

# **The Birds and Reptiles of the Iramoo Green Web, Brimbank:**

## **Scoping the Requirements for Conservation**

**By Craig Dodson  
and**

**Supervisor: Dr. Colin Hocking  
(June 2004)**

**Sustainability Group  
St. Albans Campus  
Victoria University**

VICTORIA UNIVERSITY OF TECHNOLOGY



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Conservation”**

**By Craig Dodson**

**Supervisor: Dr. Colin Hocking**

**A thesis submitted to the Sustainability Group (Faculty of  
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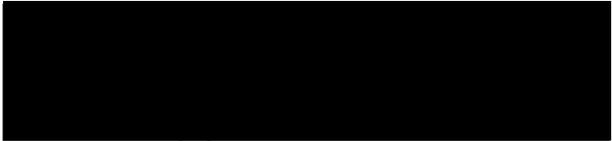
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Craig Dodson

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## ABSTRACT

A study was conducted to determine the diversity of birds and reptiles in the Iramoo Green Web, which is a series of open spaces in a rapidly developing urban area of the north-western suburbs of Melbourne, Victoria.

Sixty-seven bird species and 8 reptile species were recorded during surveys conducted between October 2003 and March 2004. It was found that bird and reptile species richness of sites was generally not influenced by area but rather by the diversity of habitat. Bird species composition of open spaces was influenced by the available habitat and the proximity of the urban matrix. Reptile species composition in open spaces was found to be generally influenced by the extent of habitat alteration with those areas retaining remnant vegetation and basalt rocks having the most complete assemblage.

The value of revegetation zones for native birds was also investigated and they were found to be used mainly by common species. Observations of human usage of open spaces were recorded and it was found that the most frequent users were males aged 20-40 years walking or walking dogs.

Most of the open spaces were found to be highly fragmented and this has implications for the long-term persistence of bird and reptiles. Strategic planning is required for the restoration and management of open spaces if the bird and reptile values of the Iramoo Green Web are to be conserved.

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# CHAPTER 1: INTRODUCTION

## 1.1 Iramoo Green Web

The Iramoo Green Web (I.G.W.) is a circuit of open spaces with environmental, recreational and cultural values, located in Brimbank City Shire in the northwestern suburbs of Melbourne, Victoria. The circuit is approximately 10 km long and is linked by Jones Creek, Kororoit Creek and the Gladstone Street Drain Lakes and is bordered by residential, commercial and industrial areas. Urban encroachment of the open spaces is continuing in the central zone of the study area (Cairnlea Estate).

The extensive urbanisation in the area has resulted in the open spaces of the I.G.W. becoming highly fragmented with most open spaces isolated by the various barriers of the urban matrix such as roads, bridges and fences. Many of these open spaces (hereafter referred to as sites unless otherwise stated) retain patches of native vegetation and are in effect “habitat islands” in a sea of urbanised land. The size and shape of the open spaces varies and most are infested with exotic vegetation such as Chilean Needle Grass (*Nassella neesiana*) and Serrated Tussock (*Nassella trichotoma*). Exotic predators such as cats (*Felis catus*) and foxes (*Canis vulpes*) are also present in the area. Despite these threatening processes the I.G.W. still maintains high environmental values such as patches of remnant native vegetation and populations of native fauna.

Local stakeholders including Victoria University, Brimbank City Council and Melton Council jointly developed a draft plan to develop the I.G.W. into a showcase of open space sustainable living and a major component will involve conserving these environmental values.

## 1.2 Present Study

This study was an attempt to determine the diversity of birds and reptiles in a rapidly developing urban setting and make some recommendations for how environmental protection and repair might optimise conditions these taxa.

There are numerous projects to repair or supplement native vegetation in urban settings but the outcomes of these actions for fauna are largely unstudied There have been few studies of diversity and distribution of native fauna within urban areas. Before strategies can be devised to conserve the environmental values of the I.G.W. the actual values must first be identified. The present study is focused on identifying the avifaunal and herpetofaunal (reptiles only) values of the I.G.W.

The specific questions of the present study are:

- (1) What species of bird and reptile occur in the I.G.W.?
- (2) Where do the bird and reptile species occur within the I.G.W.? and
- (3) How can the conservation and enhancement of bird and reptile diversity of the I.G.W. be planned for in the long-term?

The study included a review of habitat fragmentation, methods used for surveying birds and reptiles, previous fauna surveys and focal species studies that have been conducted in the area. The following text briefly reviews some of this literature.

### **1.3 Habitat Fragmentation**

The open spaces of the I.G.W. are fragments of the original Victorian Volcanic Plains ecosystem. Due to loss of habitat in the surrounding landscape these fragments have become increasingly isolated and exposed to the outside influences of the urban matrix. All of the fragments have been modified to some extent and much of the remnant flora and fauna are threatened with local extinction due to the effects of fragmentation.

The conservation of birds and reptiles in the I.G.W. will therefore require that the effects of habitat fragmentation be considered and minimised. There is extensive literature on habitat fragmentation including Andrews, A. (1990), Hobbs *et al.* (1993) and Saunders *et al.* (1993).

### **1.4 Effects of Fragmentation**

Fragmentation can affect biodiversity at different scales from changing the gene frequencies in a population to changing the number of species and the composition of assemblages (Bennett, 1990; Haila *et al.*, 1993 and Meffe & Carol, 1997).

There are four main consequences of habitat fragmentation (Haila *et al.*, 1993 and New, 2002):

- (1) Increased risk of extinction of species in fragments due to small population size and increased isolation;
- (2) Invasion by exotic predators and weeds can change the structure of the fragment;
- (3) Hydrological regime and nutrient cycle within a fragment can be disrupted and

(4) Changes in microclimate such as radiation balance and wind regime can occur within a fragment.

