habitat for birds, although there are few publications addressing this issue. The aims of this project were to determine the terrestrial avifauna of Perth's northern suburban parks, investigate physical factors that might influence the distribution of birds, and determine the attitudes of park users towards birds in suburban parks.

Sixteen suburban recreational parks, ranging from 2.5 - 10 ha, were sampled for birds in the northern suburbs of the Perth metropolitan region. Twenty-six terrestrial bird species (including five introduced species) were recorded. This is only a small sample of the potential pool of species available and may be attributed to the isolation and relatively small size of all of Perth's northern suburban parks. The feeding and foraging guilds of the birds of Perth's parks were different to those documented in other urban studies around the world, which is a reflection of high proportion of native vegetation retained in Perth's suburbs.

Tree canopy height was the most influential factor on the birds of urban parks. Native bird species richness and diversity increased with increasing tree height. There were slight influences on birds by park age, park size and the distance of the park to the nearest remnant. It was concluded that parks are just one component of the urban matrix, which also includes remnant bushland, streets and private gardens. Together, all components of the matrix determine the bird communities in urban areas. A number of bird species will be lost from an urban area, already poor in species richness, if managers do not adopt a holistic approach.

Birds were also surveyed in streets adjacent to the park sites. The results revealed that urban birds use the individual components of the urban matrix differently. In the past, results from street counts have been used to generalise about the birds in urban areas. These generalisations, based on only one part of the urban environment, have led to incomplete representations of the urban avifauna. All facets of the urban matrix should be investigated in future studies which aim to determine the effects of urbanisation on birds.

No park users mentioned watching birds as a reason to visit Perth's suburban parks. The Galah, Kookaburra and Rainbow Lorikeet were identified by Perth's park users as the most desirable urban bird species; the Raven and Magpie were considered the least desirable species. Bird song/call was identified as the most desirable bird characteristic and aggression the least desirable bird characteristic. Ninety-seven percent of park users thought that birds should be encouraged to inhabit suburban areas. The results suggest that while birds are not considered an important reason for visiting parks, most birds are liked by park users and there is a general consensus that birds should be encouraged in suburban areas.

Methods to encourage birds into suburban areas include establishing habitat corridors between isolated parks and remnant bushlands, ensuring a diverse, native vegetation of differing strata levels, controlling cats and dogs, reducing lawn cover, retaining some large, old trees with suitable nesting holes and, narrowing the gap between the public's interest and their knowledge regarding birds.

THESIS DECLARATION

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

ACKNOWLEDGMENTS

This thesis is dedicated to the memory of my grandmother, Clarice Evelyn Mansell (13/6/08 -21/4/96), who taught me to appreciate the fragile environment around us.

I would like to thank my supervisor, Professor Harry Recher, for his wisdom and guidance; Eddie van Etten for his assistance in determining appropriate vegetation sampling methods; Mark Lund for his help with the community survey; Clive Nealon, Mike Bamford and Peter Stewart for the opportunity to use their field data; Natalie Lyons and Sarah Collins for their much appreciated field assistance; Edith Cowan University for its support; and all members from the Centre for Ecosystem Management for giving me the opportunity and encouragement to concentrate on my studies.

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CHAPTER 1

The Introduction

1.1 URBAN BIRD RESEARCH

There is no doubt that the quality of life in an urban environment is greatly enlivened by the presence of animals (Recher 1972). They are often the only relief from the monotony of urban landscapes and all people can find pleasure and diversion watching their antics. Birds, in particular, add colour, movement and sound to the landscape while posing few nuisance problems (Thomas *et al.* 1977; DeGraaf and Wentworth 1986). Birds are some of the most obvious wildlife components of urban areas and, as such, provide a precious link between humans and nature, in an otherwise altered environment. As urbanisation increases, and the amount of native fauna diminishes, birds are likely to become more important to people.

The growth of human populations around the world has also made urban habitats increasingly important for birds. Knowledge of the general responses of bird populations to urbanisation and an understanding of their habitat requirements is necessary to ensure a variety of birds persist around the world (Thomas *et al.* 1977; DeGraaf 1978). Emlen (1974) considered the establishment of cities as ecological experiments in which an array of features and resources (e.g., lawns, ornamentals, buildings, telephone lines, and traffic) are introduced into an area from which many of the original features have been removed.

There are several examples of birds using features and artefacts of human origin. The Greater Wood Swallow, which traditionally flies from tall trees, now flies from radio towers and telephone poles (Diamond 1986). In Perth, the Rainbow Bee-eater and Black-faced Cuckoo-shrike are also often seen sallying between telephone posts (Serventy and Whittell 1976). Shining Starlings have transferred their nests from holes in trees to vents of air conditioners (Diamond 1986). In Perth, the Tree Martin and Welcome Swallow are also known to nest in the vents of air conditioners, as well as under verandahs (Serventy and Whittell 1976). Many birds, such as the American Crow have profited from the considerable food available from poorly covered bins in North

American city blocks (Emlen 1974). In Perth, the Australian Raven and Western Magpie have also profited from human litter.

As well as providing new habitats for birds, urban development creates new threats. In addition to deaths from domestic cats, dogs and traffic (DeGraaf 1978), plate glass, ranging in size from the smallest windows to those essentially covering multistorey buildings, poses a lethal hazard to flying birds. Estimates of avian mortality resulting from collisions between birds and glass range into tens of millions in the United States annually (Klem 1987). The unique features that exist in urban areas affect the bird communities that inhabit them.

The field of urban bird research is relatively new, spanning just two decades. The majority of such work has been undertaken in North America and Europe, although there are works published on urban birds from Fiji (Gorman 1972), Finland (Huhtalo and Järvinen 1977), Canada (Lancaster and Rees 1979; Erskine 1980), New England (DeGraaf and Wentworth 1981; DeGraaf 1987), Papua New Guinea (Bell 1986), Poland (Kot 1988; Mackin-Rogalska *et al.* 1988) and New Zealand (Gill 1989).

A number of urban bird studies have been published from eastern Australia. The birds of Sydney were recorded by Recher (1972); Jones (1981) reported on the birds of Wagga Wagga, New South Wales; the birds of Canberra have been studied by Stein (1982), Munyenyembe *et al.* (1989), and Lenz (1990); Jones (1983) has investigated the birds of Townsville, Queensland; the birds of Melbourne have been reported by Green (1984, 1986) and Mason (1985); Catterral *et al.* (1989, 1991) studied the birds of Brisbane, Queensland; and Maeda (1991) reported on the avifauna of Hobart, Tasmania.

Many of these studies have associated reduced bird species richness and diversity with increased urbanisation (Emlen 1974; Jones 1981; Beissinger and Osborne 1982; Green 1984). Total abundance and biomass are generally higher in urban areas than adjacent natural ones (Lancaster and Rees 1979). Urban bird communities are characteristically dominated by a few species (often exotic) which comprise the bulk of individuals (Huhtalo and Järvinen 1977; Erskine 1980; Jones 1981, 1983; Beissinger and Osborne 1982; DeGraaf 1987; Lenz 1990). The 'typical urban species' are cavity-nesting, ground foraging, granivores and omnivores (DeGraaf 1978; Lancaster and Rees 1979; DeGraaf and Wentworth 1981; Beissinger and Osborne 1982; Jones 1983; Green 1984; DeGraaf

and Wentworth 1986; DeGraaf 1987). There tends to be a lack of insectivores and virtual absence of ground nesters in urban areas (DeGraaf 1978; DeGraaf and Wentworth 1981; Beissinger and Osborne 1982).

There are only two published works on the urban birds of Perth. Recher and Serventy (1991) have studied the birds of Kings Park and How and Dell (1993) have surveyed the Perth region (mainly remnant habitats). Majors (1988) reported on the avifauna of Perth's urban remnants in an unpublished honours thesis. The Royal Australasian Ornithologists Union (RAOU) began a survey of backyards and areas frequented by members in Perth and Mike Bamford (Edith Cowan University) has had students collecting bird data in the streets of Perth for the past three years. The results of both of these studies are yet to be published.

Most of the literature on urban birds around the world has concentrated on streets and remnant patches. Urban parks provide much potential habitat for birds, although few bird studies have focused on them (Gavareski 1976; Cicero 1989; Recher and Serventy 1991; Honza 1992). Urban parks need to be managed in a way that encourages native birds. This management requires input from the local community, especially considering that urban parks are developed for the primary purpose of human recreation.

The following project aimed to determine what terrestrial birds inhabit Perth's northern suburbs, what physical factors affect the distribution of birds, and what are the community attitudes towards birds in suburban parks. The overall aim was to provide guidelines to managers of urban recreational parks to encourage native birds for the benefit of both humans and birds.

1.2 RESEARCH APPROACH

Chapter two serves to provide background on the study area; it introduces methodology for site selection and provides site descriptions, largely compiled through vegetation sampling. Chapter three investigates the use of a bird sampling procedure for parks, adapted specifically for this study after Loyn (1980). Chapter four looks at the effects of park age, size, vegetation and distance to remnants on urban avifauna and compares the results to past studies. Chapter five focuses on the birds inhabiting suburban streets. It compares them to those inhabiting nearby park sites to discover the importance of suburban parks to birds as potential refuge habitat. Chapter six reveals the attitudes of suburban recreational park users towards birds in parks. It also identifies the bird species and attributes considered most desirable by park users. Chapter seven draws conclusions on the presented results and provides guidelines to park managers to encourage a diverse native avifauna into Perth's suburban recreational parks.

The scientific names of birds and vegetation are presented when common names are not available. Scientific names are presented in Appendix 1 for birds and plants recorded during sampling, as well as any others mentioned throughout the text.

CHAPTER 2

Site Selection and Description

This chapter provides background on the climate, geology and avifauna of the study area. Site selection is discussed and information collected on the parks, such as vegetation and cultural feature descriptions, is presented.

2.1 PERTH'S PHYSICAL ENVIRONMENT

Perth City (31°57'S, 115°51'E) was established in 1829 and is located on the south-western coast of Western Australia. It reaches its highest point at Reabold Hill, 93 m above sea level (Seddon 1972). Perth has a Mediterranean climate typified by hot, dry summers and cool, wet winters (Barrett and Dent 1991). Winter occurs in June, July and August, summer from December to February. Average monthly rainfall varies from 8.6 mm in summer to 182.4 mm in winter. There is an average of 119.6 rain days a year, with an average annual rainfall of 869.4 mm (Bureau of Meteorology 1997).

Temperatures range from the lowest recorded temperature of 1.6°C in winter to the highest temperature of 46.2°C in summer. The average daily temperature varies from 9°C to 30°C, with an annual average temperature of 23.3°C. Perth receives an average of 8.1 hours of daily sunshine (Bureau of Meteorology 1997).

Perth's metropolitan area is located primarily on the Swan Coastal Plain, intruding slightly upon the Darling Scarp and Plateau. The Swan Coastal Plain is built up of calcareous sediments, as opposed to the igneous and metamorphic rocks of the Darling Plateau to the east. Three major series of coastal sand dunes comprise the western edge of the plain. The youngest, the Quindalup System, fringes the present coastline in the west; this is followed by the Spearwood System; the oldest, and most easterly, is the Bassendean System (Seddon 1972).

The natural vegetation on the Bassendean dune system consists of Banksia low forest, with a diverse understorey of shrubs. The Spearwood dune system, in its natural state, supports a tall open forest of Tuart, Jarrah and Marri. The families that dominate the understorey of the Bassendean and Spearwood systems (Proteaceae, Fabaceae and Myrtaceae) are poorly represented on the Quindalup dune system and there are no eucalypts or banksias in the natural vegetation. The main species are wattles, *Acacia rostellifera* and the Coastal Wattle. The only tree forms existing naturally on the Quindalup system are the Swan River Cypress and Rottnest Tea-tree (Seddon 1972).

Storr and Johnstone (1988) recorded 311 bird species on the Swan Coastal Plain and adjacent areas. Of these, 176 species are, or have been, residents or regular visitors to the Perth metropolitan region and 123 of them are terrestrial birds. Since European settlement six species have become locally extinct and many species have declined in numbers (How and Dell 1993).

2.2 SELECTION OF PARK SAMPLE SITES

Two factors were considered in evaluating the response of birds to urbanisation: the age and the size of parks. Eight parks were selected from 'old' suburbs and eight from 'new' suburbs. Within each of these age groups, there were four 'large' parks and four 'small' parks. Initially, sites were selected from street maps (Metro Map 1996 series 1:30,000). All sites were selected from the northern suburbs of the Swan Coastal Plain to reduce site variation. Suburban parks were defined as recreational parks totally surrounded by suburban housing development.

The sites were then graded as 'suitable' or 'unsuitable'. A site was considered unsuitable if the park lay adjacent to a main road, industrial area or major shopping centre because increased noise can influence the ability of the observer to detect birds (Pyke and Recher 1984). Parks that lay adjacent to remnant bushland or other parks were also considered unsuitable because they provided an extended vegetation habitat for birds in the park. All other parks were considered suitable.

The sites were classed as old, large parks; old, small parks; new, large parks; and, new, small parks. The division of age of suburbs was selected to coincide with the maximum longevity of individual birds, which is in the order of 10-15 years (H. Recher, Edith Cowan University, pers. comm., May 14, 1996). Sites were classed as 'old' if they were greater than, or equal to, 20 years old, to be on the conservative side. 'New' sites were recognised as less than 20 years old. While 'new' sites closer to 10 years would have been preferable, there was a lack of suitable sites. The relative age of each park was based on estimates of the year of subdivision, provided by local councils, because suburban parks are generally established at the time of subdivision (B. Ruscoe, Wanneroo City Council, pers. comm., May 8, 1996).

Sites were classed as large or small according to the approximate size of the parks. These estimates were obtained by overlaying 1 mm graph paper over park outlines (Department of Land Administration 1996, Scale: 1:30,000). The number of full squares and incomplete squares were counted and the area calculated using the formula: $area = a + (b/2)$, where a is the number of full squares and b is the number of incomplete squares. This number was then converted to hectares.

Perth's northern suburban recreational parks are consistently small, ranging from 0.6 ha to 17.2 ha. The newer parks tend to be smaller than the older parks and placed adjacent to remnant bushland more often. Many newer parks were, therefore, rejected from this study. Sites between 2.5 ha and 4 ha were classed as small and sites between 6 ha and 10 ha were considered large. These ranges were chosen to provide the least variation between the eight sites in each category.

Four replicate sites of each class were randomly selected. The sites were visited to ensure that they were suitable. A few parks were rejected, for example, where there was a lake in the park that would have provided habitat not available in other sites, and where the park was adjacent to undeveloped land which effectively enlarged the area of the park. In these instances other sites were selected and the groundtruthing process repeated.

In some cases, the suitability of sites had to be compromised, especially with the large sites. There was a lack of suitable large sites, which meant that the factors least likely to influence results had to be considered when choosing between unsuitable large sites. For example, parks alongside schools were chosen over those with lakes or adjacent bushland.

2.3 PARK SITE CHARACTERISTICS

2.3.1 Methods

Vegetation Sampling

Sketch maps of each park were produced from metropolitan regional aerial photographs (Scale 1:20000) from the Department of Land Administration (Job Number 95000). These were blown up to a scale of 1:10000 to improve the detection of features, and maps were drawn using a lighted magnifying glass (magnification x 5). All features were placed into one of six categories (Table 2.1).

Table 2.1: Feature category descriptions used for park sampling

Category	Title	Description
1	Development	Sealed surfaces or developed areas, e.g., toilets and drainage sites
2	Unirrigated 'grass'	Areas of grass not visibly watered without a shrub or tree layer
3	Irrigated 'lawn'	Areas of lawn visibly watered without a shrub or tree layer
4	Trees without understorey	Areas of tree cover with no shrub understorey
5	Trees with understorey	Areas of tree cover with a shrub understorey
6	Understorey only	Areas of shrub cover with no tree overstorey

Groundtruthing was undertaken at each site to ensure that the parks were categorised correctly. Maps were then converted onto 1 mm graph paper to determine the area covered by each category. The number of full squares and incomplete squares were counted and the area calculated using the formula: $area = a + (b/2)$, where a is the number of full squares and b is the number of incomplete squares. This number was then converted to hectares and the percentage cover of each category calculated.

To sample the variety in each category, individual patches that were identified during mapping were sampled separately rather than sampling categories as a whole. Two areas classified as category five, for example, could be different in species composition.

A species was identified as dominant if it was the most often seen or covered the largest area of the park, as a whole. Grass, shrub and trees dominants of each patch for each category in the parks were identified and the percentage cover of each dominant species estimated. The percentage cover of each life-form category as a whole was also estimated. Irrigated lawn species could not be identified as they were consistently mowed. Most irrigated lawn species, however, would be 'couch' grass of different varieties.

The average canopy height of each dominant tree species was measured using a clinometer and the canopy percentage cover estimated. The average height of dominant shrub and unirrigated grass species were measured using a one-metre rule. The percentage cover of sand under the trees was also noted.

Trees and shrubs were identified as 'native to Australia' or as 'non-natives'. Australian plants were identified to genus, and where possible, to species level (using Bennett 1988; Brooker and Kleinig 1990; Powell 1990; Bodkin 1993). Non-native plants were grouped into life-form categories (e.g., trees and shrubs), but most could not be identified. This would not significantly alter the interpretation of results as non-native plants are used less frequently by birds than native plants (e.g., Stein 1982; Green 1984).

Calculating Distance to Remnant Patches

The distance of each park to the closest remnant bushland patch was calculated using aerial photographs from the Department of Land Administration (Job Number 950000, Scale 1:20000). A remnant was defined as any relatively intact patch of bushland greater than, or equal to, 5.5 ha. This figure was calculated as the mean between the smallest and largest of the sampling sites. The distance was calculated by measuring the shortest distance from the edge of the remnant to the edge of the park, as the crow flies. In two cases, Beecroft and Belrose Parks', the closest remnant patches were along the coastal strip. These remnant patches were divided by tracks with vegetation vastly different to that of the parks. The second closest remnants to both sites were more similar and were, therefore, used instead.

2.3.2 Site Descriptions

The study area extended northwards from City Beach to Beldon and inland as far as Beechboro (Figure 2.1). Feature maps of each park were produced, identifying the boundaries of each of the six chosen categories (Figures 2.2-2.17). The area and percentage cover of each category in the study parks is summarised in Table 2.2. The dominant grasses, shrubs and trees of each park are attached (Appendices 2a-2c).

There was no significant difference in the percentage cover of any categories between old and new sites. Two parks of the sixteen were unirrigated - Haddington and Salata Parks'. Seacrest Park had the highest percentage cover of lawn; Avocado Reserve had the lowest. While Avocado Reserve had no value for Categories 2 or 3, a substantial amount of irrigated lawn appeared underneath the trees of Category 4. Kingsley and Glengarry Parks' had the highest percentage cover of development; Belrose Park had the lowest. Avocado Reserve had the highest percentage cover of trees without understorey. When Categories 4-6 were combined, Avocado Reserve had the highest percentage of shrubs and trees. Arbor and Salata Parks' had the highest cover of trees with understorey, which generally consisted of remnant bushland patches within the park. Belrose and Beecroft Parks' had the lowest percentage cover of trees with understorey. Few parks contained patches of shrub understorey only (Category 6). Where this cover category did exist, it covered a minimal percentage of the park.

Comparison between the vegetation of the parks and the streets described in Chapter 5 was required. The sampling methodology was less intensive in streets to avoid interfering with local residents and different cover categories were used. The total cover of development (which included open sand cover); lawn (both irrigated and unirrigated); native shrubs; introduced shrubs; native trees and introduced trees were calculated for all park sites (Table 2.3). These calculations were performed using the percentage covers of each vegetation layer, noted in each patch.

Introduced vegetation covered small proportions in all parks, the highest percentage found in Belrose Park. Blackmore, Salata and Haddington Parks' had the highest percentages of native shrub understorey; Belrose Park had the lowest. Salata, Avocado and Arbor Parks' had the highest percentages of native tree cover; Belrose Park had the lowest. Overall, Salata Park had the highest percentage of native vegetation.

Figure 2.1: Study site locations in Perth, Western Australia

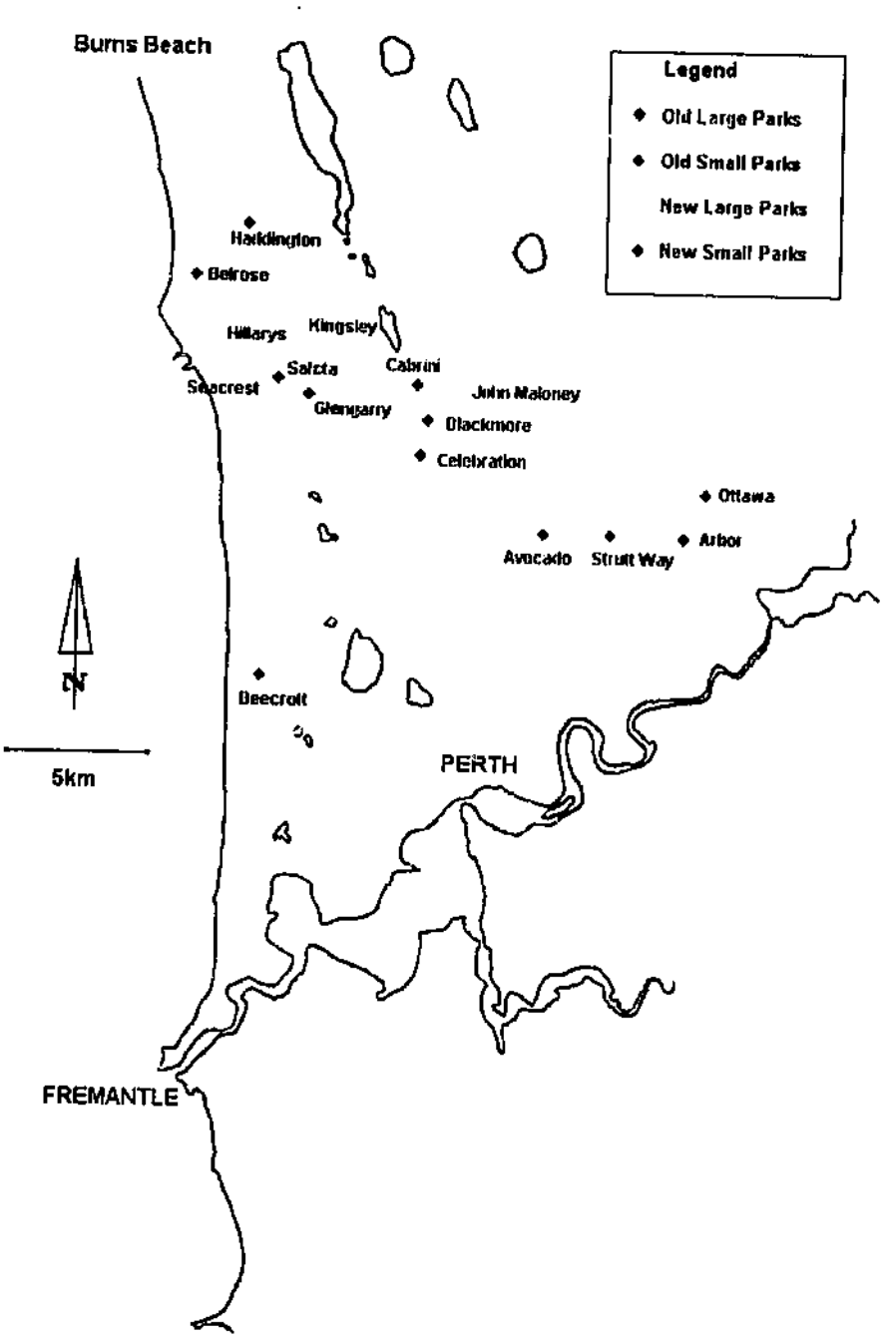


Table 2.2: Area (m^2) and Percentage Cover (in parenthesis) of each feature category in each park.

	Category					
Park/ Reserve	**1**	**2**	**3**	**4**	**5**	**6**
Arbor	3600 (3.61)	0	52300 (52.46)	0	43800 (43.93)	0
Avocado	1200 (4.14)	0	0	18900 (65.17)	8900 (30.69)	0
Beecroft	1850 (5.04)	0	24050 (65.53)	10500 (28.61)	300 (0.82)	0
Belrose	600 (1.98)	0	22500 (74.25)	6850 (22.61)	0	350 (1.16)
Blackmore	3700 (5.26)	0	37700 (53.55)	0	27500 (39.06)	1500 (2.13)
Cabrini	1900 (4.75)	0	27100 (67.75)	3000 (7.50)	8000 (20.00)	0
Celebration	2950 (3.57)	0	49600 (59.98)	23200 (28.05)	6950 (8.40)	0
Glengarry	7300 (11.30)	0	32400 (50.16)	0	24900 (38.54)	0
Haddington	750 (2.82)	13100 (49.34)	0	5300 (19.97)	7400 (27.87)	0
Hillarys	2050 (2.99)	0	36800 (53.52)	6800 (9.89)	23100 (33.60)	0
John Maloney	6550 (8.62)	0	53150 (69.93)	5100 (6.71)	11200 (14.74)	0
Kingsley	10400 (13.57)	0	46200 (60.23)	6200 (8.08)	13900 (18.12)	0
Ottawa	1100 (3.39)	0	23700 (73.15)	3600 (11.11)	4000 (12.35)	0
Salata	1750 (6.73)	12200 (46.92)	0	850 (3.27)	11200 (43.08)	0
Seacrest	4250 (4.29)	0	79650 (80.29)	10100 (10.18)	5200 (5.24)	0
Strutt Way	1800 (7.09)	0	11900 (46.85)	3500 (13.78)	8200 (32.28)	0

Categories: 1=Development; 2=Unirrigated Grass; 3=Irrigated Lawn; 4=Trees with no understorey; 5=Trees with understorey; 6=Understorey only.

Table 2.3: The percentage cover of each category in each park used for comparison with street vegetation data in Chapter 5.