As the area of a fragment decreases the number of species present usually decreases. Fragments with a larger area generally have more species than a fragment with a smaller area because a larger area usually has a greater diversity of habitat and this provides more niches for species to occupy (Bennett, 1990). More species are also able to maintain viable populations in larger areas than in smaller areas.

The isolation of fragments can prevent the movement of species due to the barriers of the urban matrix (Meffe & Carol, 1997). Barriers and the distance between populations may prevent species from exchanging genetic material and this can decrease the viability of a population and in turn a metapopulation. Species that have poor dispersal abilities are particularly vulnerable to the isolation of fragments (Andrews, 1990).

The interface between the periphery of a fragment and the surrounding matrix is referred to as an edge. There are three main effects that habitat edges can have on species (Sisk & Margules, 1993):

- (1) Some species increase in abundance,
- (2) Some species decrease in abundance and
- (3) Some species are not affected.

Species that increase in abundance are often generalists and are usually quite common while species that decrease in abundance are usually specialists that need large areas of continuous habitat (Sisk and Margules, 1993).

The 'penetration depth' of edge effects depends on many factors including the area of the fragment. Small fragments can be entirely edge habitat (New, 2000). Edges are also the boundaries across which external influences of the surrounding matrix, such as exotic predators and weeds, invade fragments (Haila *et al.*, 1993 and New, 2000). Changes in the microclimate at edges, such as fluxes in radiation and wind can also have influences on species at edges (Hobb *et al.*, 1993).

#### 1.4.1 *Effects of Fragmentation on Birds*

Fragmentation of habitat is generally detrimental to the native birds species within the fragment. There are 4 main consequences of fragmentation on birds (Marzluff and Ewing, 2001):

- (1) Increased exposure to predators;
- (2) Increased disturbance from human activity;
- (3) Increased competition from exotic bird species; and
- (4) Restricted dispersal.

An increase of native predators such as ravens and raptors can decrease the viability of native birds in fragments especially in small and linear fragments, due to increased predation of eggs, nestlings and adult birds (Marzluff and Ewing, 2001; Robinson *et al.*, 1995). The increased disturbance from human activity may increase the mortality of birds within the fragment (Marzluff and Ewing, 2001). Increases in exotic

predators, disease and competitors may lead to bird extinction in fragments (Marzluff and Ewing, 2001).

Dispersal of birds in fragments can be disrupted by barriers such as roads and buildings, resulting in reduced genetic diversity of bird populations within fragments, however the effects may only be noticed decades later (Evans, 1998; Marzluff and Ewing, 2001).

Other effects of fragmentation include disruption of the hydrological and nutrient cycle in fragments, which may lead to the degradation of habitat causing bird diversity to decrease (Marzluff et al., 1998). As the area of a fragment shrinks, the habitat becomes more homogeneous and native bird species within the fragment decrease and synanthropic species (native and exotic species) increase (Donnelly and Marzluff, 2004; Marzluff and Ewing, 2001).

#### 1.4.2 *Effects of Fragmentation on Reptiles*

The effects of fragmentation on reptiles generally depends on environmental and vegetation variables rather than the area of the fragment (Jellinek *et al.*, 2004). These variables include the geology, soil, rock cover and diversity of vegetation within a fragment (Hadden and Westbrooke, 1996; Jellinek *et al.*, 2004; Mac Nally and Brown, 2001).

Fragmentation affects generalist and specialist species differently. Generalist species are sometimes able to persist in fragments because they can use a number of different

resources. These species also usually have low spatial requirements and can utilise a variety of habitats (Smith *et al.*, 1996)

Specialist species may require specific microhabitats that may no longer exist within a fragment due to degradation (Jellinek *et al.*, 2004). The specific microhabitats may also become disjunct and isolated and this can disrupt dispersal resulting in local extinction of specialist species (Jellinek *et al.*, Mac Nally and Brown, 2001). Large fragments may retain the habitat of specialist species and this may enable them to persist (Mac Nally and Brown, 2001).

Fragments are vulnerable to increased invasion of exotic vegetation and this can result in a decrease of reptiles (Hadden and Westbrooke, 1996; Jellinek *et al.*, 2004; Smith *et al.*, 1996). As the ratio of exotic vegetation to native vegetation increases over time, reptiles may not be able to persist in a fragment (Jellinek *et al.*, 2004). This has implications for the persistence of reptiles in urban fragments (Jellinek *et al.*, 2004)

## **1.5 Choice of Methods**

The methods used to sample birds and reptiles in the present study include: (1) area surveys, and (2) quadrat surveys in grassland, riparian and escarpment/rocky slope habitats. Some of the issues involved in deciding which survey methods to use in the present study are briefly reviewed in the following text.

### **1.5.1 Bird Survey Methods**

Birds are probably the only native vertebrates ever encountered by most residents in the urban areas adjacent to the I.G.W. so their conservation is important not only for

ecological reasons but also for maintaining a feeling of the 'naturalness' of the area and maintaining connectedness between people and native wildlife.

#### *1.5.1.1 Area Surveys*

To adequately survey the avifauna of the I.G.W. various methods and combinations of methods were considered. To address the first and second objectives a detailed species list was compiled by conducting area searches of each site. Woinarski *et al.* (2001) used this method to compile comprehensive species lists of the Wessel and English Company islands off Arnhem Land, Northern Territory. Woinarski *et al.* (2001) provided a model for the present study though on a much smaller scale. Woinarski *et al.* (2001) searched all habitat types and related the species richness of each island to physical features such as island size and isolation.

A problem with area searches is that the survey time is proportional to area (Woinarski *et al.*, 2001) so larger areas require more search effort than smaller areas. The increase in search effort also increases the chances of detecting rare or cryptic species (Mac Nally & Horrocks, 2002). The differences in search effort between areas of different sizes may prevent inferences from being made on the relationship between species richness and area (Mac Nally & Horrocks, 2002) due to the variation in survey times.