Park/ Reserve	Development	Lawn	Native Shrub	Introduced Shrub	Native Tree	Introduced Tree	TOTAL
Arbor	12	52.5	13	0	31	0	108.5
Avocado	6.5	49	18.5	0	35	0	109
Beecroft	5	80	0.5	0	15	0.5	101
Belrose	2	87	0	1	7.5	2.5	100
Blackmore	12	60	28	0	12	0	112
Cabrini	5	78	2	0	16.5	1	102.5
Celebration	5	75	2.5	0	18	0	100.5
Glengarry	11.5	59.5	9	0	20	0	100
Haddington	4	62.5	25	0	15	0	106.5
Hillarys	9	65	16	0	11.5	1.5	103
John Maloney	8.5	74	11	0	8	0	101.5
Kingsley	15.5	70	8	1	17.5	0	112
Ottawa	11.5	79	2	0	10	0	102.5
Salata	7	47	26	0	39.5	0	119.5
Seacrest	4.5	88	4	0	8	0	104.5
Strutt Way	14	53	8	0	26	4	105

NB: Totals are often over 100%. This is due to an overlap in some vegetation layers.

Site Descriptions:

Feature maps of each park have been produced, identifying the boundaries of each of the six feature categories (Figures 2.2-2.17).

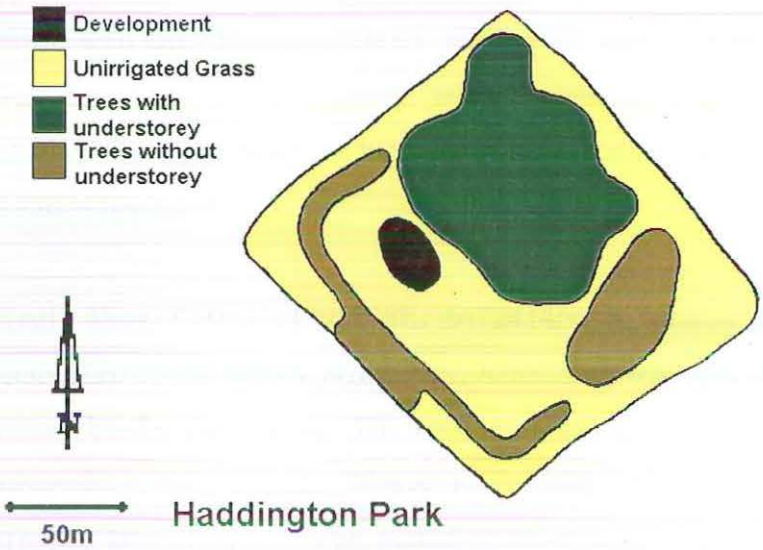
New Small Parks

Cabrini Reserve (388748E, 6477580N), established in 1980, is located in the suburb of Marangaroo. Marangaroo Drive, Cabrini Road, Lint Road and Giralt Road border the reserve. The reserve covers an area of 4 ha and occurs on the Spearwood dune system. Most of Cabrini Reserve is covered by irrigated lawn (67.5%), including an oval as the central focus. Five percent of the reserve consists of development which includes playground equipment, a carpark and toilet block. Much of the canopy layer of vegetation is restricted to the edges of the reserve and oval. This eucalypt woodland, dominated by Jarrah and Tuart, covers 27.5% of the area and has a canopy height of around 17 m. Blackboys dominate the understorey. Cabrini Reserve is 600 m from the nearest remnant bushland.

Haddington Park (382701E, 6483331N), established in 1980, is located in the suburb of Beldon. Haddington Street, Berkshire Drive, houses and Geelong Crescent border the park. The park covers an area of 2.66 ha and occurs on the Spearwood dune system. Almost half (49%) of Haddington Park is covered by introduced unirrigated grass, dominated by Summer Grass and Hare's Tail Grass. Playground facilities cover 3% of the parks' area and a remnant patch of Tuart woodland covers 28% of the park, co-dominated by the Orange Wattle. The canopy height is around 26 m. A substantive understorey, dominated by the Dwarf Sheoak, contains Honeybush, Blackboys and *Grevillea vestita*. Introduced grasses, Wild Oats and Perennial Veldgrass have invaded the remnant. Eucalypt woodland borders the park and covers 20%. This area has no understorey and is dominated by Tuart and Sugar Gum with a canopy height of about 26 m. Many of the trees in this border patch are juveniles. Haddington Park is 1.18 km from the closest remnant.

Figure 2.2: Cabrini Reserve, Marangaroo

Figure 2.3: Haddington Park, Beldon



Ottawa Park (399201E, 6473893N), established in 1976, is located in the suburb of Beechboro. The park is bordered by Amazon Drive, Sacramento Drive, Pentecost Avenue and Ottawa Crescent. The park covers an area of 3.24 ha and occurs on the Bassendean dune system. Most of Ottawa Park is covered by irrigated lawn (73%). Cultural features include a playground, picnic table and platforms, covering 3.5% of the park area. River Red Gum and Marri, with a canopy height of 22 m, dominate the eucalypt woodland that borders the park with no understorey. Three patches of remnant type vegetation with understorey cover 12.5% of the park. These patches are Marri forest, with Grey Honeymyrtle co-dominating, and a canopy height of 22 m. Geraldton Wax dominates the understorey, while Perennial Veldgrass and Summer Grass have invaded the grass layer in high numbers. Ottawa Park is 1.9 km from the nearest remnant bushland.

Strutt Way Reserve (395878E, 6472414N) is located in the suburb of Noranda, established in the 1980's. Strutt Way, Armstrong Way, Stirling Close, Steward Way and houses border the reserve. The reserve covers an area of 2.54 ha and occurs on the Bassendean dune system. Almost half (47%) of Strutt Way Reserve is covered by irrigated lawn. Development, including playground equipment and a scout hall, covers 7% of the park. Along the northern and southern borders of the park, Peppermint Trees and Fig Trees have been planted with a canopy height of around 7 m. Areas of trees with no understorey cover 14% of the park. Remnant patches of Marri forest cover 32% of the park, with a canopy height of 17 m. Blackboys comprise the dominant understorey, while the introduced Perennial Veldgrass and Rice Millet dominate the grass layer. Strutt Way Reserve is 680 m from the closest remnant bushland.

Figure 2.4: Ottawa Park, Beechboro

Figure 2.5: Strutt Way Reserve, Noranda

New Large Parks

Hillarys Park (381408E, 6479404N), established around 1985, is located in the suburb of Hillarys. The park is bordered by Kimberley Road, houses, Absolon Way, Lymburner Primary School and Lymburner Drive. The park covers 6.88 ha and occurs on the Quindalup dune system. Irrigated lawn, including an oval, covers 53.5% of Hillarys Park. Playground equipment and a toilet block cover 3% of the park area. Two remnant heath patches, with a patch of juvenile shrubs, cover 33.5% and provide the park's understorey. Heath patches are dominated by Rottnest Teatree and Acorn Banksia, with a canopy height of 5 m. *Scaveola crassifolia* dominates the understorey, while introduced grasses, such as Hare's Tail Grass and Wild Oats, cover most of the grass layer. Ten percent of the park is covered by trees with no understorey, dominated by Tuart with Bald Island Marlock and Peppermint Trees co-dominating. The canopy height is around 12 m. The closest remnant bushland to Hillarys Park is 500 m away.

John Maloney Park (390112E, 6477464N), established in 1980, is located in the suburb of Marangaroo. The park is bordered by Highclere Boulevard, houses, Trafalgar Gardens and Woodward Close. The park covers 7.6 ha and occurs on the Spearwood dune system. Seventy percent of the park is covered by irrigated grass, including two ovals. Two drainage sites (to the north and south of the park), a carpark, playground, recreational facilities and toilet block cover 8% of the park. Eucalypt woodland with no understorey occurs around the border of the park, covering 7%. While Jarrah is a dominant species, most of the eucalypts are not from the south-west. Fifteen percent of the park is covered by patches of remnant vegetation and planted understorey around the drainage sites. The remnants are Banksia/Jarrah woodland with a canopy height of 14 m. The understorey is dominated by Blackboy, while the grass layer is dominated by Purple Flag and introduced Perennial Veldgrass. The canopy layer of vegetation surrounding the drainage sites is dominated by Jarrah and the Rottnest Teatree with an height of around 14 m. Dwarf Sheoak, an unidentified Grevillea species and Blackboy dominate the understorey while Perennial Veldgrass dominates the grass layer. John Maloney is 120 m from the nearest remnant bushland.

Figure 2.6: Hillarys Park, Hillarys

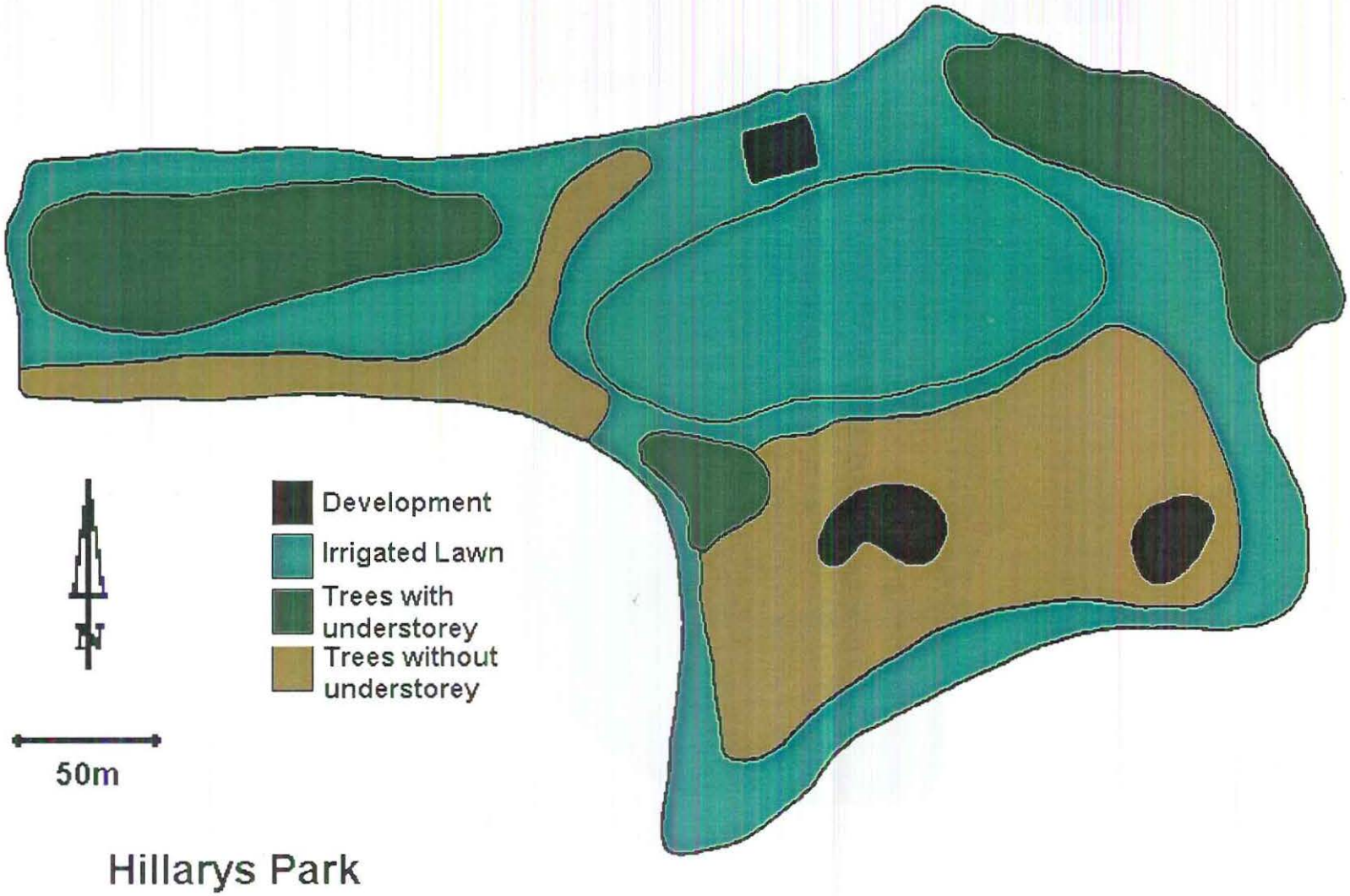
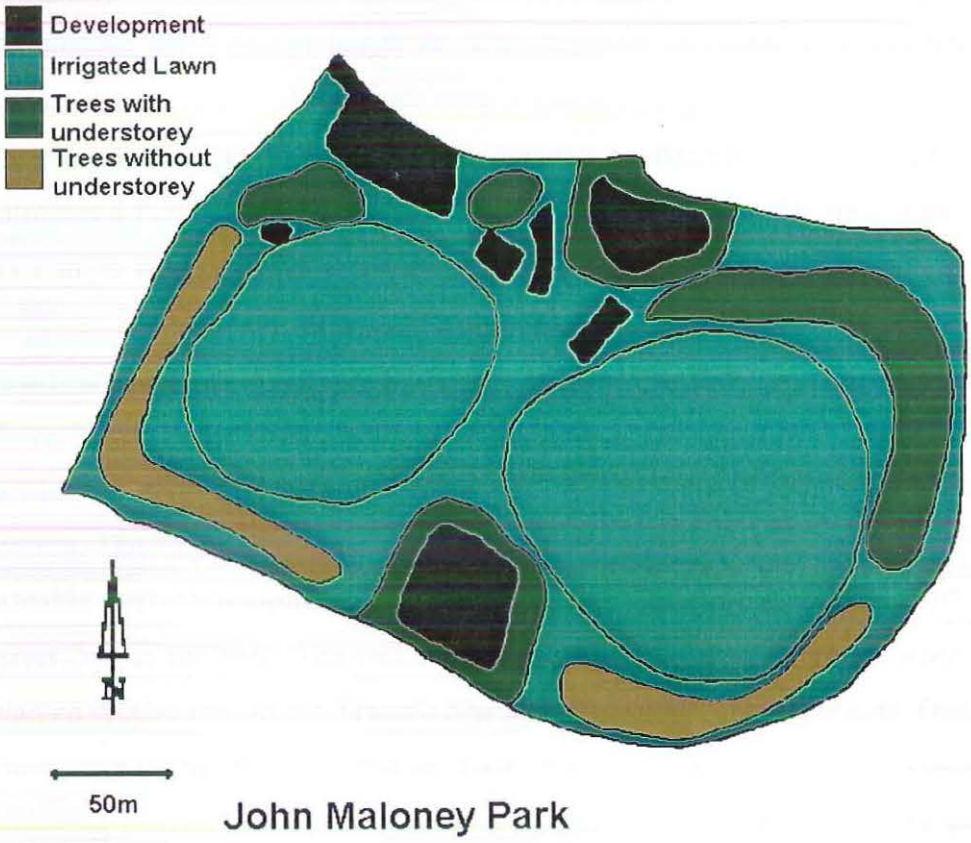


Figure 2.7: John Maloney Park, Marangaroo



Kingsley Park (385249E, 6480369N), established in 1980, is located in the suburb of Kingsley. The park is bordered by Kingsley Drive, Creaney Primary School, Creaney Drive and Kingsley Village. The park covers 7.67 ha and occurs on the Spearwood dune system. Irrigated lawn, including an oval, covers 60% of Kingsley Park. Cultural features include carparks, a playground, tennis courts, cricket pitches and a drainage site in the south-western corner, and cover 14% of the park. Eucalypt woodland with no understorey borders much of the park and playground, covering 8%. This woodland is dominated by Tuart and Jarrah, with Sugar Gum and Red Flowering Gum co-dominating, and a canopy height of 24 m. Remnant Jarrah/Banksia woodland occurs in the southern portion of the park with a canopy height of 9 m, and covers 18% of Kingsley Park. The understorey is dominated by Blackboy and *Daviesia divaricata*. Introduced Perennial Veldgrass and Blowfly Grass dominate the grass layer. The closest remnant to Kingsley Park is 260 m away.

Seacrest Park (381577E, 6478202N), established in 1982, is located in the suburb of Sorrento. St. Helier Drive, Seacrest Drive, houses, Lacepede Drive and Cervantes Place border the park. The park covers an area of 9.92 ha and occurs on Quindalup dune system. The majority of Seacrest Park (80%) is covered by irrigated lawn, including a sizeable oval. Development, including a carpark, playground facilities and toilet block cover 5% of the park. Ten percent of the park is covered by trees, which have been planted around the border. Fraser's Sheoak dominates with Peppermint Trees and Sugar Gum, with a canopy height of 4 m. Two remnant heath patches have been retained and including planted vegetation around the carpark, covers 5% of the park area. Fraser's Sheoak, Orange Wattle and Peppermint Trees dominate these areas with a canopy of height of 8 m. Coastal Wattle dominates the understorey of the remnant patches while *Atriplex isatidea* dominates the planted carpark border. A number of introduced grasses have invaded all patches. These include Wild Oats, Petty Spurge, *Isolepis nodosa* and *Trachyandra divaricata*. Seacrest Park is 940 m from the closest remnant bushland.

Figure 2.8: Kingsley Park, Kingsley

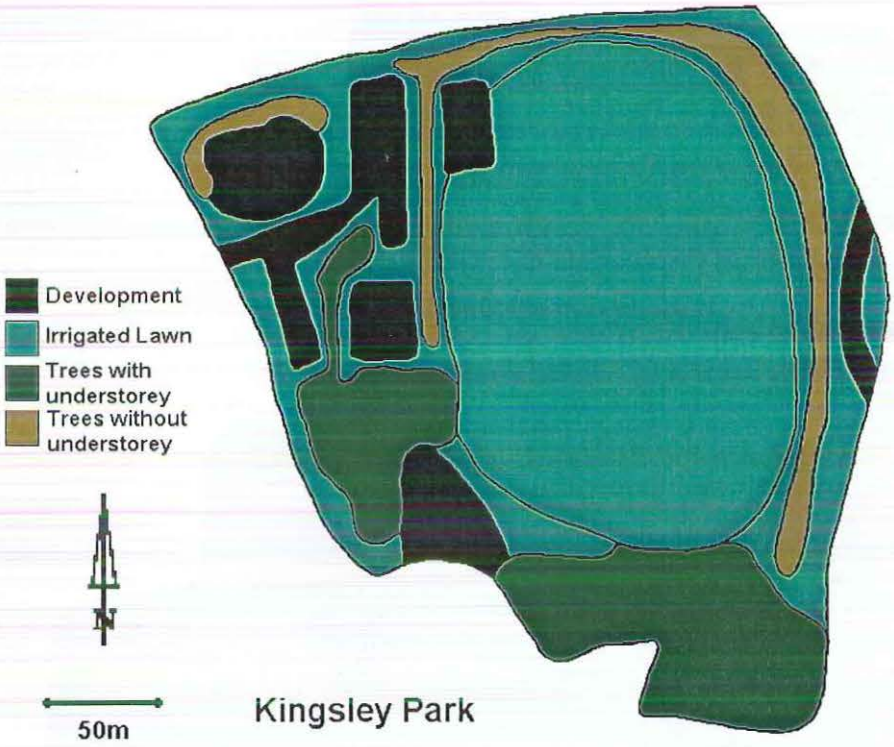
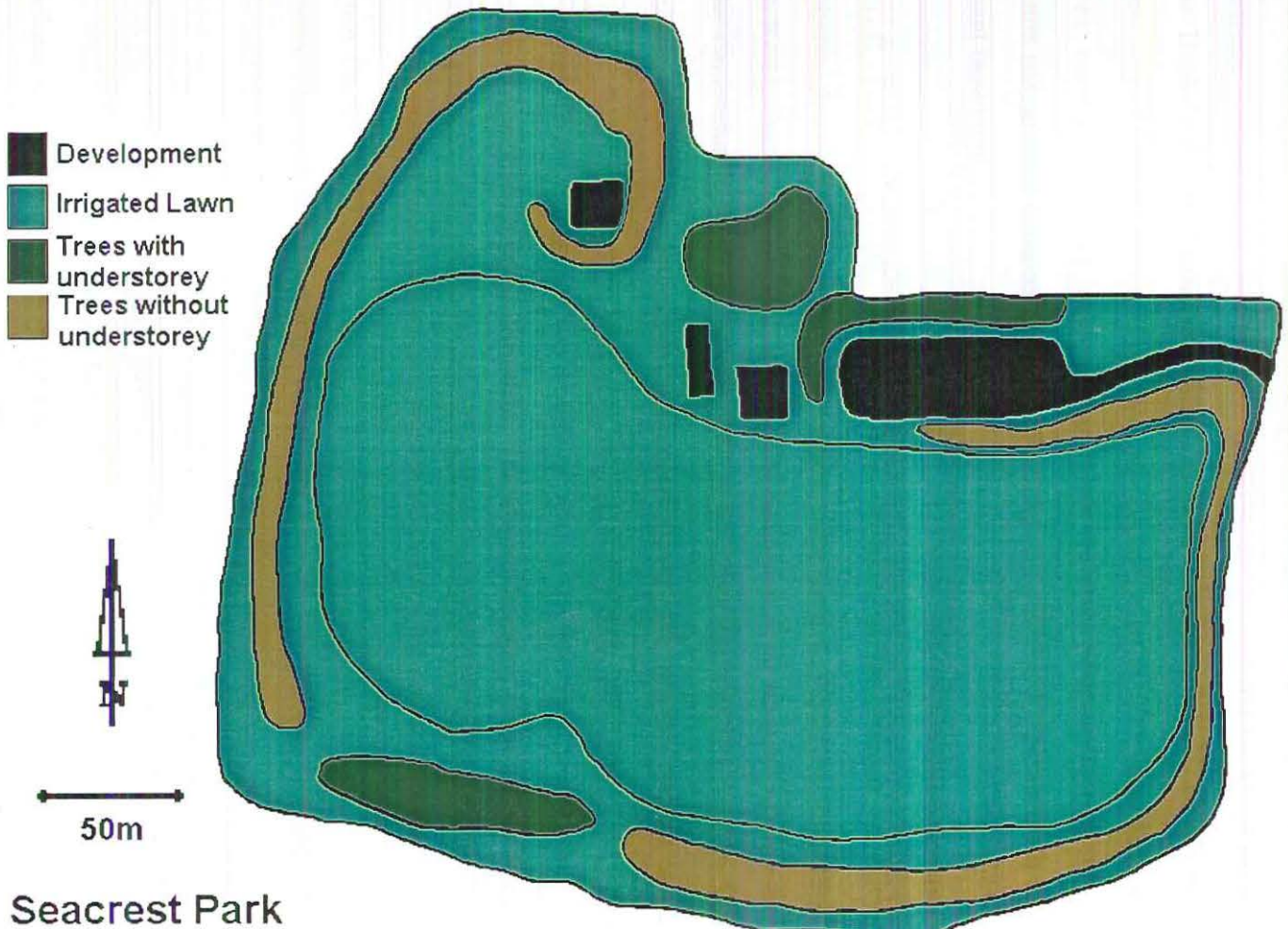


Figure 2.9: Seacrest Park, Sorrento



Old Small Parks

Avocado/Bangalay Reserve (393509E, 6472471N) is located in the suburb of Dianella, established between the 1950's and late 1970's. Avocado Drive and Bangalay Way border the reserve. The reserve covers 2.9 ha and occurs on the Bassendean dune system. Eucalypt woodland (65%) covers the majority of Avocado/Bangalay Reserve, with a canopy height of 13 m. The eucalypt species could not be identified, although they are considered to be eastern state species. Irrigated lawn occurs under the cover of these trees. A sizeable patch of the reserve (31%) retains natural bushland in the form of a low Banksia forest. Jarrah co-dominates with a canopy height of 13 m. A thick understorey of Dwarf Sheoak, Blueboys and Blackboys exists. Invasion from introduced grasses, such as Perennial Veldgrass, is relatively low. Four percent of the park area contains playground equipment. Avocado/Bangalay reserve is 780 m from the nearest remnant bushland.

Beecroft Park (383310E, 6467099N) is located in the suburb of City Beach, established between the 1930's and 1960's. The park is bordered by Gayton Road, Obon Road, Tilton Terrace and houses. The park covers an area of 3.67 ha and occurs on the Quindalup dune system. Irrigated lawn covers most of Beecroft Park (64.5%), including an oval. A playground and shed cover 5% of the park area. Eucalypt woodland is generally restricted to the park borders, and bar 1%, contains no understorey. Tuart dominates the woodland with a canopy height of 22 m. Mahogany Gum and River Red Gum co-dominate. The closest remnant bushland to Beecroft Park is 900 m away.

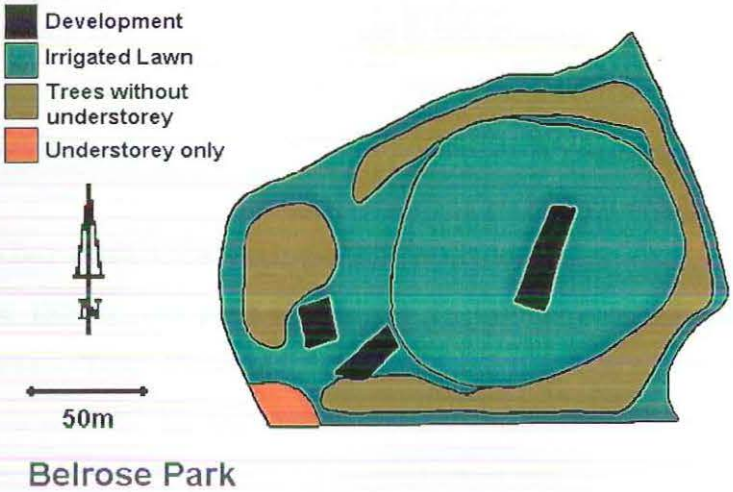
Belrose Park (380870E, 6481408N), established in 1971, is located in the suburb of Kallaroo. The park is bordered by Whitfords Avenue, the Belrose Entrance, Castlecrag Drive and Northwood Way. The park covers 3.03 ha and occurs on the Quindalup dune system. Belrose Park is mostly irrigated lawn (74%) which includes a sizeable oval. Cricket pitches and a toilet block cover 2% of the park area. The only understorey in the park, which covers 1%, is in the form of a planted garden of introduced shrubs. Tuart woodland borders the remainder of the park (23%), co-dominated by Fraser's Sheoak and an unknown introduced palm. The canopy height is around 11 m. The nearest remnant bushland to Belrose Park is 640 m away.