A solution to this problem advocated by Mac Nally and Horrocks (2002) is to conduct area-proportionate sampling that are time balanced to ensure that all sites, regardless of size, are surveyed to the same level of completeness. In the present study bird area surveys were conducted until all potential bird habitat had been visited.

### 1.5.1.2 Quadrat Surveys

In the present study quadrats were used to investigate possible associations between habitat variables in 3 habitat types and bird and reptile species diversity. The aim was to sample both birds and reptiles together in these quadrats to allow the biodiversity of these habitats to be investigated. However, there were restrictions on the number of quadrats that could be used due to the limited materials (i.e. tin sheets) available for reptile sampling.

Quadrats are normally surveyed over a fixed-time as this allows species diversity comparisons across quadrats. Field *et al.* (2002) surveyed each 2 ha. quadrat for 20 minutes and Mac Nally and Horrocks (2002) also surveyed each of their 2 ha. quadrats for 20 minutes. Mac Nally and Watson (1997) surveyed 1 ha. transects in buloke (*Allocasuarina luehmanni*) woodland in central Victoria for 20 minutes.

In the present study each quadrat was surveyed for a fixed-time period of 20 minutes.

### 1.5.2 Reptile Survey Methods

Reptile species generally have smaller home ranges than bird species and are less mobile (Scott *et al.*, 2001). This allows some reptile species to persist in small fragments longer than many other native terrestrial species such as mammals and this seems is the case in the I.G.W. The conservation of reptiles in the I.G.W. is therefore not only important for ecological reasons but also as representative examples of the original terrestrial fauna.

### 1.5.2.1 Area Surveys

To address the first and second questions of the objectives it was decided to conduct extensive area surveys of each site by actively searching for reptiles.

Woinarski *et al.* (1999) conducted extensive area searches aimed at recording all species on each island of the Wessel and English Company island groups off Arnhem Land, Northern Territory. They are vague about the details of this search method and no specific techniques are mentioned. Mac Nally and Brown (2001) provide more detail about the active search method they used to survey reptiles in fragments located in the box-iron bark forests of central Victoria. The active search method they used was area-constrained to 10 m x 25 m and they searched all potential reptile shelter sites such as under rocks, logs and shrubs. These searches were time restricted but not temperature restricted because both sheltering and active reptiles were the focus of the search.

The reptile area surveys conducted in the present study were not area-constrained or time restricted because the aim was to record all species present in each site and this required that all areas of potential reptile habitat be searched.

### 1.5.2.2 Quadrat Surveys

Both the Mac Nally and Brown (2001) and Lunny *et al.* (1991) studies used the active search method in quadrats. The size of quadrats varies from 10 m x 10 m as used by Lunny *et al.* (1991) to 50 m x 50 m used by Woinarski *et al.* (1999). Twigg and Fox (1991) used 1 ha. plots and Mac Nally and Brown (2001) used transects 50 m x 10 m

that were positioned in larger 2 ha. quadrats. The size of quadrats in the present study was constrained by the area and shape of the sites.

Most quadrat sampling involves using traps, typically pitfall traps, or active searching or a combination of both. Woinarski *et al.* (1999) set 26 traps of various types in each quadrat and also conducted active searches. Similarly Gambold and Woinarski (1993) set 23 traps in each quadrat and also conducted active searches. Some quadrat sampling involves using clusters of traps. Twigg and Fox (1991) used 2 trap units (clusters) of 5 traps in each plot and these were positioned parallel to the long axis of the plot. Some studies require that traps be set in a higher density than normally used. For example, Read (1995) set 401 pit traps in a 1 ha. quadrat during a study of reptile diversity in chenopod shrublands in arid South Australia.

The present study had limitations on the methods that could be used in quadrats due to the close proximity of human activity and the small size and significance of remnant vegetation in most sites. Pitfall traps would have been at risk of human interference and the digging of pits would have damaged significant indigenous vegetation patches.

### **1.6 Previous Bird and Reptile Studies**

A number of bird and reptile surveys have been conducted at sites within the I.G.W. but most have been part of larger studies focused on the environmental values of the area. Few focal species studies have been conducted in the area, though the Albion Explosives Factory Grasslands has had studies conducted on Tussock Skink

(*Pseudemoia pagenstecheri*) by Sullivan (1999) and the nationally endangered Striped Legless Lizard (*Delma impar*) by O'Shea (1996).

#### 1.6.1 Albion Explosives Factory

The I.G.W. is centred on the former Albion Explosives Factory, St. Albans, and most of this area has been development into the Cairnlea Estate. Larwill *et al.* (1993) conducted a flora and fauna study that included bird and reptile surveys. The aims of the study included describing fauna species, assessing habitat values and advising on management strategies to protect fauna. Surveys were conducted between 9 November 1992 and 11 February 1993 and included various techniques to record mammals, birds, reptiles and amphibians.

Bird surveys were conducted by direct observation and call identification for 9.5 hours between 2<sup>nd</sup> and 4<sup>th</sup> February 1993. Incidental sightings were also recorded. Twenty native bird species were recorded during the surveys and anecdotal records of 4 raptor species were mentioned. The total time of 9.5 hours for bird surveys seems inadequate considering that the study area was 504 ha. As the survey was conducted over 3 consecutive days the average survey works out at 190 minutes for each day and was probably conducted in conjunction with reptile surveys.

Field *et al.* (2002) found that different-day repeat surveys within a season increased the species richness estimate of an area regardless of the time span of when the different-day surveys were conducted. The Larwill *et al.* (1993) study seems adequate according to the findings of Field *et al.* (2002) however the bird surveys were conducted during one season. The species richness of the site is highly likely to

change due to seasonal visitors but these would not have been recorded during the Larwill *et al.* (1993) survey.