Figure 2.10: Avocado/Bangalay Reserve, Dianella

Figure 2.11: Beecroft Park, City Beach

OLD SMALL PARK

Figure 2.12: Belrose Park, Kallaroo



Salata Park (383783E, 6477915N), established in 1970, is located in the suburb of Duncraig. The park is bordered by Salata Place, houses and Melene Road. The park covers an area of 2.6 ha and occurs on the Spearwood dune system. Unirrigated grass, mostly Summer Grass, covers 47% of Salata Park. A playground and drainage site on the western edge cover 7%. Remnant patches of Tuart/Banksia forest, co-dominated by Jarrah, cover 43% of the park with a canopy height of 20 m. The understorey consists mainly of Blackboys, with Zamia Palms co-dominating. Wild Oats and Perennial Veldgrass are abundant in the grass layer. The remaining 3% of the park are covered by Rottnest Teatree's which have been planted around the drainage site. The closest remnant bushland to Salata Park is 800 m away.

Old Large Parks

Arbor Park (398711E, 6472295N) is located in the suburb of Morley, established in the 1950's. The park is bordered by Cassia Way, Challenger Avenue, Redgum Way, houses, Tuart Place and Peppermint Place (off Bottlebrush Drive). The park covers an area of 9.97 ha and occurs on the Bassendean dune system. Arbor Park retains a sizeable portion of natural vegetation in patches of Marri forest (44%) with a canopy height of 22 m. Fabaceae predominates in the understorey and there is a relatively low degree of invasion by introduced grasses, such as African Lovegrass. There is substantial leaf litter cover in the park. Most of the park (52.5%) is covered by irrigated lawn and a small proportion contains playground equipment (3.5%). Arbor Park is 680 m from the closest remnant bushland.

Figure 2.13: Salata Park, Duncraig

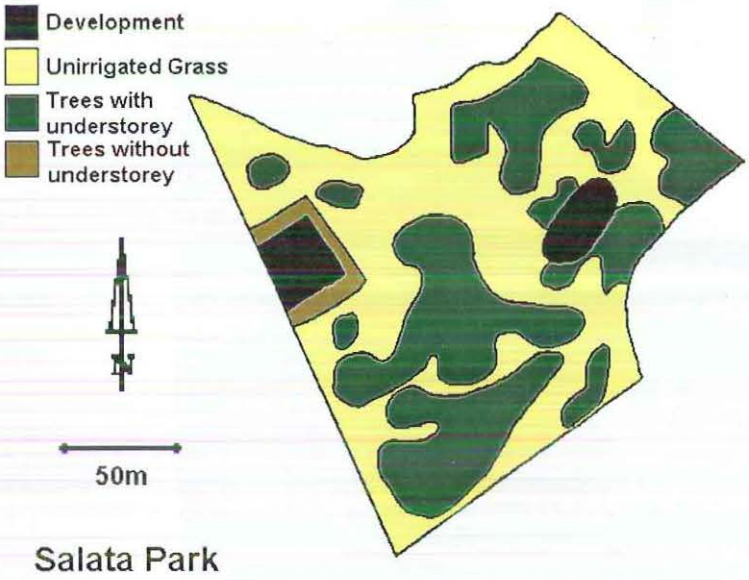


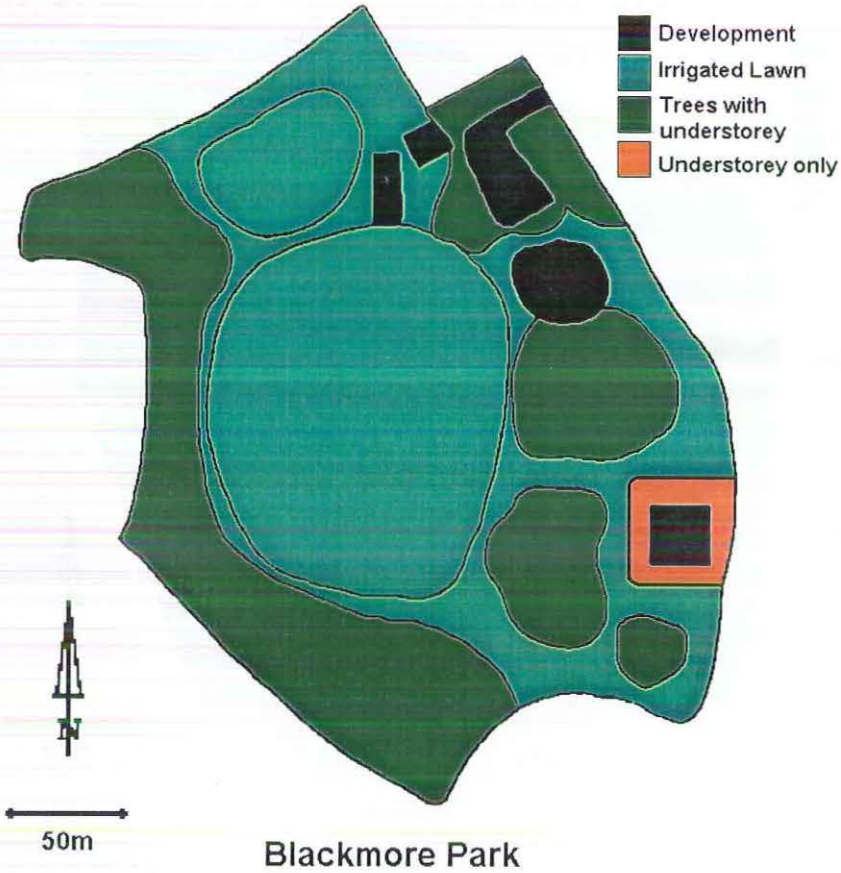
Figure 2.14: Arbor Park, Morley

Blackmore Park (389117E, 6476388N) is located in the suburb of Girrawheen, established in the 1970's. The park is bordered by Kelly Road, Blackmore Avenue and Blackmore Primary School. The park covers an area of 7.04 ha and occurs on the Spearwood dune system. Fifty-four percent of Blackmore Park is covered by irrigated lawn, which includes two ovals. Cultural features include a carpark, playground equipment, toilet block and a drainage site on the eastern border, which cover 5% of the park area. Patches of remnant Jarrah/Banksia woodland border the park, covering 39%, with a canopy height of 16 m. Blackboy dominates the understorey, while the introduced Perennial Veldgrass dominates the grass layer. A small percentage of the park is covered by shrub vegetation which borders the drainage site (2%). This patch is dominated by Coastal Honeymyrtle and a Bottlebrush species. Blackmore Park is 500 m from the nearest remnant bushland.

Celebration Park (388856E, 6475133N) is located in the suburb of Balga, established in the 1960's. The park is bordered by Rochester Close and covers 8.27 ha. Celebration Park occurs on the Spearwood dune system. Irrigated lawn covers the majority of the park (60%), including an oval. Development such as playground equipment, a carpark and toilet block cover 3.5% of the park area. Most of the canopy vegetation consists of eucalypt woodland, dominated by Jarrah and Flooded Gum, that borders the park with no understorey. The canopy height is around 17 m. Two remnant patches of Jarrah woodland cover 8.5% of the park. Blackboys are the dominant understorey and much of the grass layer contains introduced species, such as Summer Grass and Blowfly Grass. The closest remnant bushland to Celebration Park is 300 m away.

Glengarry Park (385103E, 6477278N), established in 1970, is located in the suburb of Duncraig. The park is bordered by Kinloch Place, Carlyle Crescent, Merrick Way, Arnisdale Road and Glengarry Hospital. The park covers an area of 6.46 ha and occurs on the Spearwood dune system. Half of Glengarry Park is covered by irrigated lawn, including an oval. Two playgrounds, a carpark, toilet block, tennis courts, and a drainage site positioned in the south-west corner, cover 11.5% of the park area. Eucalypt woodland, dominated by Jarrah and Marri, covers the rest of the park (38.5%) with a canopy height of 37 m. The understorey is generally Blackboy but around the drainage site *Melaleuca pentagona* dominates. No other introduced grass species, besides 'couch' grass occur in the park. Glengarry Park is 520 m from the nearest remnant bushland.

Figure 2.15: Blackmore Park, Girrawheen



OLD LARGE PARK

Figure 2.16: Celebration Park, Balga

Figure 2.17: Glengarry Park, Duncraig

Glengarry Park

CHAPTER 3

Censusing Birds in Australian Urban Parks - Testing Methodology

3.1 INTRODUCTION

As conspicuous, highly mobile and easy to count components of the environment, birds and bird communities have often been used as indicators of environmental change. Different procedures are used according to the objectives of the study, the habitat being surveyed, the time available, and the skill of the observer (Pyke and Recher 1984). A number of studies have focused on the appropriateness of censusing procedures in particular situations, their advantages and disadvantages (e.g., Anderson and Ohmart 1981; Edwards *et al.* 1981; Franzeb 1981; Svensson 1981; Arnold 1984; Pyke and Recher 1984; Recher 1984; Bell and Ferrier 1985; Recher 1988; DeGraaf *et al.* 1991).

Asynchronous breeding (prolonged nesting seasons), communal or co-operative nesting, vocal mimicry, and male/female song are ways in which Australian birds differ from those of north temperate zones (Recher 1984; 1988). These differences have rendered many standard procedures, developed and tested in north temperate zones, inappropriate in Australia. Mapping, for example, where the numbers of birds on the census plot are estimated from the number of nest sites found, is complicated by communal nesting in Australian birds because it cannot be assumed that there will be a pair of birds for each nest. Furthermore, many of the traditional survey methods (such as spot mapping) are unsatisfactory in urban areas owing to high levels of background noise (e.g., traffic), limited access and reduced visibility (DeGraaf, Geis and Healy 1991).

Most Australian urban bird censuses have used the fixed-width strip transect method along roads to count birds (e.g., Jones 1981, 1983; Stein 1982; Green 1984; Mason 1985; Munyenyembe *et al.* 1989). This method involves sampling birds by foot along a transect of known length. Each bird is counted within a pre-determined fixed distance from either side of the centre of the transect. The transect method was considered unsuitable for censusing highly heterogeneous park sites because it is unlikely that the full complement of microhabitats which exist in the parks would be sampled. Thus, a

method for counting birds in suburban recreational parks of the Perth metropolitan region was required.

This study proposes a new censusing procedure for highly heterogeneous habitats, which minimises the influence of the size of the habitat and the effort of the observer. The temporal area search, as it has been named, was compared with the more commonly used fixed-width strip transect method in the following pilot study (Gavareski 1976). This chapter reports the results of this comparison to determine the appropriateness of the temporal area search method for sampling birds in Australian suburban recreational parks.

3.2 METHODS

3.2.1 Site Selection

Three recreational parks, surrounded by suburban development, were selected from a road map in the City of Wanneroo, Perth (Department of Land Administration 1996). The City of Wanneroo was chosen due to the availability of population figures for the suburbs within it since 1969. These figures allowed an estimate of the age of the suburb, by noting the year with the largest increase in population, and subsequently the age of the parks within it. The area of each park was determined by overlaying 1 mm graph paper over park outlines (Department of Land Administration 1996, Scale: 1:30,000). Area, expressed in hectares, was calculated using the formula: $area = a + (b/2)$, where a is the number of full squares and b is the number of incomplete squares. Potential park sites were visited to get an idea of the type of vegetation on site. Parks were chosen to be of three different ages, sizes and vegetation types in an attempt to highlight any problems that may have been encountered later in the project.

3.2.2 Site Descriptions

Robin Park (382264E, 6477153N) was established in the 1960's (B. Ruscoe 1996, pers. comm). It is 5.3 ha and is dominated by a football oval and playground. About 20% of the site is covered by native vegetation.

Salata Park (383783E, 6477915N) is 2.6 ha and was established around 1970. A small playground and drainage area makes up the development on site. There is no oval, although unirrigated grass covers around 60% of the park. The other 40% retains natural vegetation.

Moolanda Park (386599E, 6480319N) was established around 1980 and is approximately 4.5 ha. Like Robin Park, a football oval and small playground dominate the park. About 7% of the park is covered by native bushland in poor condition.

3.2.3 Bird Sampling in Park Sites

Each survey was conducted between 0800 and 0930 under fine weather conditions. Temperature, percentage cloud cover and a rating of wind between 0 (no wind) and 4 (extremely windy) were recorded prior to sampling. The number of people and dogs seen during sampling were recorded. Each park was sampled four times, twice with each method between August 10 and September 2, 1996.

The fixed-width strip transect method involved starting in the most north-eastern corner of each park and slowly walking, in a south-west direction, across the site to the south-western corner. Each bird seen or heard within the park boundaries was identified and recorded, to a maximum of 25 m to each side of the transect. An effort was made to avoid counting individual birds more than once. For example, if a Western Magpie was seen and another heard calling, two were recorded and the position of the calling bird was noted so that it was not recorded again.

Transect lengths were 308 m in Robin Park, 254 m in Salata Park, and 253 m in Moolanda Park. The actual areas surveyed in each park, as a percentage of total area, were 29% of Robin Park, 49% of Salata Park, and 28% of Moolanda Park. While the majority of tree and shrub vegetation existed on the park boundaries, it was sometimes necessary to walk through patches of vegetation. This was especially true for Salata Park where small patches of vegetation covered the whole site.

The temporal area search method involved walking slowly around the site, consciously walking near those areas where it was assumed birds would be. Walking through patches of vegetation was avoided to reduce disturbing the vegetation. All birds seen or heard within the park boundaries were identified and recorded. In contrast to the transect method, the whole of the park area was censused. Salata Park and Robin Park were partially surrounded by asbestos fencing and birds seen perching on the fence were included in counts. Birds flying overhead, but not flying below the canopy level, were not recorded. An effort was made to avoid counting individual birds twice.

The method is similar to the 'area search method' of Loyn (1980), although the temporal area search takes the effort of the observer into account. Rather than a fixed time count, where efficiency is affected by the weather, the time of day and the detectability of the species at each site (Stein 1982), a cumulative frequency curve was used to determine sampling time (Figure 3.1). The number of birds was recorded at five minute intervals, with each five minutes treated as a separate count. The cumulative frequency of bird species richness was tallied every five minutes until an equilibrium level was reached. To determine an appropriate time to cease sampling, each census using this method during pilot testing was undertaken for 35 minutes. This maximum time period was determined during the first sampling period when a failure to record any new species indicated that the observer had recorded all species likely to be encountered in the park.

3.2.4 Analysis

As the two methods differed in sampling time and space, direct comparative analysis was limited. Measures of abundance were expressed differently, which added complications when comparing results. For the fixed-width strip transect method, bird abundance was expressed as the number of birds per hectare. For the temporal area search method, abundance was expressed as the total maximum number of individual birds, of each species, expected to be found during a five minute sampling period anywhere in the site. Relative abundance, where species are ranked against the most abundant species, was compared between sites and each method.

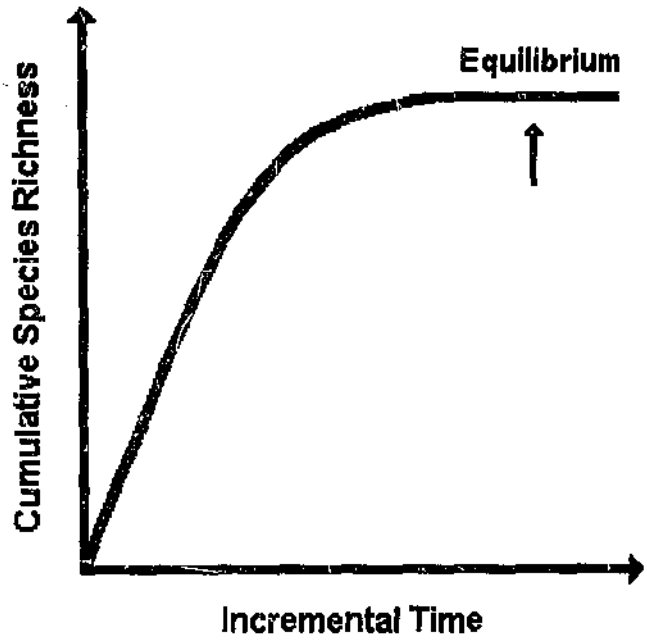


Figure 3.1: Cumulative Frequency Curve Used to Determine Sampling Time

3.3 RESULTS

3.3.1 General features

Seventeen species were recorded during the censuses. All species are considered common and are habitat generalists. Fifteen species were recorded in Robin Park, 14 in Salata Park and eight in Moolanda Park (Table 3.1). The Red Wattlebird, Ringnecked Parrot, Western Magpie and Singing Honeyeater dominated the avifauna of the three parks, using both procedures. Following Huhtalo and Järvinen (1977), a dominant species was defined as one which made up over 5% of the total bird population.

Sixteen species were recorded by both transect counts and temporal area search counts. The Black-faced Cuckoo Shrike was sampled once using the temporal area search method. The Magpie Lark was sampled during one transect count. There was no difference in the number of species recorded by the two procedures in either Salata Park or Moolanda Park. The temporal area search sampled three more species in Robin Park than were sampled by transect. Robin Park had higher species richness and more dominant species than the other parks. The temporal area search method consistently resulted in more dominant species than the transect method.

Table 3.1: Dominance of avifauna in three suburban parks, expressed as a percentage of the total bird population.

	Robin Park		*Salata Park*		*Moolanda Park*	
Species Name	TAS	Transect	TAS	Transect	TAS	Transect
Australian Raven	**5**	<5	**5**	<5	0	0
Black-faced Cuckoo Shrike	0	0	<5	0	0	0
Brown Honeyeater	<5	0	<5	<5	**16**	**25**
Feral Pigeon	<5	0	<5	<5	0	0
Galah	<5	<5	**12**	<5	<5	<5
Kookaburra	<5	<5	0	0	0	0
Magpie	**8**	**10**	**15**	**14**	**18**	**16**
Magpie Lark	0	0	0	<5	0	0
New Holland Honeyeater	**10**	**7**	<5	<5	0	0
Ringnecked Parrot	**9**	**16**	**20**	**20**	**12**	**16**
Rainbow Lorikeet	**10**	**6**	<5	<5	0	0
Red Wattlebird	**15**	**22**	**19**	**22**	**19**	**21**
Senegal Dove	**12**	**9**	**7**	**8**	**12**	<5
Silvereye	<5	0	<5	**6**	**7**	<5
Singing Honeyeater	**12**	**14**	**8**	**11**	**12**	**12**
Welcome Swallow	**8**	**9**	0	0	0	0
Willie Wagtail	<5	<5	0	0	0	0
Species Richness	15	12	13	13	8	8
# Dominant Species	9	8	7	6	7	5

NB: Figures in bold represent the dominant species using each method at each site.

3.3.2 Comparing Relative Abundance

In 86% of cases, the relative abundances of each species recorded by the temporal area search method were greater than, or equal to, the transect results (Table 3.2). Most instances where a higher relative abundance of species was measured during transect counts occurred in Salata Park. Of the dominant species, the Western Magpie had a higher abundance when sampled with the temporal area search method. The Western Magpie had its highest abundance in Moolanda Park. The Red Wattlebird and Singing

Honeyeater were most abundant in Robin Park, and the Ringnecked Parrot was most abundant in Salata Park.

Table 3.2: The relative abundance of bird species in comparison to the most abundant bird in each count (1.00).

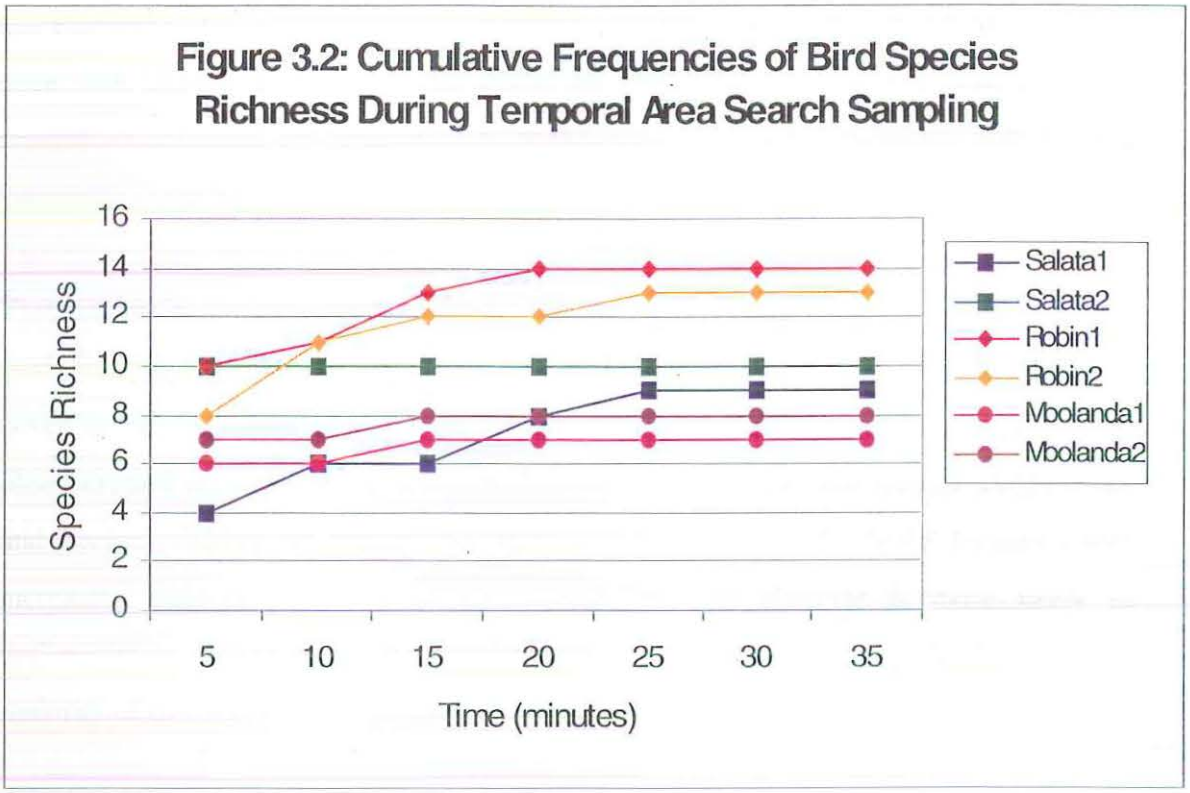
	Robin Park		*Salata Park*		*Moolanda Park*	
Species Name	**TAS**	**Transect**	**TAS**	**Transect**	**TAS**	**Transect**
Australian Raven	0.33	0.11	0.28	0.21	0.00	0.00
Black-faced Cuckoo Shrike	0.00	0.00	0.06	0.00	0.00	0.00
Brown Honeyeater	0.14	0.00	0.06	*0.16	0.82	*1.00
Feral Pigeon	0.10	0.00	0.11	0.05	0.00	0.00
Galah	0.24	0.07	0.61	0.05	0.18	0.12
Kookaburra	0.10	0.07	0.00	0.00	0.00	0.00
Magpie	0.52	0.46	0.78	0.63	0.91	0.64
Magpie Lark	0.00	0.00	0.00	*0.16	0.00	0.00
New Holland Honeyeater	0.67	0.32	0.11	0.10	0.00	0.00
Ringnecked Parrot	0.62	*0.71	1.00	0.95	0.64	0.64
Rainbow Lorikeet	0.67	0.29	0.22	0.16	0.00	0.00
Red Wattlebird	1.00	1.00	0.94	*1.00	1.00	0.82
Senegal Dove	0.76	0.39	0.33	*0.37	0.64	0.18
Silvereye	0.10	0.00	0.17	0.26	0.36	0.12
Singing Honeyeater	0.76	0.64	0.39	*0.42	0.64	0.47
Welcome Swallow	0.52	0.43	0.00	0.00	0.00	0.00
Willie Wagtail	0.05	0.04	0.00	0.00	0.00	0.00

NB: Figures marked with an asterisk highlight instances were the Strip Transect method has revealed higher relative abundances than the Temporal Area Search method.

3.3.3 The Cumulative Frequency Curve

The cumulative frequency curves of bird species richness for each temporal area search count were plotted against time to determine an appropriate time to cease sampling (Figure 3.2) during bird counts discussed in Chapter 4. The results show that bird species richness reaches equilibrium when one species is added in a fifteen minute

period. That is, when the cumulative frequency does not change over three five minute counts species richness will be at its maximum.



3.4 DISCUSSION

The pilot study determined that, using the temporal area search method, the equilibrium of species richness is reached when only one bird species is added in a fifteen minute period. After this point it is unlikely that the observer will encounter any additional species. This then became the cut off point to stop sampling during the bird counts discussed in Chapter 4.

Robin Park is larger than the other two parks, which accounts for the higher species richness using the temporal area search method in Robin Park. Fewer species are likely to be encountered using a transect through the middle of a park as park size increases, because a lesser portion of the park is sampled. While the transect length may increase, the width cannot extend beyond the observers ability to see and hear birds. The temporal area search method, on the other hand, may be adapted to sample a fixed percentage of the park, up to the whole.

The higher relative abundance for most species sampled using the temporal area search method suggests either that the temporal area search method overestimates the abundance or that the transect method underestimates it. The latter is more likely. Pyke and Recher (1984) point out that it is difficult to avoid counting the same bird more than once with increasing time spent observing an area. Each five minutes is treated as a separate count using the temporal area search method, which reduces the potential for inaccurate counting.

Transect methods underestimate density because they violate some of the assumptions made in applying such techniques: (a) that birds directly on or near the centre-line will never be missed, (b) that there is no movement of birds in response to that of the observer, and (c) that no bird is counted more than once (Bell and Ferrier 1985). Pyke and Recher (1984) point out that the number of birds likely to be heard decreases with increasing distance from the observer. Therefore, an observer is more likely to underestimate numbers by walking through the middle of urban parks because the majority of tree and shrub vegetation exists on the boundaries.

Patches of vegetation in Salata Park were not mainly restricted to the border as in the other two which explains why instances where relative abundance was higher using transect counts were largely confined to Salata Park. To transect this park it was necessary to actually walk through patches of vegetation. During temporal area search sampling this was avoided to reduce disturbing the vegetation.

The birds that had higher relative abundances using the transect method were mostly dominant species. Being surrounded by dense vegetation during transect counts would limit the ability to keep track of individual birds, especially the dominant ones. Thus, the same bird may have been counted more than once. As Gavareski (1976) points out, while some of the error of counting birds more than once can be corrected by applying various indices of conspicuousness, the process is time consuming and introduces other potential errors. The reduced sampling time used in the temporal area search method largely overcomes this problem, as it is easier to keep track of birds in five minute periods.