The reptile component of the Larwill *et al.* (1993) study was conducted by active searching and pitfall trapping. Active searching was conducted for 12.5 hours and 32 pitfall traps were operated between 8 December 1992 and 21 January 1993. Six reptile species were recorded (4 by active searches and 2 by trapping) and 3 other species were reported as likely to occur. Reptile surveys were conducted in summer and this is the season of lowest activity for most of the reptile species that are likely to occur in the area. For example, Whittaker and Shine (1999) recorded the highest encounter rates with Eastern Brown Snakes (*Pseudonaja textilis*) in spring and the lowest summer and Sullivan (1999) recorded the highest captures of Tussock Skinks (*Pseudemoia pagenstecheri*) in March.

The low activity level of reptiles would have decreased capture rates in pitfall traps because most reptiles would not be active enough to encounter traps and the ability for detecting reptiles during active searches would also be diminished. The present study aimed to alleviate the limitations of the Larwill *et al.* (1993) study concerning seasons by conducting surveys for birds and reptiles over 3 seasons.

#### 1.6.2 *Natural Heritage Strategy Report*

Muir *et al.* (1997) conducted a fauna survey during preparation of the Natural Heritage Strategy for the Brimbank City Council. The strategy was a multi-disciplinary study and was aimed at providing a framework for the planning and management of natural resources including fauna, in the Brimbank area. The study

covered an extensive area and included sites located in the I.G.W. Fauna surveys were aimed at rare and threatened vertebrate species and were conducted between 22 November and 6 December 1996. Active searching was used to find reptiles but methods for birds were not mentioned. Incidental observations of fauna were also recorded. No reptiles were recorded during the surveys and no additional species could be added to the known species list of vertebrates from the incidental observations. The Appendix lists 138 bird and 20 reptile species that have been recorded in the area.

It is surprising that no reptiles were found during these surveys considering the size of the study area. Only 15 days were devoted to fauna surveys and the time allocated for bird and reptiles is not mentioned. Considering that the surveys were also aimed at mammals, fish and amphibians it seems obvious that little time was devoted to birds and reptiles. The limited time devoted to reptile surveys probably contributed to no reptiles being recorded. It is apparent that any survey of urban areas for birds or reptiles requires considerably more resourcing to be adequate.

A summary of 31 sites with Local, Regional, State or National Significance is listed in the report and each has notes on vegetation, fauna and management issues specific to that site. Several of these sites are located in the I.G.W. and are included in the present study.

The summaries for each site are aimed primarily at species that are of significance so common species are neglected. To conserve these sites and their bird and reptile assemblages requires that the specific needs of each species be considered. Muir *et*

al. (1997) have not compiled a detailed list of birds and reptiles for each site and this puts limitations on the recommended management strategies for the conservation of each site. The present study aims to record the species of birds and reptiles that occur at each site so that adequate conservation strategies can be developed.

### 1.6.3 Bullum-Bullum Aboriginal Place

Context Pty. Ltd. And Urban Initiatives Landscape Architects (2000) prepared a conservation management plan for Bullum-Bullum Aboriginal Place (corresponding to Site K in the present study). This report was orientated primarily at the community and therefore provided limited information on the bird and reptile species occurring at the site but did include the Striped Legless Lizard as being present. It listed Cunningham's Skinks (*Egernia cunninghami*) and Little Whip Snakes (*Parasuta flagellum*) as species that have been recorded in adjacent areas and that snakes (possibly tiger snakes) have been seen in the area. No bird species were mentioned in the plan.

The conservation plan identifies exotic predators and habitat fragmentation as contributors to the decline of native fauna at this site. The plan also acknowledges that future persistence of native fauna depends on habitat links that allow animals to move into the site. The main conservation strategies recommended in the plan include fire management, weed control, revegetation and that the Striped Legless Lizard be considered in all management decisions.

A major limitation of this conservation plan is the lack of detail concerning the native fauna of the site. Apart from the Striped Legless Lizard and problem snakes that

move into residential areas, there is no consideration of any bird or reptile species. The small size of the site (8 ha.) requires that extreme care be used when making decisions concerning management.

#### 1.6.4 *Sunshine Grasslands Reserve*

Deakin and Watson (1992) prepared a draft management plan for Sunshine Grassland Reserve, corresponding to Site F in the present study. It mentions a survey conducted by environmental consultants as part of an environmental effects statement for the Western Ring Road that recorded 12 species of reptile and amphibians and notes that Striped Legless Lizards have previously been recorded at the site (Deakin and Watson, 1992). The plan suggests that enhancement of the site may attract grassland birds such as the Little Grassland (*Megalurus gramineus*) and Golden-headed Cisticola (*Cisticola exilis*).

The plan includes detailed strategies for conserving the site but lacks specific detail concerning the conservation of fauna, in particular birds and reptiles.

The management objectives listed for the site include establishing an indigenous grassland reserve to favour the persistence of indigenous fauna and introducing species that have been lost from the site. It also lists the possibility of establishing links with other grassland remnants.

Overall, the Deakin and Watson (1992) draft management plan provides a good framework for conserving and enhancing this site despite the lack of detail on fauna. The same general plan could be extended to other sites and some aspects should be adopted as strategies for the entire I.G.W. The latter would include the formation of a

Friends Group to support activities throughout the I.G.W., educating the local community through publicity about grassland conservation issues and the placement of interpretation signs at sites.

### **1.7 Focal Species Studies**

There have been a few studies conducted in the study area focused on a single species. O'Shea (1996) has conducted a number of studies on Striped Legless Lizards including an Honours Thesis mentioned below, and Sullivan (1999) conducted an Honours Thesis on Tussock Skinks.

#### *1.7.1 Striped Legless Lizard*

The Striped Legless Lizard is listed as endangered in Victoria and is a species of National Significance (Muir *et al.*, 1997). This species has been the subject of a number of studies in the area but the population study by O'Shea (1996) is of particular importance to conservation efforts. The two study sites were the Albion Explosives Factory and the Victoria University of Technology Remnant Grassland corresponding to Site A and B respectively in the present study. O'Shea (1996) estimated that the density of Striped Legless Lizards on the Albion site was 9.8 animals per hectare and that the species forms small communities. This information can be used to direct conservation strategies for the management and/or reintroduction of this species to sites within the I.G.W. by allowing estimates of the carrying capacity of each site.

### 1.7.2 *Tussock Skink*

Sullivan (1999) conducted a study on the population, life history traits and diet of Tussock Skinks on the Albion Explosives Factory site. Sullivan (1999) suggest that the conservation status of this species as locally common may need to be reviewed due to the decrease in capture rates as the study progressed. Tussock Skinks also had an apparent preference for exotic grassland.

This grassland species is not regarded as endangered, however this may change due to the continued destruction of its habitat and Sullivan (1999) suggests that they may already be decreasing in numbers. Predation, especially by exotic predators, is also regarded by Sullivan (1999) as a major threat to this species. The preference of this species for exotic grassland may allow populations to persist in many sites within the I.G.W. Sullivan (1999) offers few recommendations for the conservation of this species.

## 1.8 Study Rationale

After reviewing the available reports that include fauna surveys and recommended strategies for fauna conservation within the I.G.W., it is clearly apparent that there is a gap in the knowledge of what bird and reptile species occur or visit each site. If strategies for conserving the environmental values of the I.G.W. are going to be effective then it is essential that the distribution of native fauna, including birds and reptiles, within the I.G.W. be known. The present study aims to fill this gap by conducting extensive surveys of birds and reptiles at a number of sites located throughout the I.G.W. in the period October 2003-March 2004.

## **1.9 Main Objectives**

- (1) To compile a species list of the bird and reptile species that occurs within the Iramoo Green Web.
- (2) To record the bird and reptile species that occurs within each site.
- (3) To compare bird and reptile species diversity between quadrats in grassland, riparian and escarpment/rocky slope habitats.
- (4) To investigate habitat associations with bird and reptile diversity.
- (5) Recommend strategies for the conservation and enhancement of the bird and reptile values in the I.G.W.

## **1.10 Hypotheses**

- (1) As the area of sites increases, there will be a corresponding increase of bird and reptile species richness.
- (2) Bird species composition of sites will be influenced by the available habitat.
- (3) Reptile species composition will be influenced by the extent of habitat degradation.
- (4) Revegetation zones will be used mainly by common native bird species.

## CHAPTER 2: METHODS

### 2.1 Study Area

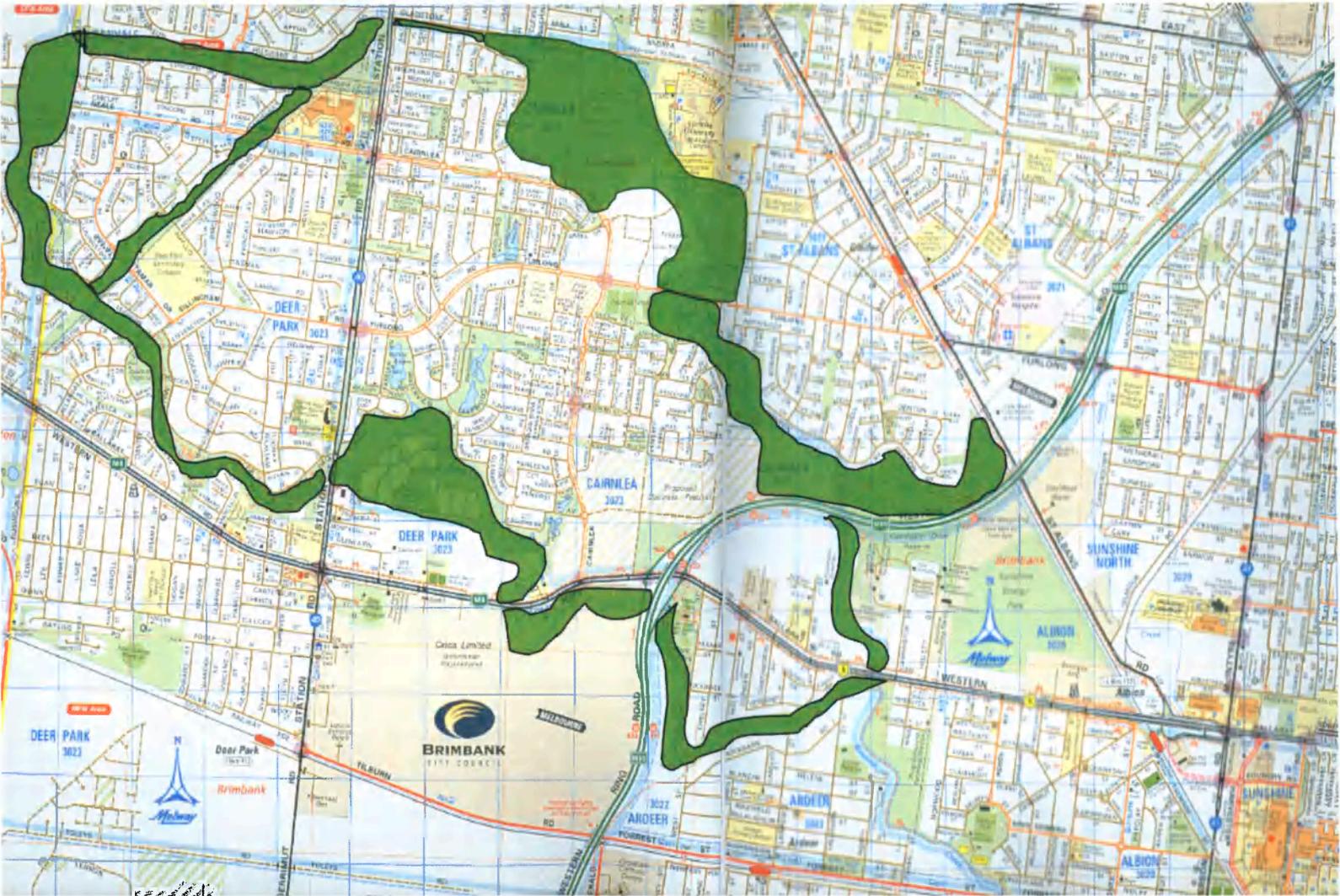
The study area was located approximately 16 km. northwest of Melbourne, Victoria, predominantly in the suburbs of Ardeer, St. Albans, Cairnlea and Deer Park, within Brimbank City Shire. The eastern boundary was St. Albans Road, St. Albans, and the western boundary Torowatta Place, Burnside in Melton Shire (See Map 1.0).