Another source of error using the transect method is inherent in the shape of the study area. Cutting diagonally through the middle of urban parks, which tend to be rectangular in shape, causes problems for the observer in determining which birds are actually inside the study area (Gavareski 1976). The transect method is more suitable for the linear shape of streets. The temporal area search method would not be appropriate for street sampling due to limited visibility and access.

The pilot study showed the temporal area search to be a feasible alternative sampling method to the strip transect method when sampling suburban parks. The temporal area search has a number of advantages over the strip transect method, including allowing the observer to cover a larger proportion of the site and sample a greater habitat diversity. There is also less chance of error when counting in five minute intervals than the more lengthy sampling periods encountered during strip transects.

CHAPTER 4

The Avifauna of Perth's Northern Suburban Parks and Factors Influencing Their Distribution

4.1 INTRODUCTION

The literature has highlighted four main avenues of study concerning the effects of key factors on bird communities in urban habitats. These are suburb age, size of study area (specific to park sites), distance to a sizeable remnant bushland, and habitat components.

Studies in Australia, Poland and California have shown that an increase in suburb age is associated with a steady linear increase in the number of individual birds, species richness, biomass and population density. There tends to be a peak in numbers between 10 and 30 years following initial development, which are comparable, or up to three times greater, than pre-development sites. This peak is followed by a slight tendency for increase (Vale and Vale 1976; Jones 1981, 1983; Stein 1982; Mason 1985; Mackin-Rogalska *et al.* 1988; Munyenyembe *et al.* 1989).

Australian studies have highlighted that older suburbs tend to have a higher percentage of exotic species, particularly the House Sparrow (Jones 1981; Mason 1985). For example, Jones (1981) found that 73.5% of all birds in the oldest site sampled in Wagga Wagga, New South Wales were exotic, compared to between 25.4-31.9% in undeveloped sites. Authors have noticed changes in species composition as suburb age increases. Ground feeding species, such as House Sparrows, Australian Magpies and Magpie Larks, are among the first birds to use the extensive, open lawn areas characteristic of new suburbs (Jones 1981; Stein 1982; Mason 1985). The older suburbs for example in Wagga Wagga, are characterised by ornamental trees, small lawns and few native plants. These conditions are unfavourable for important native species such as Australian Magpies, Currawongs and Honeyeaters (Jones 1981).

Only three studies have investigated the influence of park size on urban bird populations, Gavareski (1976) in Seattle, Washington, Suhonen and Jokimäki (1988) in Finland and Honza (1992) in Czechoslovakia. A decrease in urban park size was characterised by lower bird species richness, species diversity, population density and number of nesting species (Gavareski 1976; Suhonen and Jokimäki 1988; Honza 1992). Gavareski (1976) showed that small parks (4 ha) had an increasingly large proportion of typical urban species, such as the House Sparrow, Rock Dove, American Robin, Common Crow, Barn Swallow, and Common Starling. Large forested parks (40 ha) had a high diversity of native forest species, comparable to natural forested areas.

Reduced species richness, as a result of increasing distance of suburbs from areas of remnant bushland, has been reported by a number of authors in Arizona, Massachusetts, Melbourne and Canberra (Emlen 1974; DeGraaf 1978; Green 1986; Munyenyembe *et al.* 1989). In contrast, Catterall *et al.* (1989) reported no significant differences in bird populations in Brisbane, Queensland with increasing distance from remnant bushland. Stein (1982) showed that, in Canberra, the relationship between species richness and isolation depended on the type of source bushland. She found that, while increasing distance from suburbs to remnant open-forest reduced species richness and diversity, the relationship was not significant when the source areas were woodland or tall open-forest.

North American studies have shown that the abundance of native species is correlated to vegetation density and introduced species abundance is related to the degree of urbanisation (Lancaster and Rees 1979; Kot 1988; Mackin-Rogalska *et al.* 1988). A number of Australian studies have also identified a positive correlation between exotic bird measurements and the area covered by paved or developed surfaces (Stein 1982; Green 1984; Munyenyembe *et al.* 1989).

Stein (1982) identified the total percentage cover by vegetation and percentage cover of native vegetation to be the best predictors of bird species richness and diversity in Canberra. As these vegetation covers increased, the proportion of introduced species decreased and the number of granivores increased. These findings were supported by Green (1984, 1986) who demonstrated that, in Melbourne, the diversity of exotic birds was correlated with the total cover of exotic plants, while there was little influence on

native birds or total numbers of exotics. In contrast, Gavareski (1976) found fewer total bird species in parks with a high percentage of exotic vegetation in Seattle, Washington.

A number of factors influence birds in urban areas. These include human population density, food availability, local introductions, disease, climate and seasonal influences, predation by introduced and native vertebrates, fire history, the presence of wetland habitat, pre-development birdlife and vegetation, and the capacity of birds to adapt to new habitats. This study concerns itself with the effects of park age, size, isolation and vegetation on urban avifauna.

This chapter investigates the bird communities inhabiting Perth's suburban parks and determines whether park age, size, distance to remnant bushland or different habitat components influence the bird communities of Perth's suburban recreational parks.

4.2 METHODS

4.2.1 Bird Sampling in Park Sites

Birds were counted three times at each of the 16 park sites described in Chapter 2. Censuses were performed between 0600 and 0800 hours, between 22nd October and 8th December 1996 (Spring/early Summer) to avoid the influence of seasonal variation. The census procedure used was the temporal area search method described in Chapter 2. In addition to the methods used during pilot testing, ten minutes was spent at the start of each count making a brief inventory of the birds present and familiarising myself with their calls. This served to increase efficiency and the representativeness of the results. Weather conditions including temperature, an estimate of percentage cloud cover, and a rating of wind between 0 (no wind) and 4 (extremely windy) were recorded, and the number of people and dogs seen during a half hour period was recorded.

Sampling consistently began at the most northern boundary of each park and was conducted in a clockwise manner. If species were still being found by the time the park boundary had been covered then I walked diagonally across the park, then resumed walking in a clockwise direction until no new species were discovered in a fifteen minute period.

4.2.2 Analysis

Bird species were placed into feeding and foraging guilds after H. Recher (Edith Cowan University, pers. comm., February 24, 1997). 'Introduced' species were defined as those species which have been introduced to or colonised Perth following European settlement, after Serventy and Whittell (1976). Dominant bird species were defined following Huhtalo and Järvinen (1977) as one which makes up over 5% of the total bird population, to allow comparability with similar studies. Shannon-Weaver's Diversity Index and Pileou's Evenness Index were calculated for each site after Fowler and Cohen (1994).

The Statistical Package for Social Sciences (SPSS) for Windows was used for calculations. Two-way analysis of variance (ANOVA, expressed as an F value) were used to test the independent and interactive effects of the age and size of suburban parks on bird community indices, such as species richness and diversity (H'). Pearson's correlation co-efficient (r) was calculated to test the significance of various environmental variables against bird community indices. In cases where the variables were expressed as a percentage, the values underwent arcsine transformation before further statistical investigation. The Chi-square test was used to highlight the significant differences between the frequency of birds in each feeding and foraging group.

The PATN pattern analysis software package was used to perform UPGMA (Unweighted pair group arithmetic averaging) classification and SSH-MDS (Semi-strong hybrid multi-dimensional scaling) ordination on the bird and environmental data. Log_{10} transformation and standardisation by range were undertaken beforehand on all bird data. The Bray and Curtis (or Czekanowski) association was considered suitable for bird abundance and presence/absence data, while the Gower metric association was used on the environmental data (Belbin 1994). To determine an appropriate number of dimensions for ordination, I started with two dimensions and kept increasing the number until a stress level of less than 0.2 was reached, as recommended by Belbin (1994).

4.3 RESULTS

4.3.1 Ecological features

A total of 30 bird species were recorded in the 16 parks. Four of these, Pacific Black Duck, Pied Cormorant, Sacred Ibis and Wood Duck, are waterbirds and were excluded from the study. Of the 26 terrestrial birds, five are introduced species (Table 4.1). Introduced species made up 19% of the total maximum bird population. Only three species were found in all park sites; the Australian Raven, Senegal Turtle-dove and Singing Honeyeater. Fourteen species were found in more than half of the sites.

Seven species (Red Wattlebird, Senegal Turtle-dove, Singing Honeyeater, Western Magpie, Galah, Welcome Swallow and Australian Raven) dominated the avifauna of Perth's northern suburban parks, making up a total of 71% of the total maximum population. When a dominant species was defined as a species which made up over 10% of the total abundance, then four species dominated the avifauna (Red Wattlebird, Senegal Turtle-dove, Singing Honeyeater and Western Magpie).

The majority of the avifauna sampled were native nectarivores, comprising 34.1% of the total avifauna (Figure 4.1). There were a large number of insectivores and granivores (29.7% and 22.8%, respectively) and few herbivores, omnivores and carnivores. Most of the introduced birds were granivores. The majority of the urban birds foraged in trees and on the ground (Figure 4.2). While most native birds foraged in trees (42.9%), the majority of introduced birds were ground foragers (15.3%). There were few aerial feeders (7.6%). All species sampled nested in trees, shrubs or artificial structures. No species were ground-nesters.

Bird measures from ten urban bird studies are presented (Table 4.2). The bottom six records are from Australia, the rest overseas. Obviously there are a variety of factors influencing these results. The cold climate of England and Finland, for example, seems to have resulted in lower bird density, while Poland seems a unique case. To provide another example, Stein (1982) and Lenz (1990) both studied the avifauna of Canberra. However, Stein (1982) recorded data from 36 plots compared to the 3 areas studied by Lenz (1990) which seems to have affected the number of species. Nevertheless, there are comparisons that can be made.

Table 4.1: Bird species list, their feeding and foraging habits by presence and absence in the park sites.

			New Small				New Large				Old Small				Old Large			
Bird Species	**Foraging Class**	**Feeding Class**	**CAB**	**HAD**	**OTT**	**STR**	**HIL**	**JOH**	**KIN**	**SEA**	**AVO**	**BEE**	**BEL**	**SAL**	**ARB**	**BLA**	**CEL**	**GLE**
Australian Hobby	Ground/Tree/Aerial	Carnivore												X				
Australian Raven	Ground/Tree	Omnivore	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-faced Cuckoo-shrike	Tree	Insectivore						X	X			X	X		X	X		X
Brown Honeyeater	Tree	Nectarivore	X	X		X	X	X	X		X	X	X	X	X	X	X	X
Common Bronzewing	Ground	Graminivore								X								
Domestic Pigeon(I)	Ground	Graminivore				X	X					X		X				
Galah	Ground	Graminivore/Herbivore	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Grey Butcherbird	Ground/Tree	Insectivore/Carnivore		X				X	X		X	X			X	X	X	X
Laughing Kookaburra(I)	Ground/Tree	Insectivore/Carnivore													X	X		
Magpie Lark	Ground	Insectivore			X			X	X	X	X	X	X	X	X		X	X
Nankeen Kestrel	Ground	Insectivore											X					
New Holland Honeyeater	Tree	Nectarivore				X								X	X			X
Rainbow Bee-eater	Aerial/Ground	Insectivore						X										X
Rainbow Lorikeet(I)	Tree	Nectarivore	X					X	X	X		X		X	X	X	X	X
Red Wattlebird	Tree	Nectarivore	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
Ring-necked Parrot	Ground/Tree	Graminivore/Herbivore	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
Senegal Turtle-dove(I)	Ground	Graminivore	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Singing Honeyeater	Tree	Nectarivore/Insectivore	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Spotted Turtle-dove(I)	Ground	Graminivore				X						X		X	X			
Striated Pardalote	Tree	Insectivore	X	X	X		X	X	X			X	X	X	X	X	X	X
Tree Martin	Aerial	Insectivore			X													
Welcome Swallow	Aerial	Insectivore			X	X	X	X	X	X	X	X	X			X		X
Western Magpie	Ground	Insectivore	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
White-cheeked Honeyeater	Tree	Nectarivore						X										
White-tailed Black Cockatoo	Tree	Graminivore													X			
Willie Wagtail	Ground	Insectivore			X	X			X		X	X	X	X	X			X

X indicates presence of the species
I indicates introduced species

Figure 4.1: Avian feeding guilds in Perth's suburban recreational parks

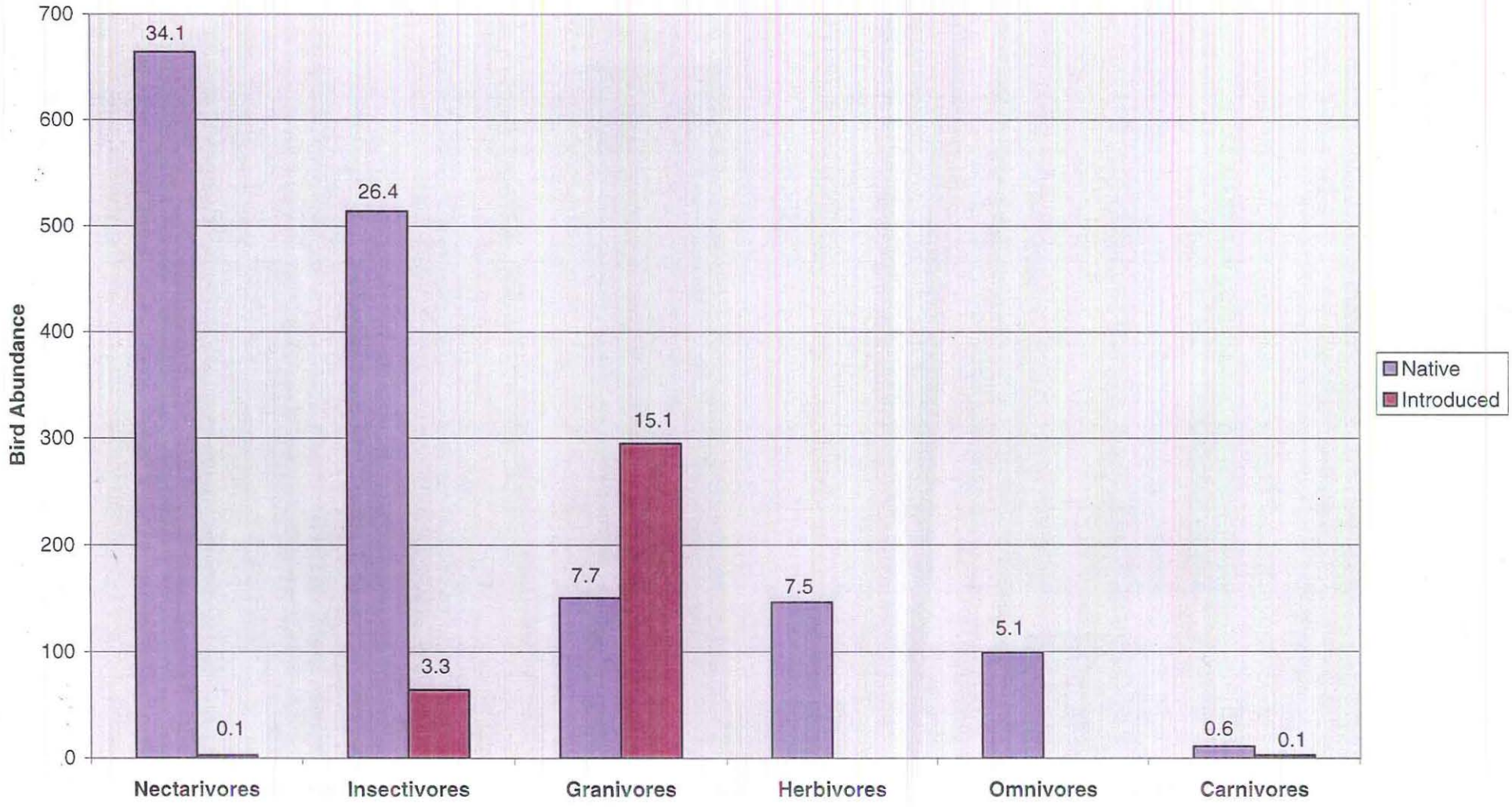


Figure 4.2: Avian foraging guilds in Perth's suburban recreational parks

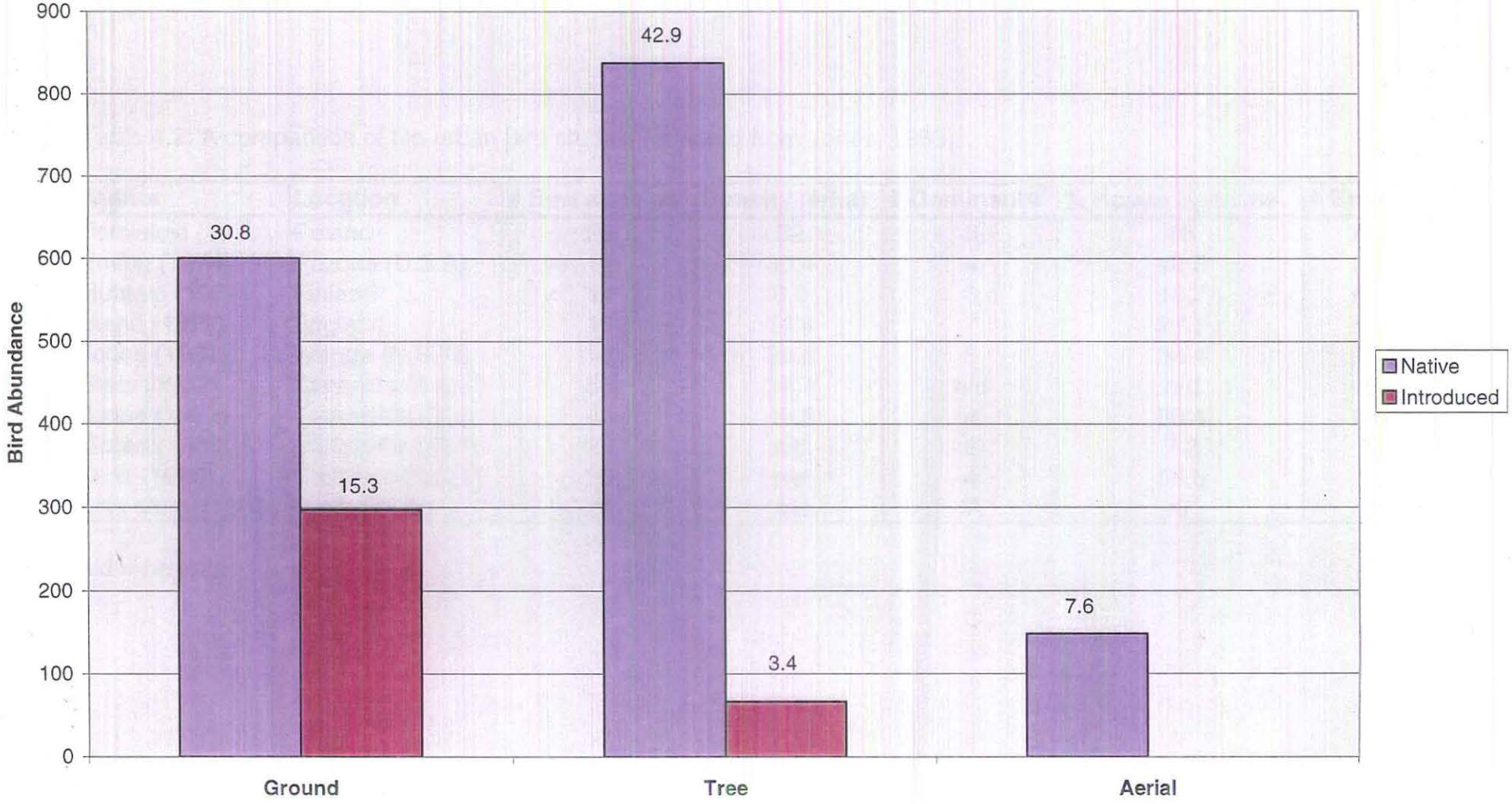


Table 4.2: A comparison of ten urban bird studies (adapted from Jones, 1983).

Author	Location	# Bird species	Density (#/ha)	# Dominants	% House Sparrow	# Exotics
Tomialojc (1970)	Poland	26	32	3	65	n/d
Emlen (1974)	Arizona (U.S.A)	14	30.4	4	42.2	n/d
Huhtalo (1977)	Finland	14	6.6	8	18.7	n/d
Bland (1979)	England	15	14.4	7	27.3	n/d
Jones (1981)	Wagga (N.S.W)	18	30.6	5	36.4	5
Stein (1982)	Canberra (A.C.T)	53	34.7	n/d	n/d	5
Jones (1983)	Townsville (Qld)	45	45.8	4	36.4	n/d
Green (1986)	Melbourne (VIC)	22	n/d	8	7.3	5
Lenz (1990)	Canberra (A.C.T)	26	n/d	4	56.3	5
This study (1996)	Perth (W.A)	26	n/d	7	0	5

n/d = no data

The number of bird species is typically higher in Australian urban centres than those of other regions and Australian urban centres consistently have around five introduced species. One introduced species that is lacking from Perth is the House Sparrow. In other urban areas, where the House Sparrow is lower in numbers, more species are seen to dominate the avifauna.

4.3.2 Factors affecting the distribution of birds

Park Age

Species richness was significantly higher in older parks than newer parks ($F=11.12$, $p<0.01$). However, there were no significant effects of age on bird abundance, the number of species per hectare, species diversity or evenness of species. The number of dominant species, at 10% of total abundance, was significantly lower in older parks than newer parks ($F=6.94$, $p<0.05$). This trend was not evident in dominant species at 5% of total abundance.

There was no significant difference in the ratio of native to introduced birds in old and new parks ($p>0.05$). There was a significant difference in the composition of avian feeding guilds between old and new parks ($\chi^2=23.4$, $p<0.01$) (Figure 4.3). Older parks had fewer insectivores and granivores, and more nectarivores. The number of carnivores, herbivores and omnivores were similar between old and new parks. The composition of foraging guilds between old and new parks were significantly different ($\chi^2=53.7$, $p<0.01$) (Figure 4.4). Older parks had more tree foragers and fewer aerial foragers than newer parks.

Park Size

The composition of avian foraging guilds was significantly different in small and large parks ($\chi^2=31$, $p<0.01$) (Figure 4.4). Larger parks had more aerial foragers, while smaller parks had more ground and tree foragers. The composition of avian feeding groups was not significantly different between small and large parks ($p>0.05$).

Figure 4.3: Avian feeding guilds in old and new suburban recreational parks

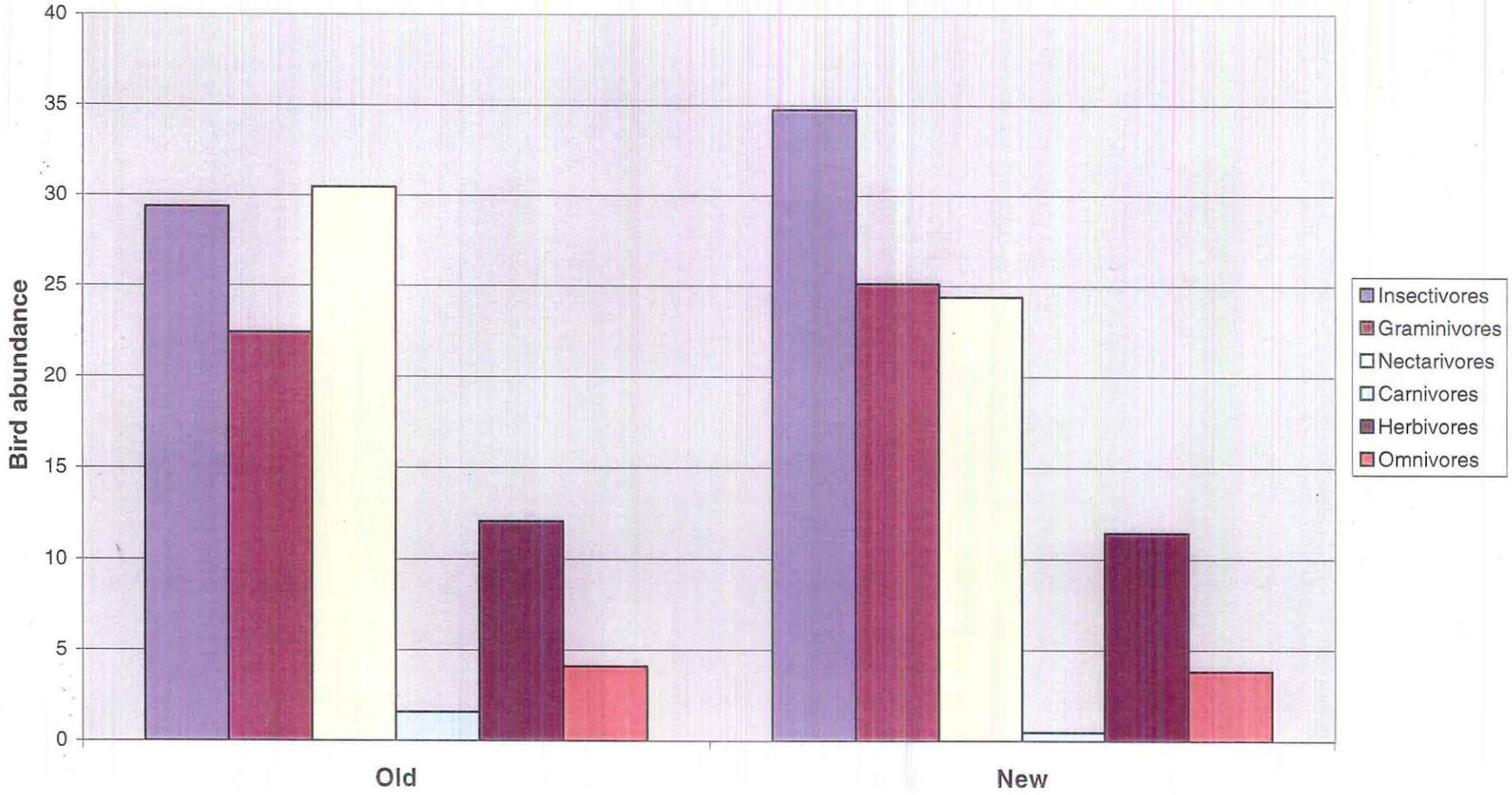
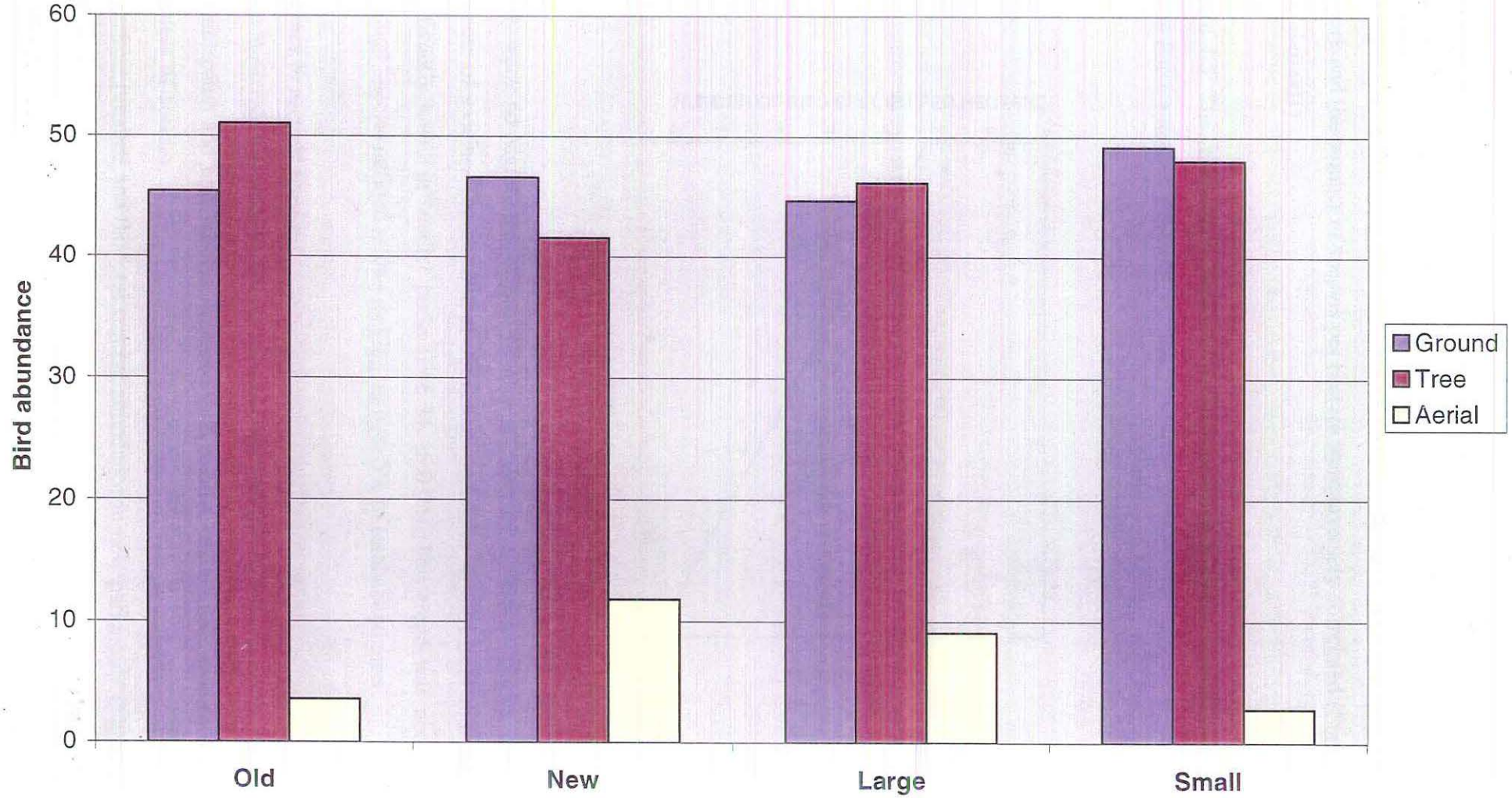
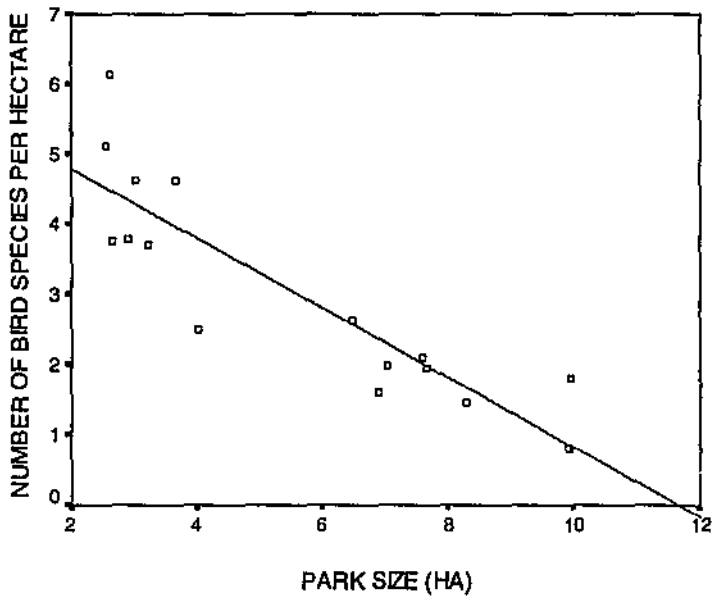


Figure 4.4: Foraging groups in suburban recreational parks



Total relative bird abundance was significantly higher in larger parks than smaller parks ($F=11.92$, $p<0.001$). As a gradient, however, the size of the park was not significantly correlated with the total relative abundance of birds. The number of species per hectare was significantly higher in smaller parks ($F=36.87$, $p<0.001$). As a gradient, the size of the park and the number of species per hectare were inversely correlated (Figure 4.5, $r=-0.88$, $p<0.001$).

Figure 4.5: The relationship between the number of bird species per hectare and park size in Perth's northern suburbs.

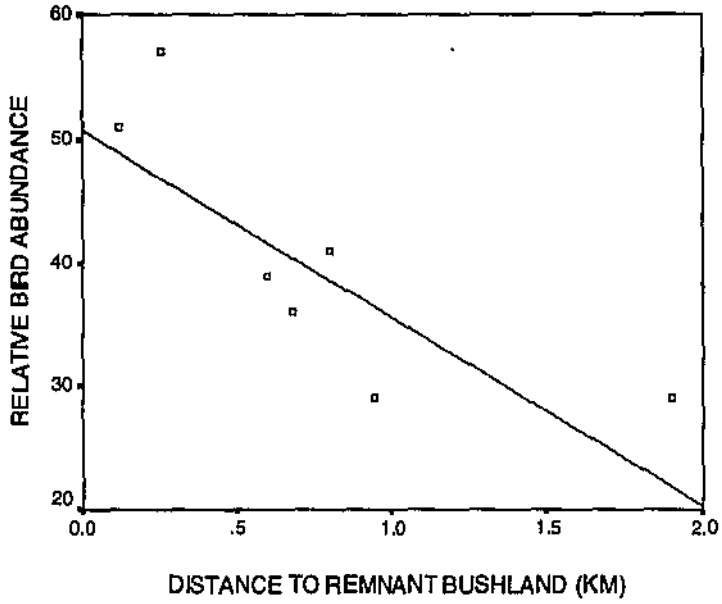


There were no significant effects of size on species richness, species diversity or evenness of species. The number of dominant species, at 10% of total abundance, was significantly lower in smaller parks ($F=6.94$, $p<0.05$). This trend was not evident in dominant species defined as one making up over 5% of total abundance.

Distance to nearest remnant

There were no significant effects between the distance of the parks to the nearest remnant patch and bird species richness, total relative abundance, species diversity or evenness of species. A significant inverse relationship was found between distance to the nearest remnant and the total relative abundance in new parks only (Figure 4.6, $r=-0.78$, $p<0.05$). That is, as the distance to remnant vegetation increased, bird abundance decreased in new parks.

Figure 4.6: The relationship between relative bird abundance and the distance to the nearest remnant bushland in 'new' parks of Perth's northern suburbs.



Habitat Components

All habitat measures, outlined in Chapter 2, were compared with bird measures (species richness, relative abundance, species diversity and evenness of species). No bird measure was significantly correlated with any of the vegetation cover categories. The total relative abundance of birds, however, increases in a linear fashion with an increase in the percentage cover of development in a park ($r=0.59$, $p<0.05$). This relationship was significant for native birds only ($r=0.6$, $p<0.05$) (Figure 4.7).

The average uppermost canopy height was significantly correlated with bird species richness ($r=0.57$, $p<0.05$), evenness of species ($r=0.55$, $p<0.05$) and species diversity (Figure 4.8, $r=0.65$, $p<0.01$). Introduced species were not significantly affected by increasing canopy heights, while native species richness ($r=0.62$, $p<0.05$) and native relative abundance ($r=0.53$, $p<0.05$) were significantly higher.

Classification and Ordination

A number of sites were separated by classification using the PATN pattern analysis software package, including Ottawa Park, Seacrest Park and Avocado/Bangalay Reserve (Table 4.3). Belrose, Haddington, Hillarys and Strutt Way Parks were also grouped apart. No identifiable patterns emerged during ordination, when environmental

data collected at each site was compared with species abundance and presence/absence data.

Figure 4.7: The relationship between the relative abundance of native birds and the percentage cover of development in Perth's northern suburban recreational parks.

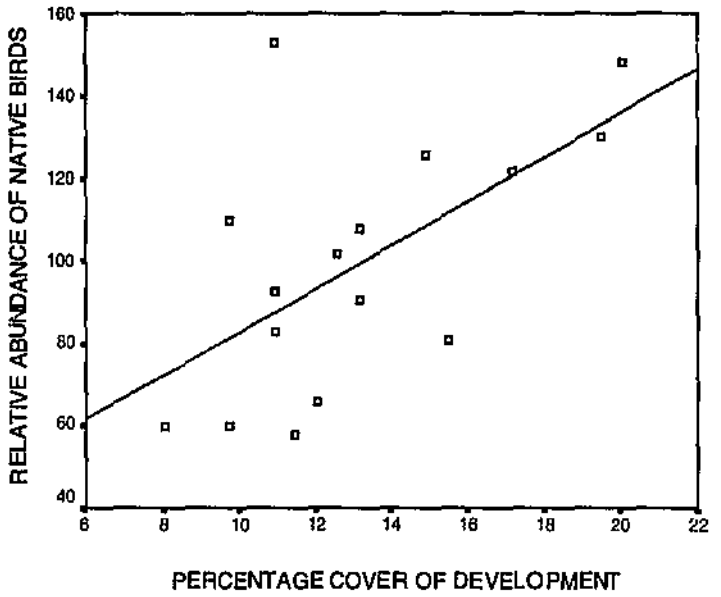


Figure 4.8: The relationship between the upper canopy height and bird species diversity in Perth's northern suburban recreational parks.

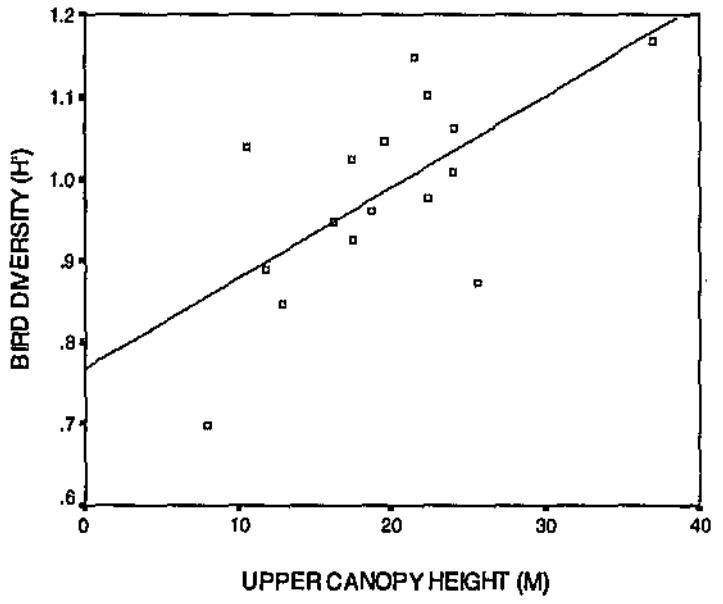


Table 4.3: PATN two-way classification of sites, based on bird abundance data.

```
          ASGMRRBMLSBWSSBBPNSK|W|W|B|NMA
          ueaaiWraotuiiwCeiHpo|C|B|r|aau
          snlgnaHgrPtlnauegHoo|H|C|o|nrs
          ReapgtoLiaBlglcEeotk|o|o|n|KtH
          aghintnakriihlkaonDa|n|c|z|eio
          va eeleredreoootneo |e|k|w|snb
          el  ceyke d nwoe yv |y|y|i|t b
          n   k   t      r    | | |n|  y
                              | | | |
ARB1      * ****** * ** *    *| | | |
KIN2      *******  * ****     | | | |
SAL3      ******** * **    *  | | | |  *
ARB2      ********* *** *  **  | |*| |
ARB3      ********  **      **| | | |
KIN3      ****** *  ****      | | | |
BEE1      ***************   * | | | |
KIN1      ******  **** *      | | | |
CEL1      ****** ** *         | | | |
CEL2      *********** *       | | | |
CEL3      ****** **** *       | | | |
BLA2      ** **** **  **      | | | |
CAB2      ******* **  *       | | | |
SAL2      **********  *     * | | | |
SAL1      ********** **   *   | | | |
BLA3      ******  **  *       | | | |
CAB3      ******  **  *       | | | |
CAB1      * ****  **  *       | | | |
GLE1       ************* *    | | | |
GLE2      ** ******* *****    | | | |
GLE3      ********** ***** *  | | | |
JOH1      ** *******  *  *    | | | |
JOH2      **** *** *  ****    | | | |
JOH3      ****** **** ****    |*| | |
BEE2      ******  *  ***  * * | | | |
BEE3      ** *** *** **** *   | | | |
          --------------------+-+-+-+---
BEL1      *** **** *  * *     | | | |
BEL3      ***  **     ***     | | | |
BLA1      ******* * * * *    *| | | |
HAD1      ******    * *       | | | |
HAD3      *** ***  ** *       | | | |
HAD2      ******      *       | | | |
HIL1      *******  *  **      | | | |
HIL2      ******   *  **  *   | | | |
HIL3      ** ***   *  **      | | | |
STR3      ** ****     **  *   | | | |
STR2      ** * *      *    *  | | | |
          --------------------+-+-+-+---
AVO1      *  * **   *         | | | |
AVO2      ** *****  * *       | | | |
AVO3       * * **   ****      | | | |
STR1       ******    ***   ** | | | |
          --------------------+-+-+-+---
BEL2      ****  ** * ***      | | | |*
SEA1      **     **   **      | | |*|
SEA2      **     *    **      | | | |
SEA3       **    *    **      | | | |
          --------------------+-+-+-+---
OTT1      ****** *     *      | | | | *
OTT2      *  * * *   ***      | | | | *
OTT3       ****  * * ***      | | | | *
```

4.4 DISCUSSION

4.4.1 Ecological features of Perth's northern suburban park avifauna

Twenty-six bird species were recorded in the parks surveyed in Perth's northern suburbs. Of these, there were seven dominant species which accounted for 71% of the total avifauna. Five of the 26 species were introduced the Perth region; two species from eastern Australia, one from south-east Asia, one from Africa and one from Europe.

Forty terrestrial bird species, including four exotics, were recorded in Kings Park between 1986 and 1995 (Recher, in press). Eighteen of the Kings Park species were not sampled during this study. These tended to be small, habitat specific birds such as the Western Spinebill and Yellow-rumped Thornbill. In bushland remnants of Perth, 32 terrestrial bird species were found in 1988, none of which was introduced (Majors 1988, unpub.). Seventeen of these species were not recorded in this study and five of them were not recorded in Kings Park. Again these species tended to be small, habitat specific birds, such as the Splendid Wren and Scarlet Robin. 176 species are, or have been, residents or regular visitors to the Perth metropolitan region, 123 of which are terrestrial birds (How and Dell 1993). These records show that the avifauna of Perth's northern suburban parks is only a sample of the pool of species available.

Nine other surveys of urban birds from Australia, North America and Europe (Tomialojc 1970; Emlen 1974; Huhtalo and Järvinen 1977; Bland 1979; Jones 1981; Stein 1982; Jones 1983; Green 1986; Lenz 1990) have been reported. Although these studies sampled different avifaunas in different environments, some comparisons were possible. The number of species recorded in Perth is similar to the species richness documented in the other studies. However, Australia seems to have more urban species, on average, than North America and Europe. This may be due to Australia's urban centres being historically recent or it may be an expression of climatic differences.

Five exotic species were consistently recorded in all Australian studies, although no data was available for Jones (1983). The species were different in each location; Wagga Wagga (Jones 1981), Canberra (Stein 1982; Lenz 1990), and Melbourne (Green 1986). The Common Starling, Blackbird, and House Sparrow were common to all locations, except Perth. The Common Starling was eradicated by a destruction programme in Western Australia in the 1970s (Serventy and Whittell 1976) and has failed to re-establish in Perth. The Blackbird is generally associated with moist vegetation, which may account for its absence in the drier climate of Perth (H. Recher, Edith Cowan University, pers. comm., July 5, 1997).

Jones (1983) reported that the House Sparrow occupies over two thirds of the land surface of the earth and has become the dominant species in many urban areas around the globe. So why has the House Sparrow not established itself in Perth? Serventy and Whittell (1976) documented an invasion during 1917, which died out during the summer of 1918-1919. There have been no further invasions of this kind, although the odd pair have appeared and subsequently been shot.

In regions where the House Sparrow is low in numbers (Finland, England, Melbourne and Perth), the number of species dominating the urban avifauna is larger than in areas where the House Sparrow is high in numbers. This suggests that Perth's avifauna will decline in species richness and diversity if the House Sparrow were to successfully invade.

Another limiting factor, besides a dry climate, to the invasion of the House Sparrow in Perth, may be the well-established presence of the Senegal Turtle-dove and Spotted Turtle-dove. All three species occupy similar feeding niches by feeding on small seed. The presence of the House Sparrow in high numbers in the studies of eastern Australia, may be largely responsible for the absence of the two Turtle-doves. In support of this theory is the presence of Spotted Turtle-doves in Melbourne, where the House Sparrow is low in abundance.

Perth has a higher number of species dominating the avifauna in comparison to most other cities. This is similar to the findings of Green (1986) in Melbourne. Studies around the world have consistently remarked that only a few species dominate urban areas, generally three to five species, making up 63-95% of all individuals (Huhtalo and Järvinen 1977; Erskine 1980; Jones 1981, 1983; Beissinger and Osborne 1982; DeGraaf 1987; Lenz 1990). This study found seven species dominating, comprising 71% of all individuals. Studies have also noted that the dominant species tend to be exotic (Emlen 1974; DeGraaf 1978; Erskine 1980; Jones 1981, 1983; Green 1984). The tendency for exotics to persist in large numbers may account, in part, for the relatively high number of dominants found in Perth as only one of the dominant species was introduced.

In agreement with other authors, many of the bird species of Perth are ground foragers (DeGraaf 1978; Lancaster and Rees 1979; DeGraaf and Wentworth 1981; Beissinger and Osborne 1982; Jones 1983; Green 1984; DeGraaf and Wentworth 1986; DeGraaf 1987). In Perth, however, just as many birds forage in trees as on the ground. Species that forage on lawns in urban areas have advantages over other foraging groups because they are assured of repeatedly finding suitable foraging sites (Beissinger and Osborne 1982). The majority of introduced species are ground foragers. The tree-foragers are generally natives. They are able to persist in Perth given the relatively high cover of native trees, as most native species rely heavily on native trees for food and habitat (Green 1984, 1986).

Studies around the world have highlighted the high proportion of introduced omnivores and granivores and the lack of insectivorous birds in urban areas (DeGraaf 1978; Lancaster and Rees 1979; DeGraaf and Wentworth 1981; Beissinger and Osborne 1982; Jones 1983; Green 1984; DeGraaf and Wentworth 1986; DeGraaf 1987). A different complement of feeding guilds occurs in Perth, where the number of insectivores is high and the number of omnivores is low. The majority of the avifauna sampled in Perth northern suburban recreational parks were native nectarivores. This is not surprising considering that around one fifth of Australian birds are nectar-feeders. Consistent with the above mentioned studies, granivores were abundant in Perth.

The proliferation of granivorous and omnivorous species elsewhere has been explained by a large number of ornamental trees, often fruit bearers providing food for omnivorous and seed-eating birds. These non-native trees also tend to support fewer species of insects than native trees, contributing to the lack of insectivores (Beissinger and Osborne 1982). The reverse is true for the northern suburbs of Perth. The majority of the suburbs retain a high proportion of native trees with few ornamentals, which explains why insectivores are still present in large numbers.

The Australian Raven was the only true omnivore recorded in Perth. The success of omnivores in other urban areas is often attributed to their generalistic feeding behaviour (e.g., DeGraaf 1978; DeGraaf and Wentworth 1986). The lack of omnivores in Perth is most likely due to the low number of naturally occurring omnivorous birds in the south-west avifauna. Most native birds surveyed in Perth, perhaps in contrast to other regions, tend to be habitat generalists and opportunistic feeders. The Western Magpie, for example, is naturally insectivorous but has become largely omnivorous in urban areas, profiting from the food scraps of humans.

4.4.2 Factors affecting the distribution of birds in urban Perth

Contrary to the findings of other authors (Vale and Vale 1976; Jones 1981, 1983; Mason 1985; Mackin-Rogalska *et al.* 1988; Munyenyembe *et al.* 1989), age was not found to influence all measures of birds in urban Perth. However, species richness was higher in older parks in agreement with the above authors. It is unlikely that increased species richness is a reaction of the birds to the age of the site, *per se*, but more likely to the changes in habitat conditions over time, such as the growth of trees and increased coverage by shrubs (Vale and Vale 1976; Jones 1981; Stein 1982).

Different habitat factors were compared with various bird measures. The results showed that tree maturity was the most influential factor on the birds in Perth's northern suburban parks. The percentage cover of vegetation did not significantly affect avifauna but the top tree canopy height had a significant influence on species richness, abundance, diversity and evenness of species. Furthermore, the effect of tree maturity was more pronounced in native species. This is most likely because introduced species are more inclined to use non-native plants and artificial structures for feeding, nesting and perching sites (Emlen 1974; Lancaster and Rees 1979; Green 1984).

Several attempts have been made to test the hypothesis that the increased habitat partition of the urban environment, brought about by the addition of artificial structures, should result in an increased species diversity (Emlen 1974; Walcott 1974; Lancaster and Rees 1979). The data has tended to support the alternative hypothesis, that human-made elements of structural diversity contribute to decreased species diversity. In Perth's recreational parks, native bird abundance increases with increased cover of development. Other authors have found the opposite, that the proportion of introduced species was positively correlated with increased building cover (Stein 1982; Green 1984; Munyenyembe *et al.* 1989). While this may be an anomaly of the data, it may also be a reflection of Perth's native avifaunas ability to adapt to the artificial characteristics of urbanisation.

A number of the native species reported in this study have been known to utilise artificial structures of the urban environment. Rainbow Bee-eaters and Black-faced Cuckoo-shrikes frequently perch on telephone lines and fences, which they use as sally posts from which to dart after passing insects (Serventy and Whittell 1976). Tree Martins and Welcome Swallows have taken to nesting behind ventilators and under verandahs (Serventy and Whittell 1976). Ravens and Magpies are known to utilise the rubbish left by humans. Increased development in a park generally reflects more facilities for people to use, which results in more litter available from open bins. This may account for the unusual result of an increased native bird abundance with an increase in development on site.

While there was no evidence of a higher percentage of exotic trees in older parks, the suburbs surrounding the older parks tended to have more introduced trees (see Chapter 5). This may explain why there tends to be less insectivorous birds in the older parks because, as mentioned earlier, introduced trees tend to have less insect species (Beissinger and Osborne 1982). The nectarivores seem to benefit from the reduction in insectivore numbers and are more plentiful in older parks, for reasons unknown.

There were more tree foragers in the older parks than newer parks possibly because the larger trees in older parks can provide more habitat to canopy-feeders. There were less aerial foragers in older parks. The newer parks in this study tended to be dominated by large ovals, on which Welcome Swallows seem particularly abundant. This is most likely due to the increased visibility afforded to aerial foragers looking for insects, and the improvement in their ability to chase them. The size of ovals in the parks was proportional to the size of the park; the larger the park, the larger the oval. This may account for the increased abundance of aerial-feeders in large parks.

A decrease in urban park size has been characterised by lower bird species richness, species diversity and population density (Gavareski 1976; Suhonen and Jokimäki 1988). Perth's northern suburban parks did not conform to this trend, which is probably a reflection of the relatively small size of all the park sites in this study. Eighteen more species were recorded in Kings Park, which is 40 times larger than the largest site in this study (10ha) (Recher, in press). This suggests that the species diversity in Perth's parks may be increased if larger parks were retained in suburban areas.

The relative maximum abundance increased with an increase in park size. The increased habitat diversity supported by larger parks will be more important to higher bird numbers than the effect of size, *per se*. Larger parks tend to contain more heterogeneous habitats and so can support a larger number of species, and consequently more individuals.

A number of authors have reported lower bird species richness with increasing distance of suburbs from remnant bushlands (DeGraaf 1978; Green 1986; Munyenyembe *et al.* 1989), although there is conflicting data on this topic (see Catterall *et al.* 1989). In Perth, bird abundance is higher with increasing distance from remnant bushland sites in new parks only. Newer parks are likely to be more representative of the original avifauna. There will have been less extinctions and the longevity of the birds inhabiting the area prior to clearing not yet expired. Older communities will be more stable, the birds having reduced to a core group of species that are able to survive in the urban environment. Those birds in older parks will be responding to the entire urban matrix (streets, parks, suburban gardens and remnants), while the birds in new parks will be largely dependent on the original habitat.

PATN analysis failed to show any distinct groupings among the sites, although some parks were grouped apart from others. These groupings may be explained by a number of different variables. Ottawa Park replicates were most likely separated from the other sites because of the presence of the Tree Martin in each count, a species not encountered at any other site. This park exists at the eastern most extreme of the study area, which may also have been an influencing factor (Figure 2.1).