The area is urbanised with land use including residential, industrial, commercial and open space. The Western Ring Road and Western Highway are situated in the southeast and south respectively, and the area is under flight paths for Melbourne International Airport and Essendon Airport.

Prior to European settlement the study area was part of the Keilor Plains, at the eastern section of the Victorian Volcanic Plains (Muir et al., 1997; Sullivan, 1999). The plains were predominantly native grasslands dominated by Kangaroo Grass (*Themeda triandra*) and sub-dominated by wallaby grasses (*Austrodanthonia* spp.), spear grasses (*Austrostipa* spp.) and tussock grasses (*Poa* spp.) (Hadden, S.A., 1998).

The geology consists of New Volcanics that were deposited 4-5 million years ago in the early Quaternary period and lava continued to flow to about 7,300 years ago (Deakin and Watson, 1992; Muir et al., 1999). The landform is generally flat to undulating and the drainage lines, Kororoit Creek and Jones Creek, have incised small valleys in the plain (Muir et al., 1997). Soils are heavy clays that dry out and crack in summer (Sullivan, 1999). Average rainfall is approximately 500-600 mm and

temperatures vary distinctly between seasons. The area is about 60m above sea level (Muir *et al.*, 1997; Sullivan, 1999).



(Map 1) Study Area: Iramoo Green Web

## **2.2 Site Selection**

An initial reconnaissance of the study area was conducted in the pre-survey phase to assist in the planning of bird and reptile surveys and assess sites for possible inclusion in the surveys. Sites were selected for surveys if they had:

- Potential habitat value for birds and reptiles within sites,
- Importance of sites as possible links between other sites and
- Accessibility of sites for survey purposes.

## **2.3 Site Classification**

Sites were classified as either natural or modified. All habitats within the I.G.W. have been modified to some extent however natural in this context refers to areas that are not maintained and are essentially 'wild'. Modified refers to areas that can be considered part of the urban matrix and areas that are regularly maintained such as mown grass.

Eight sites were classified as being natural and 5 sites as modified. Additionally, 1 site was classified as an artificial lake system. Sites were labelled with capital letters to prevent confusion with previous studies. Table 2.1 lists the sites.

(Table 2.1) List of sites with their labels and classification.

Label	Classification	Site
A	Natural	Victoria University Grassland Reserve
B	Natural	Victoria University Remnant Grassland
C	Natural	Jones Creek Grasslands
D	Natural	Denton Avenue Grassland
E	Modified	Denton Avenue Bike Trail/ Gardens
F	Natural	Sunshine Tip Grassland
G	Modified	Kororoit Creek, Ardeer
H	Natural	Kororoit Creek, Adjacent to Western Ring Road
I	Natural	Albion Explosives Factory Grassland/Kororoit Creek
J	Modified	Kororoit Creek Escarpments, Deer Park
K	Natural	Bullum-Bullum Aboriginal Place
L	Modified	Transmission Line Open Space, Deer Park
M	Modified	Proposed Rockbank Middle Rd., Albanvale
N	Modified	Gladstone Street Drain Lakes

## 2.4 Survey Period

Surveys were conducted in 3 rounds between 21 October 2003 and 19 March 2004. Each round was scheduled for 4 weeks though all were extended due to the postponement of some surveys. The scheduled starting and finishing dates for each round was as follows:

**Round 1:** 21 October 2003-21 November 2003

**Round 2:** 15 December 2003-23 January 2004

**Round 3:** 15 February 2004-19 March 2004

The visiting order for sites was designed to allow adjacent sites to be surveyed on the same day, thus minimising travel times between sites. To minimise disturbance to flora and fauna, each site was visited once a week either for area or quadrat surveys.

The order of surveys for each round was as follows:

**Week 1:** Bird Area Surveys

**Week 2:** Quadrat Surveys (bird and reptile)

**Week 3:** Reptile Area Surveys

## Week 4: Quadrat Surveys (bird and reptile)

All surveys were conducted between 07.30 hours and 12.00 hours (Australian Eastern Standard Time and Australian Eastern Daylight Saving Time).

### 2.5 Area Surveys

The aim of area surveys was to compile a bird and reptile species list for the I.G.W and record the bird and reptile species that occur in each site.

For each area survey the date, starting time, finishing time, ambient temperature, and cloud cover were recorded. The number of each species, habitat, microhabitat, behaviour and comments of all bird and reptiles encountered was recorded (Lunney *et al.*, 1991).

The time taken for an area survey depended on the area of a site, the level of bird or reptile activity detected and the difficulty in identifying individual bird or reptile species. Area surveys were not conducted if there was constant rain, high wind or if the temperature was  $>35^{\circ}\text{C}$  (Lunney *et al.*, 1991; Mac Nally and Horrocks, 2002).

The temperature restriction was placed for the safety of the researcher and was not necessary for birds or reptiles (Lunney *et al.*, 1991).

#### 2.5.1 Bird Area Surveys

Bird area surveys were conducted in 14 sites with each site surveyed once in every round. The area search method was used to record all native birds observed or heard calling in a site. The same general route was used in each site and included all potential bird habitat features (i.e. Sugar Gum (*Eucalyptus cladocalyx*) shelter belts).