Seacrest Park was separated, which was expected. Seacrest Park is almost entirely irrigated lawn, encouraging Welcome Swallows in high abundance. While one of the largest parks, it lacks habitat diversity and most of the vegetation consists of immature plantings. Seacrest park had the lowest bird species richness of all of the sites.

Avocado/Bangalay Reserve is unique in its vegetative character, which is most likely responsible for its division. This park had a sizeable unfragmented portion of remnant low Banksia woodland, which seems to attract high numbers of Red Wattlebirds, Brown Honeyeaters and Singing Honeyeaters. The other portion of the park is covered by planted Eucalypt species, most likely native to eastern Australia, which may have produced different bird assemblages than other sites. One of the Strutt Way Reserve replicates was placed in this group which is probably a result of its proximity to Avocado/Bangalay Reserve. It also contains some remnant cover, although it is severely fragmented. Belrose Park, Haddington Park and Hillarys Park were grouped together, along with the two other Strutt Way replicates, which are shown to be close to the Avocado sites. This may be a reflection of their northerly position in the study area.

The inability of PATN to identify any specific park features responsible for the bird communities within them and the broadness of the factors influencing the division of the above sites suggests that the physical factors of the parks themselves are not overly important to what birds inhabit them. Parks are just one component of the urban matrix, which also includes remnant bushland, streets and private gardens. Together, these components determine the complement of birds occurring in an urban area.

CHAPTER 5

The Avifauna of Perth's Northern Suburban Streets

5.1 INTRODUCTION

Many authors on urban birds have used data on the birds existing in suburban streets to draw conclusions about urban avifauna (e.g., DeGraaf 1978; Lancaster and Rees 1979; DeGraaf and Wentworth 1981; Jones 1981; Stein 1982; Jones 1983; Green 1984; Mason 1985; DeGraaf and Wentworth 1986; Munyenyembe *et al.* 1989; Erskine 1992). However as shown in the previous chapter, birds in urban areas will utilise the entire matrix of urban development, including the streets, suburban blocks, recreational parks and remnant bushlands. The objective of this chapter was to determine the separate contributions to the urban avifauna of street gardens and parks.

5.2 METHODS

5.2.1 Selection of Street Transects

Bird counts were conducted in streets close to the park sites. The cumulative frequency method was not appropriate for street sampling and the fixed-width strip transect method was used. The streets were selected from street maps (Department of Land Administration 1996) based on a number of criteria: the street had to be parallel to a park sample site, at least two rows of houses from any park, and at least 200 m in length. Main roads were avoided because increased noise reduces the ability to detect birds (Pyke and Recher 1984). The streets were then visited to ensure no other biasing features were present that were missing on the roadmaps. Two instances occurred where streets were rejected due to the presence of vacant blocks of land containing a large proportion of vegetation. Where the vegetation was minimal and an alternative not available, some vacant blocks occurred along transects.

Landmarks, such as letterbox numbers, were used to divide each transect into 100m intervals. These intervals were measured using a motor vehicle tripmeter, after being tested five times for accuracy using a 100 m measuring tape. The length of each transect was 200 m placed on the straightest length in the street that was most consistently parallel to the corresponding site.

5.2.2 Bird Sampling in Street Transects

All birds seen or heard while slowly walking the transect were identified and counted for each 100 m of the transect. Birds that were in front of the observer and within one house (approximately 25 m) to the left or right were counted. As with the park sampling, weather conditions were recorded before the count began; temperature, an estimate of percentage cloud cover, and a rating of wind between 0 (no wind) and 4 (extremely windy). Sampling took, on average, 5 minutes for each 200 m transect.

5.2.3 Vegetation Sampling in Street Transects

To establish the number of houses which should be sampled for vegetation characteristics within each street, one street was sampled intensively. Casilda Road in Duncraig was chosen as there was a high degree of habitat heterogeneity in comparison to the other streets and would, therefore, show the highest degree of sampling necessary to encompass the variation. Each house along the 200 m transect was sampled for vegetation.

The front yard of each house on the transect was divided into six categories. The yard began from the front door to the road verge. Where the house was located on a corner, the immediate front yard and the yard from the fence to the verge around the corner was counted as the 'front yard'. Percentage cover (in relation to the total size of the front yard) was estimated for each of the six categories. These categories were development (e.g., paved areas and bare sand), lawn, native shrubs (those of Australian origin), introduced shrubs, native trees, and introduced trees. It was possible to class shrubs and trees as native or introduced by sight. Vegetation sampling was not species specific.

The average of each of the cover categories was calculated over the whole transect and compared to the average of each category when only one house was randomly selected, then two houses, and so on. Running means were also investigated. These averages highlighted that the percentage cover of each category was similar after sampling five houses along the transect. It was decided that 10 houses could easily be sampled with little additional effort and would improve accuracy.

At each sample street, the number of houses along the transect was counted. This number was divided by ten to determine how often houses needed to be sampled. This meant that the sampled houses were evenly spread, to encompass the variation over the entire length of the transect. Both sides of the street were sampled evenly in most cases. One sample street, the most suitable in the area, had fences of the backyard facing the street. Therefore, the other side of the street was sampled for 10 houses instead.

5.2.4 Analysis

Paired sampled t-tests were used to determine whether there was a significant difference between bird species richness and maximum abundance in old and new streets. Paired sampled t-tests were also used to compare bird measures (species richness, relative abundance, species diversity and evenness of species) and vegetation cover categories between streets and parks. Pearson's correlation was used to test for significant relationships between species richness, abundance, the number of dominants and the percentage of introduced birds with all cover measures (development, lawn, introduced shrubs, introduced trees, native shrubs and native trees). Statistical analysis was assisted by the Statistical Package for Social Sciences (SPSS) for Windows.

5.3 RESULTS

5.3.1 Vegetation cover in the streets

The percentage cover of each category for each street is presented in Table 5.1. There were no significant differences between the cover categories in old and new sites. Anaconda Place, Emporer Avenue, and Culloton Drive had the highest percentage cover of development; Norbury Way had the lowest. The lowest cover of lawn was in Dampier Avenue. Norbury Way, Milstead Way, and Rhine Crescent had the highest lawn cover.

Rhine Crescent had the lowest native cover of all streets. Rhine Crescent had the lowest native shrub cover and, together with Orion Way and Trinity Way, the lowest cover of native trees. The highest overall native cover was in Aberfeldy Way. Trinity Way had the highest native shrub cover. Culloton Drive, Norbury Way and Aberfeldy Way had the highest native tree cover. Jessamine Street had the highest introduced cover, both for introduced shrubs and introduced trees. Culloton Drive, while having the equal highest cover of introduced trees had the lowest cover of introduced shrubs (together with Trinity Way). Dampier Avenue and Campbell Drive had the lowest cover of introduced trees.

5.3.2 Vegetation differences between streets and parks

Streets had significantly higher percentage covers of development ($t=-10.04$, $p<0.001$), lawn ($t=-7.71$, $p<0.001$) and introduced trees ($t=-7.67$, $p<0.001$) than parks. The percentage cover of native shrubs ($t=6.07$, $p<0.001$) and native trees ($t=4.11$, $p=0.001$) was significantly higher in parks than streets. There was no significant difference in the percentage cover of introduced shrubs between streets and parks.

Table 5.1: The percentage cover of vegetation categories in each street (averaged over ten houses)

Street	*Park*	Development	Lawn	Native Shrub	Introduced Shrub	Native Tree	Introduced Tree	TOTAL
Mercury Pl	ARBOR	28.5	47.5	5.9	15	8	8.5	113.4
Jessamine St	AVOCADO	24	47.5	4.1	22.5	0.2	20	118.3
Norbury Wy	BEECROFT	14	72.5	4	9	16.5	14.7	130.7
Dampier Ave	BELROSE	52	28	10	10	7	5	112
Burgland Drv	BLACKMORE	33	41.5	11.2	9.9	4.5	10	110.1
Milstead Wy	CABRINI	23.5	54	8	11.5	4.5	8.75	110.25
Culloton Drv	CELEBRATION	37.5	34.5	9.2	7.2	17	20	125.4
Aberfeldy Wy	GLENGARRY	29	39	18	10.5	15.4	8.2	120.1
Emporer Ave	HADDINGTON	39	37.8	4.7	17.2	1.7	9.5	109.9
Campbell Dve	HILLARYS	26	43.5	15.75	11.75	9.5	3.9	110.4
Orion Wy	JOHN MALONEY	36	43.5	6.75	12.35	0	6.6	105.2
Trinity Wy	KINGSLEY	33.5	35.5	20.7	7.2	0	8	104.9
Rhine Cr	OTTAWA	34	54	2.1	8.8	0	7.1	106
Casilda Rd	SALATA	26.5	47.5	11.5	16	10.5	6	118
Anaconda Pl	SEACREST	39.5	40	5.3	12.2	1.25	6.25	104.5
Wonga Rd	STRUTT WAY	20.5	49	12.75	12.3	11.95	10.5	117

NB: Totals are often over 100%. This is due to an overlap in some vegetation layers

5.3.3 Street avifauna

Eighteen bird species were recorded during the 16 street transects. Four species were introduced to Perth post-European settlement (the Rainbow Lorikeet, Senegal Turtle-dove, Spotted Turtle-dove and Domestic Pigeon). Exotics comprised 41% of the total bird population. Four species dominated the transects (the Senegal Turtle-dove, Singing Honeyeater, Brown Honeyeater and New Holland Honeyeater, respectively) making up 71% of the total population. The Senegal Turtle-dove, Singing Honeyeater and Spotted Turtle-dove were dominant in all sites where they were present.

Introduced granivores comprised the majority of Perth's northern suburban street avifauna (Figure 5.1). There was also a large proportion of nectarivores and insectivores. There was a notable lack of carnivorous birds during street counts and herbivores and omnivores were present in low numbers. The majority of the street avifauna foraged on the ground, although nearly as many bird species were tree foragers (Figure 5.2). Most ground foragers in the streets were introduced species while most native birds were tree foragers.

There was no significant difference between bird species richness or bird abundance in old and new streets. Bird species richness and abundance were significantly positively correlated with the amount of native shrub ($r=0.64$, $p<0.01$) and native tree cover ($r=0.66$ $p<0.01$). Bird abundance was also positively correlated with the cover of native shrubs ($r=0.67$, $p<0.01$).

5.3.4 Avifaunal differences between streets and parks

Eight more bird species were found during park sampling than in the streets. These species were all uncommon visitors to the park sites (Butcherbird, Common Bronzewing Pigeon, Laughing Kookaburra, Nankeen Kestrel, Australian Hobby, Rainbow Bee-eater, Tree Martin, and White-tailed Black Cockatoo). Introduced species comprised a larger proportion of the total bird population in streets than those of parks (41% versus 19%). Fewer species dominated the avifauna of Perth's northern suburban streets than parks, making up the same percentage of the total population as the seven dominant species in parks (71%).

Introduced granivores comprised a higher percentage of the total avifauna in streets than parks (40.1% versus 15.1%). There were fewer native granivores in streets than in parks (2.3% versus 7.7%). Native and introduced nectarivores were present in similar proportion in streets and parks (Figure 4.1 and 5.1). The percentage of native and introduced insectivores, native herbivores and native omnivores were all lower in streets than parks.

Introduced ground foragers comprised a higher percentage of the total avifauna in streets than in parks (40.1% versus 15.3%). Native ground foragers were present in lower numbers in the streets than in the parks (10.3% versus 30.8%). Native and introduced tree foragers were present in similar proportions in streets and parks (Figures 4.2 and 5.2). There were fewer aerial foragers in streets than parks (1.2% versus 7.6%).

Bird species richness, total relative abundance and diversity (H') were higher in Perth's northern suburban parks than streets in all cases bar one – Seacrest Park (Table 5.2). These differences were all statistically significant (species richness, $t=8.7$, $p<0.001$; relative abundance, $t=7.2$, $p<0.001$; diversity, $t=7.5$, $p<0.001$). The evenness of species was also higher in the corresponding street of Seacrest Park (Anaconda Place), although evenness of species was not significantly different between streets and parks. As each transect covered an area of one hectare, the species richness of streets was compared to the number of species per hectare in parks. The number of species per hectare was significantly higher in streets than parks ($t=4.0$, $p=0.001$).

Comparing the relative abundances of species revealed that the New Holland Honeyeater was present in higher numbers in the streets than the parks in four of five cases; the Senegal Turtle-dove in fourteen of sixteen cases; and the Spotted Turtle-dove in five out of five cases.

Figure 5.1: Avian feeding guilds in Perth's northern suburban streets

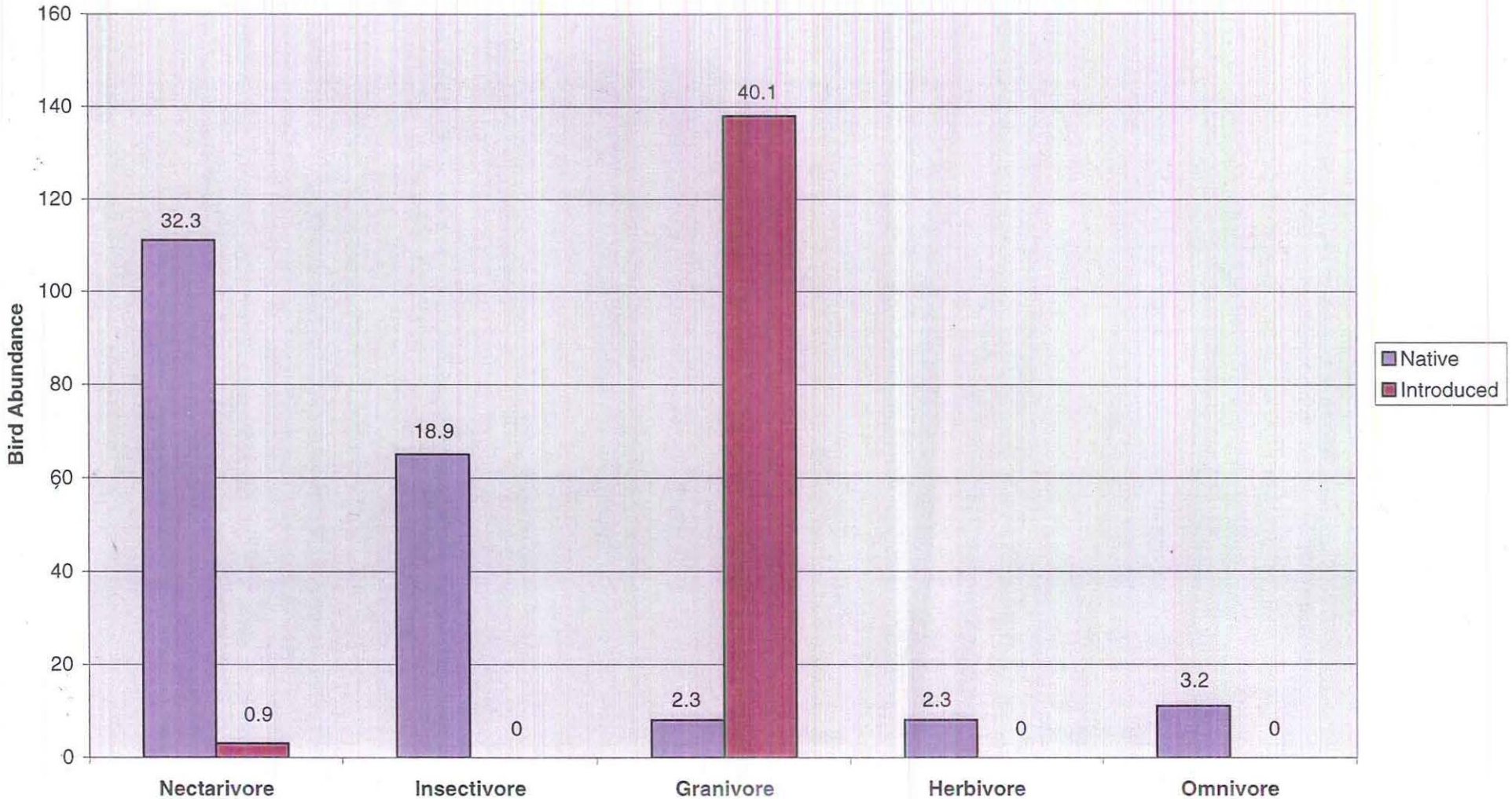


Figure 5.2: Avian foraging guilds in Perth's northern suburban streets

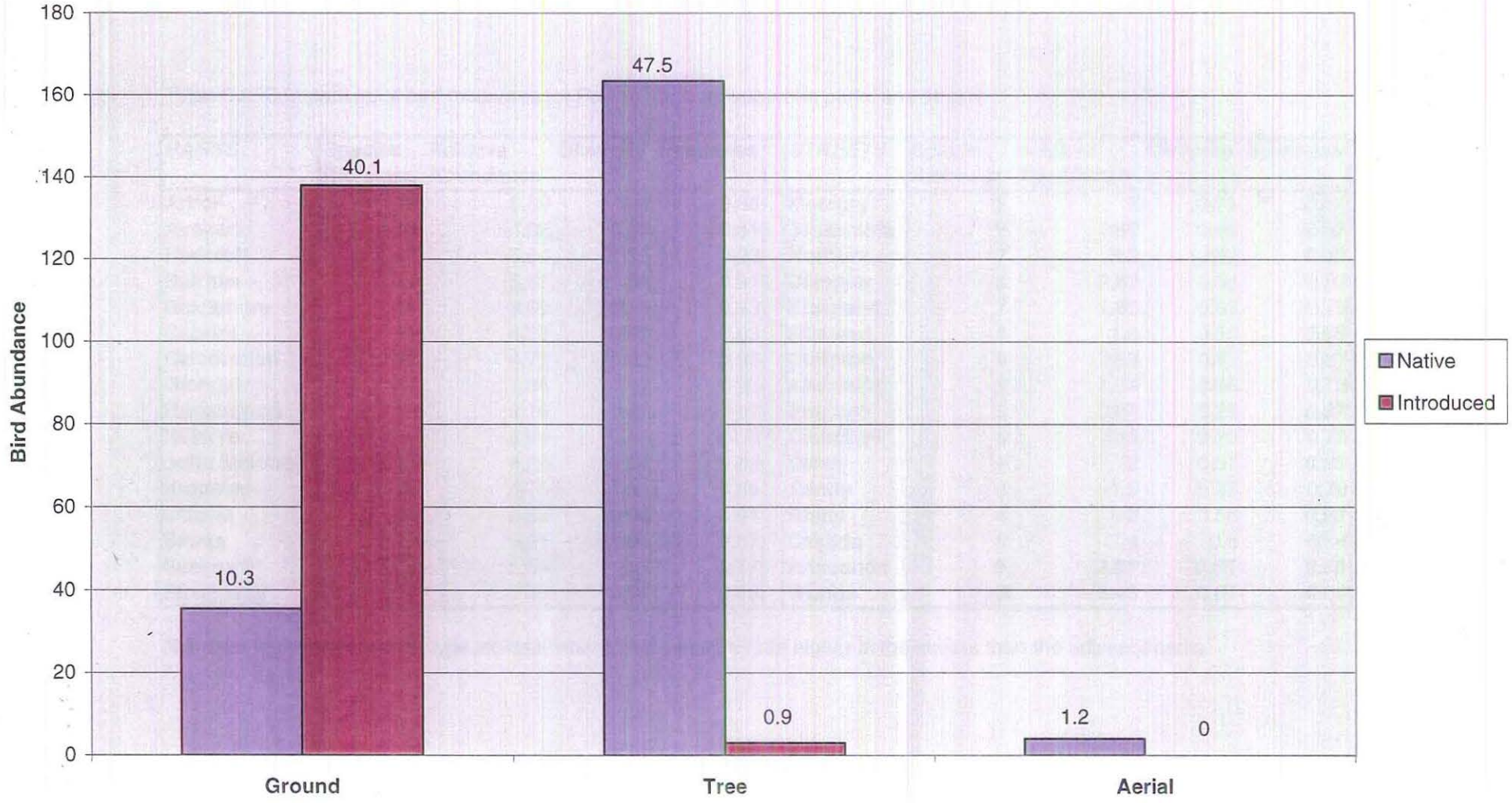


Table 5.2: Comparison of bird measures for Perth's northern suburban parks and streets

PARKS	Species Richness	Relative Abundance	Diversity	Evenness	*STREETS*	Species Richness	Relative Abundance	Diversity	Evenness
Arbor	18	5.89	1.1	0.88	Mercury	6	3	0.71	***0.91***
Avocado	11	4.02	0.85	0.81	Jessamine	3	1.86	0.44	***0.92***
Beecroft	17	6.64	1.15	0.93	Norbury	7	3.5	0.83	***0.98***
Belrose	14	5.67	1.04	0.91	Dampier	5	2.67	0.58	0.83
Balckmore	14	3.69	0.95	0.83	Burgland	7	1.85	0.63	0.75
Cabrini	10	4.28	0.93	0.93	Milstead	4	1.6	0.58	***0.96***
Celebration	12	4.79	1.02	0.95	Culloton	9	3.53	0.83	0.87
Glengarry	17	7.36	1.17	0.95	Aberfeldy	8	1.97	0.66	0.73
Haddington	10	3.16	0.87	0.87	Emporer	2	0.67	0.29	***0.97***
Hillarys	11	2.69	0.89	0.85	Campbell	8	1.43	0.72	0.79
John Maloney	15	4.26	1.06	0.88	Orion	4	2	0.57	***0.95***
Kingsley	15	5.75	1.01	0.86	Trinity	3	1.5	0.37	0.78
Ottawa	12	4.59	0.98	0.91	Rhine	4	3	0.56	***0.93***
Salata	16	5.61	1.05	0.87	Casilda	9	4	0.8	0.84
Seacrest	8	2.54	0.7	0.77	Anaconda	***9***	***2.84***	***0.85***	***0.89***
Strutt Way	13	5.35	0.96	0.86	Wonga	6	3.43	0.67	0.86

Numbers highlighted in bold type indicate where bird measures are higher in the streets than the parks.

5.4 DISCUSSION

The avifauna of Perth's streets was more similar to the urban bird communities documented elsewhere, than the avifauna of the parks. Eighteen species were recorded in the streets. Four species were introduced to Perth post-European settlement and comprised over 40% of the total population. This was more than two times higher than the percentage of introduced species in parks and more similar to the high percentages reported elsewhere (e.g., Emlen 1974; DeGraaf 1978; Erskine 1980; Jones 1981, 1983; Green 1984). The higher proportion of exotic species in streets than parks may be attributable to the higher percentage cover of introduced trees and lower cover of native shrubs and trees in the streets.

Four species dominated the avifauna of Perth's northern suburban streets, making up 71% of the total population. This was more consistent with other studies of urban birds, than the comparison of the park avifauna with other suburban bird studies (Huhtalo and Järvinen 1977; Erskine 1980; Jones 1981, 1983; Beissinger and Osborne 1982; DeGraaf 1987; Lenz 1990). The conditions present in Perth's streets seem to favour fewer species, so it seems reasonable to assume that fewer species will be able to dominate in the streets.

Consistent with other findings was the high percentage of introduced ground-foraging granivores in the streets (DeGraaf 1978; Lancaster and Rees 1979; DeGraaf and Wentworth 1981; Beissinger and Osborne 1982; Jones 1983; Green 1984; DeGraaf and Wentworth 1986; DeGraaf 1987). The streets had significantly more lawn cover than the parks. Ground foragers are known to benefit from large expanses of lawn, especially introduced species (Green 1986).

Eight more species were found in the parks than in the streets. The majority of these birds were found in lower numbers in the parks. Species richness, relative abundance and species diversity were higher in the parks in all cases except one, Seacrest Park. This park had the highest percentage cover of lawn (Table 4.2) and sparse vegetation of mainly immature trees. The corresponding street (Anaconda Place), which had one of the highest percentage covers of development and minimal native vegetation, was greater in

all bird measures than Seacrest Park. This is an example of where the complete urban matrix is more important to the birds than either habitat (street versus park) alone.

The differences identified between the birds of Perth's suburban parks and streets suggest that past practice of using street counts to make generalisations about urban birds as a whole has led to incomplete representations of urban avifauna. Not only do urban birds use all components of the urban matrix, but they use the individual components differently. Therefore, when reporting on the avifauna in an urban area, all facets of the urban environment should be investigated (the streets, the gardens, the parks and the remnant bushlands).

CHAPTER 6

Are Birds in Suburban Parks Important to Park Users?

6.1 INTRODUCTION

As human populations become more urbanised, managing cities in which wildlife can flourish becomes increasingly important. Birds are especially important because they are among the largest and most readily seen wildlife still able to inhabit urban areas. Birds pose few nuisance problems and contribute much to the habitability of cities and suburbs (Thomas, DeGraaf and Mawson 1977; DeGraaf and Wentworth 1986). As DeGraaf *et al.* (1991) point out, people have their most frequent contact with birds around their home and work areas.

Surveys on community attitudes towards birds are scarce. One study, conducted in Seattle, Washington, concluded that people show great interest in birds (Penland 1987). Recent nationwide surveys in America indicate that 79.9 million Americans observe wildlife in residential areas (the majority of which will be birds) and that 8 million feed birds, spending more than US$1.3 billion a year on seed-related items (DeGraaf, Geis and Healy 1991). In Australia, a large number of people are members of ornithological groups. For example, 4,775 Australians were members of the R.A.O.U. (Royal Australasian Ornithologists Union) at the end of 1996, with these figures increasing every year (S. Robinson, R.A.O.U, pers. comm., April 10, 1997).

Determining the way people value things in our communities, especially in areas of public use, is vital to ensure management plans encompass community needs. Questionnaires are a useful tool in determining public opinion and have been recognised as the most widely used data collection technique in social research (DeVaus 1995). The questionnaire conducted as part of this research aimed to determine the community attitudes towards the birds in suburban parks. Specifically, the questionnaire was carried out to fulfil the following aims:

a) Are birds valued as important by the users of Perth's northern suburban recreational parks?

b) Are any types of birds valued over others by users of Perth's northern suburban recreational parks?

c) Are any bird characteristics valued over others by users of Perth's northern suburban recreational parks?

This chapter outlines the steps taken in constructing, administering and analysing the results of the questionnaire. The results of the questionnaire are presented and the major findings discussed in relation to the aims provided above.

6.2 METHODS

6.2.1 Questionnaire Construction

A descriptive approach to the questionnaire was sufficient to satisfy the aims. The questionnaire was kept as short and interesting as possible. It took, on average, seven minutes to complete. The questionnaire tested for behaviour (e.g., how often do you visit Perth's recreational parks?), beliefs (e.g., do you think birds should be encouraged to inhabit suburban areas?), attitudes (e.g., what is it about birds that you find most appealing?), and attributes (e.g., gender and age group) of the respondent. The questionnaire made use of open and closed questions. While open questions are harder to analyse, they identify categories that may not have been foreseen. The closed questions used checklists and ranking formats.

Measures were taken to reduce non-response and to avoid biasing the questions, such as wearing neutral clothing and an identity card. Attention was paid to question wording to ensure respondents understood the questions and interpreted them correctly. DeVaus (1995) provided a checklist to avoid problems with question wording, such as avoiding jargon or technical terms and keeping questions short and simple. A pilot test was undertaken, prior to administering the questionnaire, to establish how best to phrase each question.

An example of the final questionnaire is attached (Appendix 6a). The introduction of the questionnaire was designed to encourage the respondent to agree to participate. It introduced the interviewer, the reason for the questionnaire and defined the major terms. The true nature of the questionnaire was not revealed to the respondent in the beginning to avoid biasing the results. The respondent was asked to spare five to ten minutes to participate in a survey on community attitudes towards features of Perth's northern suburban recreational parks. The gender of each respondent was noted. Questions 1 and 2 determined the age of the respondent and how often they visited Perth's northern suburban recreational parks.

Questions 3 to 5 addressed the first aim of the questionnaire by comparing birds to other features of recreational parks. These questions identified why the respondents visited recreational parks and what features of the parks were most important to them. Question 11 served to find out if the park users valued birds in suburbia by asking them if they thought birds should be encouraged to live in suburban areas. Question 12 asked the respondents for ideas on how to encourage birds, to highlight possible management issues.

Questions 6 to 8 were designed to address the second aim of the questionnaire by identifying which bird species were most liked, and most disliked. Respondents were shown pictures of common birds in the Perth metropolitan area to increase their interest and ability to answer the questions (Appendix 6b). The species selected were those frequently encountered in the parks surveyed. The respondent was asked to identify other birds, not found in the northern suburban recreational parks, that they would like to see in the parks. Questions 9 and 10 then addressed the final aim of the questionnaire by distinguishing which bird characteristics were most liked, and which were most disliked.

6.2.2 Questionnaire Administration

During bird counts (see Chapter 4), the number of people in each park over a half-hour period was recorded. Parks with an average number of people greater than six were sampled to maximise the number of respondents available. Ten of the 16 parks studied met this criterion.

With the assistance of one volunteer, the chosen parks were sampled during February 1997 for the attitudes of park users towards birds in Perth's suburban recreational parks. The questionnaire was administered face-to-face, with the interviewer recording the answers. The volunteer was briefed on the questionnaire prior to sampling to ensure that both interviewers were sampling in a consistent manner. A person was considered a park user if they entered the park, for whatever reason. Children less than 15 years old were excluded from the sampling. Of the 108 people approached, 100 were willing to participate in the survey.

To obtain a range of views, questionnaires were conducted in the morning (0700-0900), afternoon (1300-1500), and the evening (1700-1900) on weekdays and weekends. The questionnaire was conducted over six days, with three replicate samples and a total of 18 sampling periods. The sequence in which the ten parks were sampled was randomised.

6.2.3 Analysis

Univariate and bivariate analysis were used to analyse the responses to the questionnaire (DeVaus 1995). Univariate analysis consisted of descriptive statistics such as mean, mode and ranking which were used to describe the majority of results. Cross-tabulation accounted for the bivariate analysis used to compare the results of descriptive statistics with respondent attributes. Where open questions were used, interpretation was necessary to fit the broad answers into fewer categories. Parametric and non-parametric tests were conducted using the Statistical Package for Social Sciences (SPSS) for Windows for the following analysis:

- Chi-square was used to test the null hypothesis that there was no significant difference between the frequency of respondents in each age class (Fowler and Cohen 1994).
- Pearson's Correlation was used to test the null hypothesis that there was no significant correlation between the age of the respondent and the rank they placed on birds (Blackmore 1994).
- The non-parametric Mann-Whitney U-test was used to test the null hypothesis that there was no significant difference between bird rank responses from males and females (Zar 1984).

6.3 RESULTS

6.3.1 Respondent demographics

A total of 100 people responded to the questionnaire, 51 males and 49 females (Table 6.1). There was no significant difference between the number of people in each age class questioned (χ^2=1.3, d.f.=4, p=0.01), with 8 to 13 people in each age group for each gender. Slightly more people were surveyed during weekdays than on weekends (54 versus 46), and most respondents' (51) were surveyed between the 1700-1900 sampling period.

Table 6.1: The demographics of respondents. Age groups and the time sampled are provided for both females (top) and males (bottom).

FEMALE	15-19	20-29	30-39	40-49	50+	TOTAL
Weekday 7-9am	2		3	3	4	12
Weekday 1-3pm		2	1			3
Weekday 5-7pm	5	3	2	3	1	14
Weekend 7-9am		1		2	2	5
Weekend 1-3pm		1	1	1		3
Weekend 5-7pm	3	2	2	4	1	12
TOTAL	10	9	9	13	8	49
MALE	15-19	20-29	30-39	40-49	50+	TOTAL
Weekday 7-9am				1	4	5
Weekday 1-3pm	2	5	2	1	1	11
Weekday 5-7pm	1	5		2	1	9
Weekend 7-9am				2	1	3
Weekend 1-3pm	1	1	2	1	2	7
Weekend 5-7pm	4	2	4	3	3	16
TOTAL	8	13	8	10	12	51
Grand Totals:	18	22	17	23	20	100

The majority of the respondents were daily visitors to Perth's suburban recreational parks (Table 6.2). Frequent visitors were classed as those people who visited the parks twice a week or more, the rest were classed as non-frequent users.

Table 6.2: The frequency of visits by the respondents to Perth's suburban recreational parks (*Question 2 – How often do you visit Perth's recreational parks, on average?*).

	MALE	FEMALE	TOTAL
DAILY	20	27	47
2 x WEEK	5	0	5
3 x WEEK	11	7	18
4 x WEEK	1	5	6
WEEKLY	9	4	13
FORTNIGHTLY	4	3	7
MONTHLY	1	3	4
TOTAL	51	49	100

6.3.2 Attitudes towards birds

The main reason park users visited recreational parks in Perth's northern suburbs was to walk their dogs, with 39% of respondents using the park for this reason (Table 6.3). The number of females who come to the parks with the main intention of walking their dogs was twice that of men (26 versus 13). The second highest reason among females, at 16%, was for exercise. Men also visited parks to walk their dogs (25%), but exercise and active recreation rated highly, both 22% (Table 6.3).

Table 6.3: The frequency of response for categories explaining the main reason for visiting Perth's northern suburban parks (*Question 3a – What is the main reason that you visit Perth's recreational parks?*).

Activity	Male	Female	TOTAL
Children to park/Use playground	6	4	10
Exercise	11	8	19
Active Recreation	11	1	12
Walk Dog	13	26	39
Picnic	2	0	2
Relax	2	1	3
Watch Sport	0	1	1
Access	4	5	9
Work	2	1	3
Meet people	0	2	2
TOTAL	51	49	100

Walking the dog was given as the main reason for visiting the park in each sampling time (64% between 0700-0900 hours, 25% between 1300-1500 hours, and 33.3% between 1700-1900 hours). Using the park for access to other places was close behind for park users sampled between 1300-1500 hours, at 21%. Between 1700-1900 hours, 25.5% used the parks for exercise. Only two respondents, both female, mentioned visiting the park to see birds. In each case, this was a secondary reason for being in the park.

The respondents were asked to rank eight features of recreational parks in order of importance to assess what features, including birds, were considered most valuable to park users. A score of one was given to the most important, and so on with eight being the least important. Only one person, a male respondent, rated birds as the most important feature of recreational parks. When all the scores for each category were tallied, birds rated sixth overall and cleanliness first (Table 6.4). Females rated birds slightly higher than males, fifth versus sixth. However, this was not found to be statistically significant (Mann Whitney U-test, $p>0.05$).

Table 6.4: Importance ranking of features of Perth's suburban recreational parks by males and females, where a score of one is most important.

	Female	Male	Total
AMENITIES	3	4	3
CLEANLINESS	1	1	1
BIRDS	5	6	6
REC. FACILITIES	6	5	5
TREES/SHRUBS	2	2	2
OPEN SPACE	4	3	4
ANIMALS	7	8	7
SOLITUDE	8	7	8

Respondents sampled between 1300 and 1500 hours rated birds slightly higher than at other sampling times with females ranking birds fourth, males ranking birds fifth (Table 6.5). Birds were ranked lowest by respondents that were sampled between 1700 to 1900 hours, with females ranking birds seventh and males ranking birds sixth.

Table 6.5: Importance ranking of features of Perth's suburban recreational parks by time sampled, where a rank of one is the most important (Tied ranks were averaged, for example, 3.5 indicates that respondents considered the 3rd and 4th ranks of equal importance).

	0700-0900			1300-1500			1700-1900		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
AMENITIES	3.5	3	3	2.5	5	4	4	2	2
CLEANLINESS	1	2	1	4	3	3	1	1	1
BIRDS	6	5	5	5	4	5	6	7	6
REC. FACILITIES	7	7	6	6	7.5	6	5	5	5
TREES/SHRUBS	5	1	2	1	1	1	3	3	3
OPEN SPACE	2	4	4	2.5	2	2	2	4	4
ANIMALS	8	6	8	8	7.5	8	7	6	7
SOLITUDE	3.5	8	7	7	6	7	8	8	8

When asked if any features of recreational parks important to them had been missed in the list, most responded with features already encompassed in the eight categories. For example, bins, water taps, and open toilets, which fall under amenities, were mentioned. Security, mainly in the form of lights, was mentioned most often, by 22% of the 41 respondents who answered this question, as another important feature of parks.

A strong correlation was evident between age and the rank placed on birds. The ranking of birds varied between four and eight (Table 6.6). Birds ranked significantly higher with increasing age of the respondent ($r=0.89$, $p<0.05$), a trend evident in males ($r=0.89$, $p<0.05$) and females ($r=0.94$, $p<0.05$). Birds began at rank seven in 15 to 19 year old males, peaking at fifth rank in males over 50 years old. Fifteen to 19 year old females ranked birds eighth. This rank peaked at fourth in females over 50 years old. The trend was also evident when males and females were combined in the different age groups, beginning at eighth place in 15 to 19 year olds and finishing fifth in over 50 year olds.

Birds were rated fifth by frequent users and sixth by non-frequent users (Table 6.7). Non-frequent female visitors ranked birds seventh, compared to non-frequent males who ranked them sixth. Both male and female frequent users ranked birds fifth, although males rated them equal to recreational facilities. A point of interest was that birds were generally rated very close in importance to recreational facilities.

Table 6.6: Importance ranking of features of Perth's suburban recreational parks by different age groups, where one is the most important (Tied ranks were averaged, for example, 3.5 indicates that respondents considered the 3rd and 4th ranks of equal importance.).

	15-19yrs			20-29yrs			30-39yrs			40-49yrs			50+yrs		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total
AMENITIES	1.5	4	2	5	3.5	4	2	2	1	2.5	3	3	4	5	4
CLEANLINESS	1.5	1	1	3.5	3.5	3	5	1	2	1	2	1	1	3	1
BIRDS	7	8	8	6	6	6	6	5	5.5	6	5	5	5	4	5
REC. FACILITIES	4.5	3	3.5	1.5	5	5	3	6.5	5.5	6	7	6	8	6	7
TREES/SHRUBS	4.5	5	5	3.5	1	2	4	3	4	2.5	1	2	2.5	1	2
OPEN SPACE	3	4	3.5	1.5	2	1	1	4	3	4	4	4	2.5	2	3
ANIMALS	6	6	6	8	7	7.5	7.5	6.5	7	8	6	7	7	8	8
SOLITUDE	8	7	7	7	8	7.5	7.5	8	8	6	8	8	6	7	6

Table 6.7: Importance ranking of features of Perth's suburban recreational parks by frequent and non-frequent users, where one is the most important (Tied ranks were averaged, for example, 3.5 indicates that respondents considered the 3rd and 4th ranks of equal importance).

	Non-frequent Users			Frequent Users		
	Male	Female	Total	Male	Female	Total
AMENITIES	2	1	1	3.5	4	4
CLEANLINESS	5	3	4	1	1	1
BIRDS	6	7	6	5.5	5	5
REC. FACILITIES	4	4	5	5.5	6	6
TREES/SHRUBS	3	2	2	2	2	2
OPEN SPACE	1	5	3	3.5	3	3
ANIMALS	7	8	7	8	7	7
SOLITUDE	8	6	8	7	8	8

Ninety-three of the 100 respondents thought that steps should be taken to encourage birds to live in suburban areas. Of the seven that did not, six were female. Most were happy with how many birds there are. One person thought that only some birds should be encouraged. Another person thought that with the large numbers of domestic animals it was not fair to the birds to encourage them. One woman admitted to having a bird phobia and was scared of the thought of any birds being encouraged.

Respondents who thought steps should be taken to encourage birds to inhabit suburban areas were asked to share any ideas on how that may be achieved. The responses were knowledgeable but varied, and were therefore summarised into categories (Table 6.8). The most common response was to have more trees. This was included in the 'more vegetation' category (81 respondents). This category also encompasses answers including making sure there is a diverse range of native trees and shrubs that are suitable for the birds. It was also pointed out that vegetation should include different maturity stages. Thirteen respondents mentioned that clearing of bushland should be stopped.

Table 6.8: Respondent suggestions on how to encourage birds to inhabit suburban areas.

	Male	Female	Total
More Vegetation	46	35	81
Water	10	20	30
Control of Pets	16	13	29
Feeding	12	13	25
Other	6	8	14
Nesting Boxes	4	5	9
Education	2	3	5

Providing water, generally in the form of birdbaths, was the second most frequent answer (30% of respondents), closely followed by the need to control pets. This answer was generally limited to controlling or "shooting" cats, although four people mentioned controlling dogs. Providing food for birds to encourage them into suburban areas was suggested by 25% of respondents. The need for the food to be native and the potential danger of birds becoming dependent on artificial sources of food was alluded to by four of the respondents.

The 'other' category, which accounted for 14% of responses, included having more parks, encouraging green corridors between suburbs, keeping dead material in the park, less pesticide spraying, less noise, and not keeping birds in cages. There was a suggestion that bird enclosures in the parks may encourage other birds. Recommendations that nesting boxes be introduced into parks and that people should be encouraged to appreciate birds more were given by nine and five people, respectively.

6.3.3 Desirable and undesirable bird species

Respondents were asked to identify the three bird species that they considered most desirable from a picture list of birds in the area (Appendix 6b). The three most often listed birds were the Galah, Laughing Kookaburra and Rainbow Lorikeet (Table 6.9). These species were listed by 54%, 50% and 50% of respondents, respectively. The Willie Wagtail and Ringnecked Parrot also rated highly (35% and 19%). The Western Magpie, Rainbow Bee-eater and Singing Honeyeater ranked fifth, sixth and seventh, respectively. Females preferred the Galah, Rainbow Lorikeet and Willie Wagtail, closely followed by the Laughing Kookaburra. Males seemed to like the Laughing Kookaburra, Rainbow Lorikeet and Galah, in that order.

Table 6.9: The frequency that different bird species were considered most desirable by respondents (*Question 6 – Which three bird species do you consider most desirable in recreational parks?*).

Bird Species	Female	Male	Total
Galah	30	24	54
Laughing Kookaburra	20	30	50
Rainbow Lorikeet	22	28	50
Willie Wagtail	21	14	35
Ringnecked Parrot	7	12	19
Western Magpie	7	8	15
Rainbow Bee-eater	6	8	14
Singing Honeyeater	5	8	13
New Holland Honeyeater	7	2	9
Red Wattlebird	2	5	7
Welcome Swallow	5	1	6
Spotted Turtle-dove	3	2	5
Senegal Turtle-dove	2	2	4
White-tailed Black Cockatoo	0	4	4
Butcherbird	2	1	3
Australian Raven	2	0	2
Magpie Lark	1	1	2
Black-faced Cuckoo-shrike	2	0	2
Brown Honeyeater	2	0	2
White-cheek Honeyeater	1	1	2
Striated Pardalote	0	1	1

The Australian Raven and Western Magpie were the least desired species (Table 6.10). Sixty-six percent of all respondents identified the Raven as undesirable, 62% mentioned the Magpie. A response of "Dislike None" rated the third most popular (18%), followed by the Magpie Lark at 12%. When respondents were asked what other birds they would like to see in the parks, there was a limited response. The Splendid Blue Wren and Sulphur-crested Cockatoo were mentioned most often (six and five times respectively).

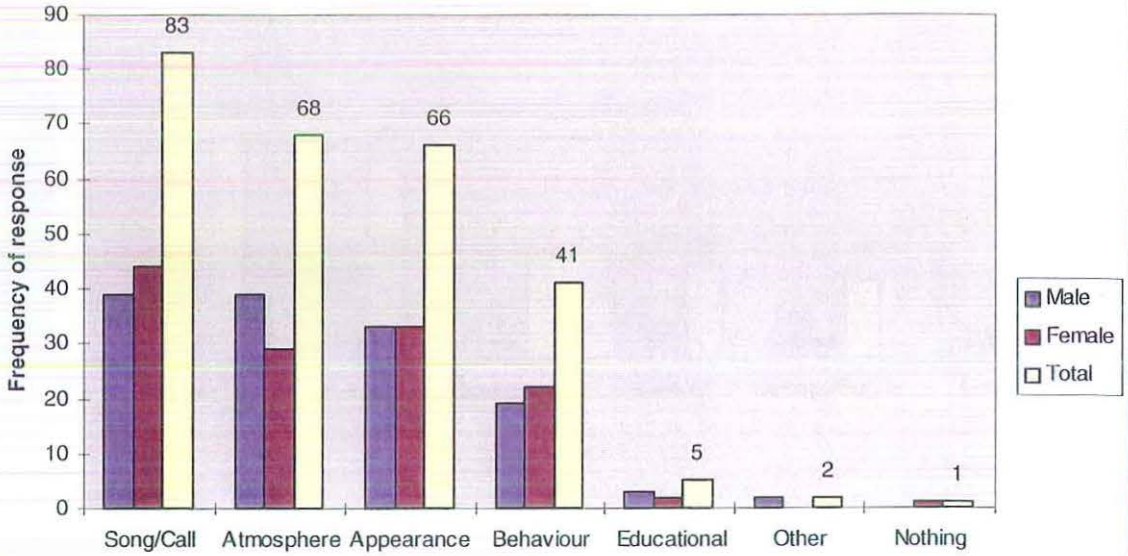
Table 6.10: The frequency that different bird species were considered least desirable by respondents (*Question 7 – Which three bird species do you consider least desirable in recreational parks?*).

Bird Species	**Female**	**Male**	**Total**
Australian Raven	34	32	66
Western Magpie	31	31	62
*Dislike None	8	10	18
Magpie Lark	4	8	12
Senegal Turtle-dove	2	5	7
Butcherbird	3	3	6
Galah	3	3	6
Spotted Turtle-dove	1	5	6
Laughing Kookaburra	3	1	4
Red Wattlebird	4	0	4
White-tailed Black Cockatoo	1	3	4
Ringnecked Parrot	0	2	2
Welcome Swallow	0	2	2
Rainbow Lorikeet	0	1	1
New Holland Honeyeater	1	0	1
Tree Martin	0	1	1

6.3.4 Desirable and undesirable bird characteristics

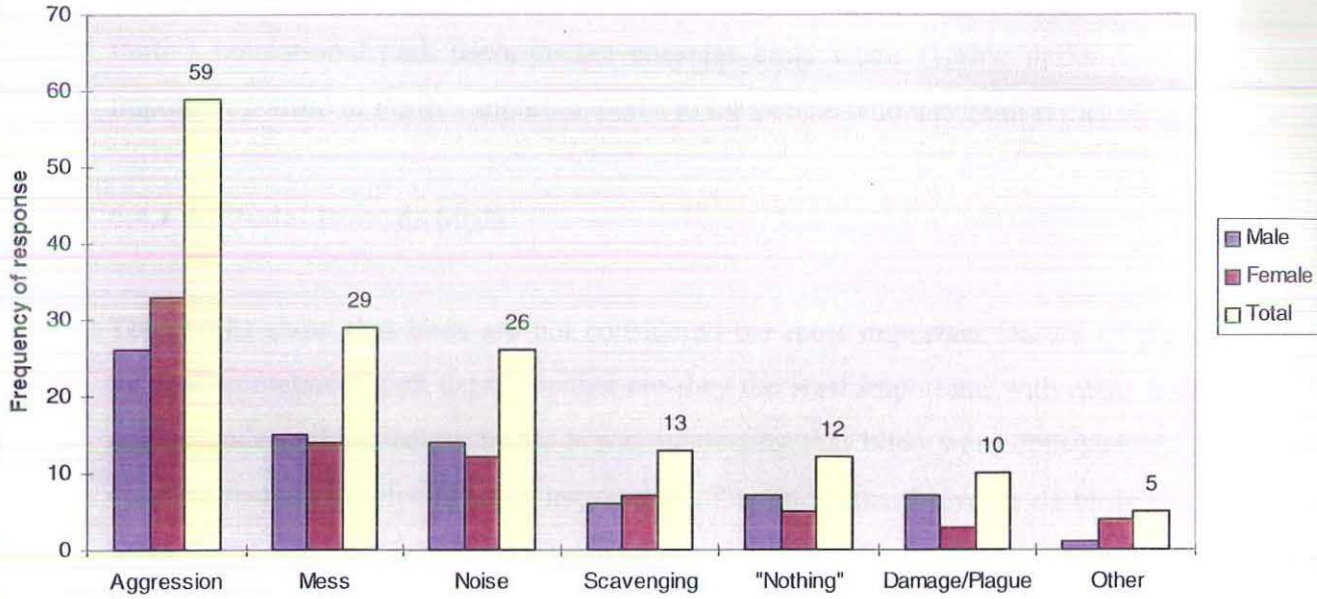
Respondents were asked to list the three most desirable characteristics of birds. There was a varied response (see Appendix 6c). The answers were grouped into seven categories, similar to those used by Penland (1987). Bird song/call was considered the most desirable characteristic of birds by 83 respondents (Figure 6.1). The atmosphere they provide, their appearance and behaviour also rated highly (68, 66 and 41 respondents, respectively). The educational value of birds, other (which included responses of "everything" and "originality"), and nothing (i.e., no bird characteristics were considered desirable) were uncommon answers. Males equally appreciated bird song/call and the atmosphere they provide, closely followed by their appearance. Females considered song/call to be the most desirable characteristic, followed by their appearance and then the atmosphere they provide.

Figure 6.1: Most Desirable Bird Characteristics
(Question 9 - What is it about birds you find most appealing?)



Bird characteristics considered undesirable by respondents were also investigated. The answers were grouped into seven categories, similar to Penland (1987). The variation of response was less than in the previous question. The aggressiveness of birds was mentioned by 59 respondents as an undesirable characteristic (Figure 6.2). Mess and noise were considered undesirable by 29 and 26 respondents, respectively. Thirteen respondents considered scavenging an undesirable characteristic, while 12 thought no bird characteristic undesirable. A dislike of birds causing damage or having high abundance was mentioned by 10 respondents. The 'other' category, provided by five respondents, includes responses that birds were annoying or "stupid".

Figure 6.2: Least Desirable Bird Characteristics
(Question 10 - What is it about birds that you find least appealing?)



6.4 DISCUSSION

The results suggest that there is a fairly even spread of age and gender in people who visit Perth's northern suburban recreational parks. The parks are mainly used by people walking their dogs and/or exercising after working hours (1700-1900 hours). Before normal working hours (0700-0900 hours), the parks are mostly used by people walking their dogs. During the day (1300-1500 hours), the parks are often used for access to other places. While it may be argued that these people are not really using the park, some respondents added that they would prefer to walk through the more natural setting of a park than use the streets.

Birds were not listed as a main reason for visiting the parks, although two people said that they watched birds when they were there. This demonstrates that the majority of Perth's recreational park users do not consider birds when visiting parks. The most important feature of Perth's suburban parks to the people who use them is cleanliness.

6.4.1 Attitudes towards birds

The results show that birds are not considered the most important feature of parks to 99% of recreational park users. Neither are they the least important, with other animals and solitude ranking below birds. It was interesting that birds were consistently rated close to recreational facilities in importance. This indicates the value of birds to park users, given that the parks studied were all zoned as 'public open space' and planned for the primary purpose of public recreation (M. O'Neill, Ministry for Planning, pers. comm., March 9, 1997).

There was evidence that people sampled between 1300 and 1500 hours ranked birds higher than other groups. Many respondents sampled during these times use the park mainly for access to other areas. It is unlikely that people just walking through the park have much interest in recreational facilities or amenities and are more likely to be interested in the atmosphere the park provides - features such as trees/shrubs, open space and birds.

The results demonstrate that as the age of the park user increases, birds are considered more important. This trend seems to agree with the stereotypical ideal that young people do not appreciate nature as do older people. As people get older they tend to seek more passive recreation and acquire an increased knowledge and awareness of the importance of nature.

Birds are valued as more important by frequent users of Perth's north suburban recreational parks than non-frequent users. Frequent users probably visit the parks more often in the first place because they prefer the more natural park setting. As they visit the parks more often, frequent users may notice and appreciate the birds and their antics more than non-frequent users.

Perhaps the best indication of whether birds are valued as important by park users was that 93% of respondents thought that birds should be encouraged in suburban areas. This shows that park users do value having birds in their suburban parks and supports recent authors who have noted the increasing interest by private householders and councils to entice native birds into suburban parks and private gardens (Jones 1981; Mason 1985; Green 1984; DeGraaf 1987).