In some sites the route included vantage points that allowed inaccessible areas to be searched (i.e. slopes overlooking waterholes surrounded by reeds).

Birds were detected either visually or by their characteristic call when unseen (Field *et al.*, 2002). Binoculars (8 x 40) were used to scan large areas of a site for bird activity and for identifying distant birds. For the more cryptic species (ie. Owls) dense vegetation was searched by parting branches and scanning the interior. Scats were also examined for the characteristic prey items of owls.

All surveys were conducted by walking slowly with efforts made to minimise disturbance to birds that may take flight before they could be identified.

#### *2.5.2 Reptile Area Surveys*

Reptile area surveys were conducted in 9 sites with each site surveyed once in every round. The active search method was used and this involved searching for both active and sheltering reptiles (Mac Nally and Brown, 2001).

The same general route was used in each site and usually consisted of traversing along parallel lines. Each route was planned to (1) give extensive coverage of a site, and (2) include all potential reptile habitat (ie. basalt rock outcrops) within a site (Woinarski *et al.*, 1999).

Surveys were conducted by walking slowly with efforts made to minimise noise.

Active reptiles were detected by visually scanning the immediate area along a route and by using binoculars (8 x 40) for scanning at greater distances. The search technique for locating sheltering reptiles included overturning surface debris such as

rocks, logs, concrete slabs, tin, wood, plastics and prising the loose bark of eucalypts (Mac Nally and Brown, 2001). A torch was used to search rock crevices.

## 2.6 Quadrat Surveys

The aims of the quadrat surveys was to:

- (1) Compare species diversity between quadrats in similar habitat types; and
- (2) Investigate habitat associations with species diversity.

Quadrats were used in 8 sites to sample 3 different habitat types; grassland, riparian and escarpment/rocky slope habitats. The same quadrats were used for bird and reptile surveys in riparian and escarpment/rocky slope habitats. Reptile grassland quadrats were embedded in the larger bird grassland quadrats.

Each bird grassland quadrat was 0.5 ha. in area and measured either 100 m x 50 m (6 quadrats) or 200 m x 25 m (2 quadrats). Each riparian and escarpment/rocky slope quadrat was 0.05 ha in area and measured 100 m x 5 m. Four 30 cm wooden reference stakes were used to circumscribe grassland and escarpment/rocky slope quadrats. Two 30 cm stakes and the waterline circumscribed riparian quadrats.

Birds were surveyed for a fixed-time period of 20 minutes. All birds observed using the habitat in the quadrat or heard calling within the quadrat were recorded. This included birds that were stationary or foraging within a quadrat but excluded birds flying over or through a site (Field *et al.*, 2002).

Reptiles were surveyed by laying ten 40 cm x 20 cm sheets of tin randomly in grassland quadrat and at 10 m intervals in riparian and escarpment/rocky slope quadrats. Each quadrat was surveyed in a 10 minute time frame by uplifting the sheets of tin and checking for sheltering reptiles.

The date, starting time, finishing time, ambient temperature and cloud cover were recorded for each quadrat survey. The number of each species, microhabitat and behaviour of birds and reptiles observed in a quadrat were recorded.

Quadrat surveys were not conducted if there was constant rain, high wind or if the temperature was  $>35^{\circ}\text{C}$ . Each quadrat was surveyed a total of 6 times (twice every round).

In sites that had two riparian quadrats (Sites B, C, H and I), the quadrats were positioned on opposite sides of the waterway (inner/outer). In Sites H and I the escarpment/rocky slope quadrats were also placed on opposite sides of the waterway and parallel to the riparian quadrats.

### *2.6.1 Quadrat Labels*

Each quadrat was labelled with an abbreviation for easy identification. Grassland quadrats were identified by two capital letters, the first denotes the site and the second, G, denotes that it is a grassland quadrat. For example, the grassland quadrat in Site A is labelled AG.

Riparian quadrats were labelled with 3 letters, the first denoting the site, the second whether the quadrat is on the inner (I) of the I.G.W. or outer (O) according to the

waterway, and the third letter, (R) denotes that the quadrat is a riparian quadrat. For example, the inner riparian quadrat in Site B is labelled as BIR and the outer quadrat on the opposite side of Jones Creek as BOR.

Escarpment/Rocky Slope quadrats were labelled in the same manner as riparian quadrats with the exception that E replaces R to denote the quadrat as an escarpment/rocky slope quadrat.

### *2.6.2 Habitat Variables*

Habitat variables were estimated and measured in each grassland, riparian and escarpment/rocky slope quadrat during late March and early April 2004. The aim was to investigate possible associations between habitat variables and bird and reptile species diversity.

#### *2.6.2.1 Grassland Variables*

Four sets of four 1 m x 1 m quadrat readings were taken 10 m apart and perpendicular to the 100 m boundary of the grassland quadrat at 20 m intervals in 6 quadrats. In 2 narrow quadrats (HG and KG) eight sets of two 1 m x 1 m quadrat readings were taken 5 m perpendicular to the 250 m boundary of the quadrat at 30 m intervals

Estimates of percentage vegetation coverage, litter coverage, bare soil coverage and basalt rock coverage were taken in each 1 m x 1 m quadrat. The depth of litter and ground layer was measured four times, once in each quarter of the 1 m x 1 m quadrat. The mean of estimates and measurements was recorded as the value for that grassland quadrat. The number of all shrubs >1m tall were recorded in each quadrat. The

abundance of Spanish Artichoke (*Cynara cardunculus*) was rated in each quadrat from 1-5.