Penland (1987) undertook a study on the attitudes of urban residents towards avifauna in Seattle, Washington. He concluded that while knowledge of neighbourhood bird species was poor, people showed great interest in birds. The sophistication of answers on how to encourage birds in suburban areas suggests that while many people may remain ignorant of information specific to individual bird species, they are knowledgeable on their biological needs as a whole.

6.4.2 Desirable Species and Species' Attributes

Penland's (1987) survey showed that the American Robin and House Sparrow were the most desired species in Seattle, Washington. This survey found the three most desirable species to be the Galah, Laughing Kookaburra and Rainbow Lorikeet. In both studies, species native to the areas sampled were identified as the most popular (the American Robin and Galah). It was surprising that the Galah was considered the most desirable bird by respondents as it is often considered a pest, especially in rural areas, where it causes substantial crop damage. Galah's have attractive plumage, however, and are often domesticated and taught to talk. This may explain why more than half of the respondents identified the Galah as the most desirable bird in urban areas.

Laughing Kookaburras and Rainbow Lorikeets have been introduced to Perth from Eastern Australia. Their popularity may reflect a lack of knowledge as to the origins of local avifauna or that the community does not mind whether species are native or introduced in Perth's northern recreational parks. Interestingly, 18 respondents mentioned the 'naturalness' of birds as a desirable characteristic. The ambiguity of this word however allows no further interpretation. The Laughing Kookaburras popularity is most likely attributable to its song, which is uniquely Australian. The Rainbow Lorikeet, like the Galah, has been domesticated and taught to talk. Its popularity, however, is most likely due to its colourful appearance.

Penland (1987) found the inclusion of the House Sparrow as highly desirable interesting because they are not native to Seattle, frequently construct their nests in houses, create mess around their nest sites, compete with native birds for nesting sites, occur in large flocks and have no pleasant song or call. He considered their small size and "cuteness" to be their redeeming features.

Other species that were considered desirable by more than 10% of respondents were the Willie Wagtail, Ringnecked Parrot, Western Magpie, Rainbow Bee-eater and Singing Honeyeater. These species are all native to the study area. The Splendid Blue Wren and Sulphur-crested Cockatoo were mentioned by respondents as species they would like to see in the parks. The Splendid Blue Wren would have originally inhabited the park areas; the Sulphur-crested Cockatoo would not (How and Dell 1993).

Bird song/call was found to be the most desirable bird characteristic in this study. In comparison, Penland (1987) found behaviour and colour to be the most desired characteristics, with song/call rated third. The atmosphere birds provide, their appearance and behaviour rated highly in this survey. There was nothing substantially different between the characteristics of birds preferred by males and females. While females consider birds slightly more important than males do, it seems that both males and females both like birds for the same reasons.

6.4.3 Undesirable Species and Species' Attributes

The Australian Raven and Western Magpie were considered to be the least desirable species by Perth's suburban recreational park users. The American Crow was considered the least desirable bird in Penland's (1987) study in similar proportions to those who considered the Australian Raven undesirable in this study (59% and 66%, respectively). Respondents commented that Ravens are noisy, aggressive and messy. European folklore tells us that Ravens foretell death and disaster (Armstrong 1970) and it is well known that Ravens are carrion-feeders (Rowley 1974). These characteristics seem to be responsible for the Ravens unpopularity.

In a recent survey by P. Stewart (Edith Cowan University, unpub. data) on the attitudes of people towards Ravens in Perth, 601 respondents of 1500 (40%) commented that they thought Ravens were a problem. It seems that while the majority of Perth people do not consider Ravens a problem, a large proportion consider them the least desirable of urban birds.

The Western Magpie was the only bird species to rank highly as both a desirable and undesirable species. Magpies' have a reputation for swooping aggressively during their nesting season in spring, which is undoubtedly the reason it is considered undesirable by many park users. At other times of the year, the Western Magpie is tame and has a pleasant call.

The mixed feelings about the Western Magpie that were seen in this study are similar to those described by Jones and Everding (1991) regarding the Australian Brush-turkey. In the suburbs of Brisbane, householders have made numerous complaints about the destruction of landscaping and plantings, the harassment of pets and children, and the nuisance associated with removing mounds and debris caused by Australian Brush-turkeys. On the other hand, a number of householders enjoy the birds' presence and actively encourage them into their gardens by feeding them (Jones and Everding 1991).

Penland (1987) found noise and mess to be the most undesirable characteristics of birds. These characteristics were considered highly undesirable in this study also, although aggressiveness was identified most often. Scavenging was considered undesirable by similar proportions in both studies, 13% in this study versus 12% in Penland's (1987) study.

The third highest response for the most undesirable bird species was that the respondent did not dislike any birds. This supports the conclusion that, in general, park users 'like' birds. While birds do not spring to mind as important reasons for visiting parks, their presence is appreciated by park users. There is a general consensus among park users that birds should be encouraged to inhabit suburban areas.

CHAPTER 7

CONCLUSIONS & MANAGEMENT IMPLICATIONS

Perth's suburban park and street avifauna is poor in comparison to the pool of species available to the region. This is expected in a region where the majority of bushland patches are small and isolated (Majer and Recher 1994). The questionnaire administered to users of Perth's northern suburban recreational parks revealed that most park users would like to see birds encouraged to inhabit suburban areas. In addition to the appreciation of birds by park users, the Western Australian community has the second highest number of members per capita in the Royal Australasian Ornithologists Union of all Australian states (S. Robinson, R.A.O.U, pers. comm., April 10, 1997).

One way to assist birds in overcoming problems associated with habitat fragmentation (such as the threat of fire to isolated populations) is to maintain connectivity to other areas by means of habitat corridors (e.g., Majors 1988; Majer and Recher 1994). Ideally, some suburban development should be replaced with bushland because the majority of bushland areas in urban Perth are small and not considered sufficient to maintain a diverse avifauna. However, even small areas of bushland and suburban parks can be useful, providing habitat and acting as stepping stones for birds moving into larger reserves.

Management plans to encourage native avifauna in urban areas need to take a holistic approach and acknowledge the importance of the entire urban matrix. In addition to council efforts, the local community should be encouraged to incorporate management ideas into their own gardens. Gardens, if designed properly and integrated together, can act as a corridor for wildlife (Majer and Recher 1994). As Thomas *et al.* (1977) point out, wildlife requires four basic elements for survival; water, food, suitable breeding habitat, and cover. Combinations of these four elements are unique for each species, but with careful planning, habitats can be managed to attract the greatest number and diversity of birds.

Where water is scarce, birdbaths could be introduced into the parks. Paying for birdbaths and the maintenance required in keeping them free of dead materials may be an expense that the general community is unwilling to cover. Encouraging local residents to place them in their gardens could mitigate this problem. Many households around Perth have already taken this initiative.

Many respondents to the questionnaire conducted during this study mentioned that feeding the birds would encourage them into urban areas. This is not recommended because the birds will become dependent on humans for food. While I did not find conclusive evidence that birds are affected by different vegetation types, there is overwhelming evidence from other sources that indicates the importance of native, diverse vegetation of different strata levels to birds (e.g., Lancaster and Rees 1979; Green 1984, 1986; DeGraaf 1987). Encouraging a diverse array of native shrubs and trees provides birds with a natural source of food. Selecting plants for the maximum overlap of flowering and fruiting times will also encourage a more diverse avifauna (Thomas *et al.* 1977).

Green (1986) suggested that, to encourage native birds, eucalypts should be planted in abundance because they are important to many foliage gleaners and as perches for native ground foragers. The percentage cover of lawn should also be reduced and more habitat provided for a greater range of native birds. While some native ground foragers use lawn for foraging, they are outnumbered by exotic species (Green 1986). Some seed-eating birds, such as the native finches, require the small seed produced by grass, but in urban Perth most grass is mown and not allowed to develop long enough to set seed. If lawn is necessary, managers should consider leaving parts of it unmowed (Majer and Recher 1994).

Planting a diverse range of strata levels, with at least some tall trees and low dense shrubs, will provide birds with increased cover from enemies and the weather, as well as nest sites. The perpetuation of birds in urban areas obviously relies heavily on having suitable nesting sites. This study showed that the native species richness and diversity increased with an increase in average tree height in the parks. Old, large trees provide many bird species with nesting sites and/or materials. However, urban areas rarely have large, old trees because they are dangerous to humans or not aesthetically pleasing. Urban areas need to be managed for different successional stages of vegetation because

different species are associated with different stages in the development of plant communities (Majer and Recher 1994). Where there is public aversion to the retention of large trees in urban areas and lack of suitable nesting sites, it is recommended that nesting boxes be introduced. If there are suitable sites, but materials to build nests are unavailable, nesting material (e.g., woody debris and litter) could be provided.

Cats and dogs are common enemies to birds. Many respondents recognised the need to control cats by wearing bells, have a curfew, or limiting their numbers, but few people recognised the threat of dogs. While increasing the cover of vegetation will assist birds in avoiding predators, pets need to be controlled. In parks the threat of dogs killing birds could be reduced by enforcing that they be on a leash.

Every management plan should include some form of monitoring. This study has introduced a simple method for sampling highly heterogeneous sites, such as parks and remnant bushland. The temporal area search method can be used to monitor the health of bird communities in urban areas, quickly and with minimum effort. After an initial survey of parks and remnants in selected suburbs throughout Perth, a few five minute counts at each site should be able to provide indications of changes in the urban avifauna. However, transect methods are more appropriate for sampling birds in streets. Studies such as the one being undertaken by Clive Nealon at the R.A.O.U., where members record the birds they see in their backyards over time, will become increasingly important. Such surveys provide comprehensive information on the suburban avifauna that is otherwise difficult to obtain.

The lack of education about birds within local communities is a management issue that needs to be addressed. A number of people actually thanked the interviewers for asking them to do the questionnaire, commented how interesting it was and asked many questions regarding the birds seen around them at the time. I am left in no doubt that the public has a definite interest in birds. Unfortunately, as recognised by Penland (1987) the public's knowledge of local birds seems to be minimal. One of primary aims of any management program should be to narrow the gap between the public's interest and its knowledge regarding birds. Penland (1987) suggested educational programs and activities such as newspaper columns, classes and workshops, species identification posters and other means to address this problem.

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APPENDICES

BIRD SPECIES LIST

Birds sampled in Perth's northern suburban recreational parks and streets (not including pilot testing)

COMMON NAME	SCIENTIFIC NAME
Australian Hobby (Little Falcon)	*Falco longipennis*
Australian Raven	*Corvus coronoides*
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
Brown Honeyeater	*Lichmera indistincta*
Common Bronzewing Pigeon	*Phaps chalcoptera*
*Domestic Pigeon (Rock Dove)	*Columba livia*
Galah	*Cacatua roseicapilla*
Grey Butcherbird	*Cracticus torquatus*
*Laughing Kookaburra	*Dacelo novaeguineae*
Magpie Lark	*Grallina cyanoleuca*
Nankeen Kestrel	*Falco cenchroides*
New Holland Honeyeater	*Phylidonyris novaehollandiae*
Pacific Black Duck	*Anas superciliosa*
Pied Cormorant	*Phalacrocorax varius*
Rainbow Bee-eater	*Merops ornatus*
*Rainbow Lorikeet	*Trichoglossus haematodus*
Red Wattlebird	*Anthochaera carunculata*
Ringnecked Parrot	*Platycercus zonarius*
Sacred Ibis (White Ibis)	*Threskiornis spinicollis*
*Senegal (Laughing) Turtle-dove	*Streptopelia senegalensis*
Singing Honeyeater	*Lichenostomus virescens*
*Spotted Turtle-dove	*Streptopelia chinensis*
Striated Pardalote	*Pardalotus striatus*
Tree Martin	*Hirundo nigricans*
Welcome Swallow	*Hirundo neoxena*
Western Magpie	*Gymnorhina tibicen*
White-cheek Honeyeater	*Phylidonyris nigra*
White-tailed (Carnaby's) Black Cockatoo	*Calyptorhynchus latirostris*
Willie Wagtail	*Rhipidura leucophrys*
Wood Duck (Maned Duck)	*Chenonetta jubata*

NB: * denotes species introduced to Perth, post-European settlement.

Other bird species mentioned throughout text

COMMON NAME	SCIENTIFIC NAME
American Crow (Common Crow)	*Corvus brachyrhynchos*
American Robin	*Turdus migratorius*
Australian Brush-turkey	*Alectura lathami*
Barn Swallow	*Hirundo rustica*
Blackbird	*Turdus merula*
Common Myna	*Acridotheres tristis*
Common Starling	*Sturnus vulgaris*
European Goldfinch	*Carduelis carduelis*
Greater Wood Swallow	*Artamus maximus*
House Sparrow	*Passer domesticus*
Little Corella	*Cacatua pastinator*
Shining Starling	*Aplonis metallica*
Silvereye	*Zosterops lateralis*
Splendid Blue Wren	*Malurus splendens*
Sulphur-crested Cockatoo	*Cacatua galerita*

PLANT SPECIES LIST

Plants sampled in Perth's northern suburban recreational parks and streets (not including pilot testing)

COMMON NAME	SCIENTIFIC NAME
Acorn Banksia	*Banksia prionotes*
*African Lovegrass	*Eragrostis curvula*
Bald Island Marlock	*Eucalyptus conferruminata*
Blackboy	*Xanthorrhoea preissii*
Blowfly Grass	*Briza maxima*
Blue Gum	*Eucalyptus leucoxylon*
Blueboy	*Stirlingia latifolia*
Chenille Honeymyrtle	*Melaleuca huegelii*
Coastal Honeymyrtle	*Melaleuca acerosa*
Coastal Wattle	*Acacia cyclops*
*Couch Grass	*Cynodon dactylon*
Dwarf Sheoak	*Allocasuarina humilis*
Firewood Banksia	*Banksia menziesii*
*Flaxleaf Fleabane	*Conyza bonariensis*
Flooded Gum	*Eucalyptus ?rudis*
Fraser's Sheoak	*Allocasuarina fraseriana*
Geraldton Wax	*Chamelaucium uncinatum*
Grey Honeymyrtle	*Melaleuca ?incana*
*Hare's Tail Grass	*Lagurus ovatus*
Honeybush	*Hakea lissocarpha*
Jarrah	*Eucalyptus marginata*
Large Flowered Bog Rush	*Schoemus grandiflorus*
Mahogany Gum	*Eucalyptus botryoides*
Marri	*Corymbia calophylla*
No Common Name	*Isolepis nodosa*
No Common Name	*Mesomelaena stygia*
No Common Name	*Acacia rostellifera*
No Common Name	*Atriplex isatidea*
No Common Name	*Daviesia divaricata*
No Common Name	*Eremaea pauciflora*
No Common Name	*Grevillea vestita*
No Common Name	*Jacksonia furcellata*
No Common Name	*Melaleuca pentagona*
No Common Name	*Scaveola crassifolia*
No Common Name	*Spyridium globulosum*
*No Common Name	*Trachyandra divaricata*
No Common Name	*Trymalium ledifolium*
Orange Wattle	*Acacia saligna*
Peppermint Tree	*Agonis flexuosa*
*Perennial Veldgrass	*Ehrhata calycina*
*Petty Spurge	*Euphorbia peplus*
Prickly Moses	*Acacia pulchella*
Purple Flag	*Patersonia occidentalis*
Red Flowering Gum	*Corymbia ficifolia*
*Rice Millet	*Piptatherum miliaceum*

(cont'd)

COMMON NAME	SCIENTIFIC NAME
River Red Gum	*Eucalyptus camaldulensis*
Rottnest Teatree	*Melaleuca lanceolata*
Salmon Gum	*Eucalyptus salmonophloia*
Silver Princess	*Eucalyptus caesia*
Slender Banksia	*Banksia attenuata*
Spotted Gum	*Eucalyptus maculata*
Sugar Gum	*Eucalyptus cladocalyx*
*Summer Grass	*Digitaria ciliaris*
Tuart	*Eucalyptus gomphocephala*
Unknown	*Conostylis* sp.1
Unknown	*Grevillea* sp.1
Unknown	Unknown sp.1
Unknown	Eucalypt sp.1
Unknown	Eucalypt sp.2
Unknown	Eucalypt sp.3
Unknown	Eucalypt sp.4
Unknown	Eucalypt sp.5
Unknown	Eucalypt sp.6
Unknown Bottlebrush	*Callistemon* sp.1
*Unknown Fig Tree	*Ficus* sp.1
*Unknown Palm	Unknown sp.2
*Wild Oats	*Avena fatua*
Zamia Palm	*Macrozamia riedlei*

NB: * denotes species introduced to Perth.

Other plant species mentioned throughout text

COMMON NAME	SCIENTIFIC NAME
Swan River Cypress (Rottnest Island Pine)	*Callitris preissii*

The Dominant Grass Species found in each Park

Scientific name	Common Name	ARB	AVO	BEE	BEL	BLA	CAB	CEL	GLE	HAD	HIL	JOH	KIN	OTT	SAL	SEA	STR
**Avena fatua*	Wild Oats									X	X				X	X	
**Briza maxima*	Blowfly Grass							X				X	X				
Conostylis sp.1	Unknown	X															
**Conyza bonariensis*	Flaxleaf Fleabane				X												X
**Cynodon dactylon*	Couch Grass	X	X	X	X	X	X	X	X		X	X	X	X		X	X
**Digitaria ciliaris*	Summer Grass							X		X		X		X	X		
**Ehrhata calycina*	Perennial Veldgrass		X			X				X		X	X	X	X		X
**Eragrostis curvula*	African Lovegrass	X															
**Euphorbia peplus*	Petty Spurge															X	
Isolepis nodosa	No Common Name															X	
**Lagurus ovatus*	Hare's Tail Grass									X	X				X	X	
Mesomelaena stygia	No Common Name					X		X				X					
Patersonia occidentalis	Purple Flag	X										X					
**Piptatherum miliaceum*	Rice Millet																X
Schoemus grandiflorus	Large Flowered Bog Rush										X						
**Trachyandra divaricata*	No Common Name															X	

* indicates introduced species

The Dominant Shrub Species found in each Park

Scientific name	Common Name	ARB	AVO	BEE	BEL	BLA	CAB	CEL	GLE	HAD	HIL	JOH	KIN	OTT	SAL	SEA	STR
Acacia cyclops	Coastal Wattle															X	
Acacia pulchella	Prickly Moses	X															
Acacia rostellifera	No Common Name								X			X					
Allocasuarina humilis	Dwarf Sheoak		X							X		X					
Atriplex isatidea	No Common Name															X	
Callistemon sp.1	Unknown Bottlebrush					X										X	
Chamelaucium uncinatum	Geraldton Wax													X			
Daviesia divaricata	No Common Name												X				
Eremaea pauciflora	No Common Name		X									X					
Grevillea sp.1	Unknown											X		X			
Grevillea vestita	No Common Name									X							
Hakea lissocarpha	Honeybush									X							
Jacksonia furcellata	No Common Name	X															
Macrozamia riedlei	Zamia Palm														X		
Melaleuca acerosa	Coastal Honeymyrtle					X											
Melaleuca huegelii	Chenille Honeymyrtle			X													
Melaleuca pentagona	No Common Name					X			X					X			
Scaveola crassifolia	No Common Name										X						
Spyridium globulosum	No Common Name										X						
Stirlingia latifolia	Blueboy		X									X					
Trymalium ledifolium	No Common Name										X						
Unknown sp.1	Unknown																X
Xanthorrhoea preissii	Blackboy	X	X			X	X	X	X	X		X	X		X		X

The Dominant Tree Species found in each Park

Scientific name	Common Name	ARB	AVO	BEE	BEL	BLA	CAB	CEL	GLE	HAD	HIL	JOH	KIN	OTT	SAL	SEA	STR
Acacia saligna	Orange Wattle									X			X	X		X	
Agonis flexuosa	Peppermint Tree			X					X		X					X	X
Allocasuarina fraseriana	Fraser's Sheoak			X	X		X				X	X	X			X	
Banksia attenuata	Slender Banksia		X			X						X	X		X		
Banksia menziesii	Firewood Banksia		X			X		X				X					
Banksia prionotes	Acorn Banksia											X					
Corymbia calophylla	Marri	X					X		X					X			X
Corymbia ficifolia	Red Flowering Gum												X				
Eucalyptus botryoides	Mahogany Gum			X				X									
Eucalyptus caesia	Silver Princess						X										
Eucalyptus camaldulensis	River Red Gum		X	X										X			
Eucalyptus cladocalyx	Sugar Gum									X			X			X	
Eucalyptus conferruminata	Bald Island Marlock										X						
Eucalyptus gomphocephala	Tuart			X	X		X	X		X	X		X		X		
Eucalyptus leucoxylon	Blue Gum						X					X					
Eucalyptus maculata	Spotted Gum											X					
Eucalyptus marginata	Jarrah		X			X	X	X	X			X	X		X		
Eucalyptus ?rudis	Flooded Gum							X									
Eucalyptus salmonophloia	Salmon Gum								X								
Eucalypt sp.1	Unknown										X						
Eucalypt sp.2	Unknown											X					
Eucalypt sp.3	Unknown					X											
Eucalypt sp.4	Unknown													X			
Eucalypt sp.5	Unknown		X														
Eucalypt sp.6	Unknown		X														
**Ficus* sp.1	Unknown Fig Tree																X
Melaleuca ?incana	Grey Honeymyrtle													X			X
Melaleuca lanceolata	Rottnest Teatree			X							X	X			X	X	
*Unknown sp.2	Unknown Palm				X												

* indicates introduced species

COMMUNITY ATTITUDES TOWARDS FEATURES OF SUBURBAN RECREATIONAL PARKS IN THE PERTH METROPOLITAN AREA

Gender: M / F (Circle)

1. **What age group do you belong to?**

- ☐ 15-20
- ☐ 20-30
- ☐ 30-40
- ☐ 40-50
- ☐ 50+

2. **How often do you visit Perth's recreational parks, on average? Remembering that I'm only interested in those without lakes.**

- ☐ Daily
- ☐ Weekly
- ☐ Fortnightly
- ☐ Monthly
- ☐ Six Monthly
- ☐ Yearly
- ☐ Other _____

3. a). **What is the main reason that you visit Perth's recreational parks?** (Place a one (1) in the box that is closest or add any that you can't group into 'other').

b). **What other things do you do in them?** (Place a two (2) in the box that is closest or add any that you can't group into 'other').

- ☐ Use Playground (Take children to park, etc)
- ☐ Exercise (Jog, Walk, etc)
- ☐ Use Amenities (ie. toilet, drinking fountain, carpark, bins)
- ☐ Walk Dog
- ☐ Picnic (Have lunch, etc)
- ☐ Watch Birds
- ☐ Active Recreation (Soccer, Football, Cricket, etc.)
- ☐ Other (Please Specify)

_____

_____

_____

_____

4. **Please rank the following features of recreational parks in order of importance to you, from most important to least important.** GIVE SHEET AND TAKE DOWN THE ORDER THEY GIVE.

- ☐ Amenities (Picnic Facilities, Carpark, Toilets, Playground, Bins, etc.)
- ☐ Cleanliness
- ☐ Birds
- ☐ Active Recreational Facilities (Cricket Pitches, Ovals, Courts, etc.)
- ☐ Trees/Shrubs
- ☐ Open Space
- ☐ Animals
- ☐ Solitude

5. **Are there any other items that are important to you in recreational parks that I may have missed?**

_____

_____

_____

_____

SHOW THE RESPONDENT PICTURES OF THE BIRDS

These birds are currently found in recreational parks of Perth's northern suburbs. The domestic pigeon is also found but I was unable to get a picture (describe).

6. **Which three bird species do you consider most desirable in recreational parks?**

1. _____
2. _____
3. _____

7. **Which three bird species do you consider least desirable in recreational parks?**

1. _____
2. _____
3. _____

8. **Are there any other particular birds that you would like to see in Perth's recreational parks?** (Please Specify)

_____

_____

_____

9. **What is it about birds that you find most appealing?**

1. _____

2. _____

3. _____

10. **What is it about birds that you find least appealing?**

1. _____

2. _____

3. _____

11. **Do you think that steps should be taken to encourage birds to live in suburban areas?**

Y / N (Please Circle)

12a. **If not, why?** _____

12b. **If so, have you any ideas on how this may be achieved?** _____

_____

_____

_____

_____

_____

_____

_____

_____

Thank-you for your time!


Singing Honeyeater
New Holland Honeyeater
White-cheek Honeyeater
Spotted Turtle-dove
Brown Honeyeater
Senegal/Laughing Turtle-dove
Rainbow Bee-eater
Willie Wagtail
Welcome Swallow
Tree Martin
Striated Pardalote


Pink & Grey Galah
Laughing Kookaburra
White-tailed/Carnaby's Black Cockatoo
Rainbow Lorikeet
Port Lincoln/Ringnecked Parrot ('28')
Red Wattlebird
Black-faced Cuckoo-shrike
Grey Butcherbird
Magpie
Magpie/Mud Lark
Australian Raven

CATEGORISING THE DESIRABLE CHARACTERISTICS OF BIRDS

Most Like About Birds	Female	Male	Total	Category
Friendly/Approachable	6	1	7	Behaviour
Presence	5	11	7	Atmosphere
Sound/Song	44	39	83	Song/Call
Relaxing	3	5	8	Atmosphere
Fascinating/Pleasure to watch	3	1	4	Atmosphere
Colour	23	30	53	Appearance
Freedom	9	7	16	Atmosphere
Appearance	5	2	7	Appearance
Happiness	2	0	2	Behaviour
Movement	5	3	8	Behaviour
Daintiness	1	0	1	Appearance
Antics	3	6	9	Behaviour
Feeding/Eat Insects	2	2	4	Behaviour
Natural	9	10	19	Atmosphere
Large Size	1	0	1	Appearance
Lifestyle	1	1	2	Behaviour
Nesting	1	0	1	Behaviour
Flight	1	6	7	Behaviour
Vulnerability	1	0	1	Appearance
Educational for children to see	2	3	5	Educational
Aesthetic beauty	1	1	2	Appearance
Adaptability	1	0	1	Behaviour
Pretty	1	0	1	Appearance
Nothing	1	0	1	Nothing
Peacefulness	0	3	3	Atmosphere
Serenity	0	1	1	Atmosphere
Atmosphere	0	1	1	Atmosphere
Endemism	0	1	1	Other
Everything	0	1	1	Other