#### *2.6.2.2 Riparian and Escarpment/Rocky Slope Variables*

Ten 1 m x 1 m quadrat readings for estimates and measurements of habitat variables were taken at 10 m intervals along the riparian and escarpment/rocky slope quadrat. The procedure followed that used in the grassland quadrats. The number of all shrubs >1m tall were recorded in each quadrat. The height of all trees in each quadrat was calculated using an inclinometer. The abundance of Spanish Artichoke was rated in each riparian and escarpment/rocky slope quadrat in the same manner as grassland quadrats. The abundance of reeds was rated from 1-5 in all riparian quadrats.

### **2.7 Analysis**

One way Analysis of Variance was used to test for differences between quadrats in each habitat type on SPSS 10. The data was normalised using log transformation,  $\log(x+1)$  prior to analysis (Fowler and Cohen, 1990).

The species diversity of each bird quadrat was calculated using Shannon's Diversity Index with the following formula (Margurran, A., 1988):

$$H = -\sum p_i \ln p_i$$

### **2.8 Revegetation Zone Bird Surveys**

The aim of revegetation zone bird surveys was to investigate the contribution of revegetation to bird species diversity. Twelve revegetation zones were surveyed in

Site J (10 revegetation zones) and Site K (2 revegetation zones) for a fixed-time period of 10 minutes. Each revegetation zone measured approximately 20 m x 5 m. All bird species observed using the revegetation zone such as perching or foraging, were recorded. Birds flying through a revegetation zone that did not forage were not recorded. Each revegetation zone was surveyed twice in Round 1 and 2 and surveyed once in Round 3.

Each revegetation zone was scored from 0-3 on five categories: trees, shrubs, ground layer, litter and vegetation density. A top score of 3 was given for characteristics of a mosaic habitat. The highest total score possible was 15. Associations between the species richness and habitat score were investigated.

The scores were derived from Lowe, K., Griffioen, P. and Newell, G. (2003):

**Trees**

- 0= Trees absent
- 1= Trees present, not mix of species, not multi-aged
- 2= Trees present, mix of species, not multi-aged
- 3= Trees present, mix of species, multi-aged

**Shrubs**

- 0= Shrubs absent
- 1= Shrubs present, not mix of species
- 2= Shrubs present, mix of species
- 3= Many shrubs, mix of species

**Ground Layer**

- 0= Bare soil/rocks
- 1= Almost completely bare
- 2= Partly covered
- 3= Patches of coverage

**Litter**

- 0= Litter absent
- 1= Litter present
- 2= Litter consists of mulch
- 3= Patches of litter

**Density of Vegetation**

- 0= Very dense
- 1= Almost completely dense
- 2= Partly dense
- 3= Patches of density

## 2.9 Incidental Surveys

Incidental surveys were conducted in 15 sites in the period between Round 1 and Round 2. The survey method used was a combination of the area search method and active search method as used for bird area surveys and reptile area surveys respectively. Each site was visited once and the survey time varied according to the size of the site and the level of bird and reptile activity detected.

The date, site, time, ambient temperature and cloud cover were recorded for all incidental surveys. The number, location, habitat, microhabitat, behaviour and comments were recorded for all species identified. Table 2.2 lists the location of each Incidental Site.

(Table 2.2) Location of each Incidental Site.

Incidental Site	Location
1	Grassland North of Victoria University, St. Albans Campus
2	Rock Dump Adjacent to Iramoo Sustainable Living Precinct
3	Victoria University, St. Albans Campus
4	Sugar Gum Shelter Belt, Parallel to Levenia Street, St. Albans
5	Proposed Civic/Education Precinct, Furlong Road
6	Proposed Business Precinct, Cairnlea Estate
7	Western Ring Road Grassland Reserve
8	Carrington Drive Reserve/Sunshine Energy Park
9	Southern Site next to Site H
10	Waterfield Park Artificial Lakes, Cairnlea Estate
11	Station Waters Artificial Lakes, Cairnlea Estate
12	Shearwater Meadow Artificial Lake, Cairnlea Estate
13	Jones Creek between Western Ring Road and Western Highway
14	Kororoit Creek, Link between Site K
15	Kororoit Creek, Orica Limited

## 2.10 Focal Species Surveys

Focal species surveys were conducted for Marbled Geckos (*Christinus marmoratus*), Striped Legless Lizards (*Delma impar*) and large elapids (Eastern Tiger Snakes (*Notechis scutatus*) and Eastern Brown Snakes (*Pseudonaja textilis*)).

The aim was to detect the presence of these species in natural sites and provide information on the distribution of these species within the I.G.W. Data was recorded as miscellaneous observations.

#### 2.10.1 *Marbled Gecko*

Marbled Geckos were surveyed by laying six tiles in 5 sites (Sites B, C, F, H and I) in locations usually under eucalyptus trees. Each tile was uplifted and checked for sheltering Marbled Geckos once a week during visits to sites for area or quadrat surveys.

#### 2.10.2 *Striped Legless Lizards*

Surveys for this species involved laying 6 tiles in areas of potential habitat in 5 sites (Site C, D, F, I and K). Each tile was uplifted and checked for sheltering Striped Legless Lizards once a week during visits to the sites for area or quadrat surveys.

#### 2.10.3 *Elapids*

To survey for elapids six 50 cm x 50 cm tin sheets were laid in areas of potential habitat in 6 sites (Sites A, B, C, F, H, and I). Each tin sheet was uplifted and checked for sheltering elapids once every week during visits for area or quadrat surveys.

### **2.11 Miscellaneous Observations**

Sightings of birds and reptiles were recorded as miscellaneous observations if they were:

- (1) Birds observed during reptile area or quadrat surveys;

- (2) Birds observed during bird quadrat surveys that do not enter the quadrat or are classified as not using the habitat in the quadrat;
- (3) Reptiles observed during bird area or quadrat surveys;
- (4) Reptiles observed outside of a quadrat during a reptile quadrat survey; and
- (5) Birds or reptiles observed in sites when surveys were not being conducted.

Additionally, sightings of frogs, tortoises, foxes and cats within sites were also recorded as miscellaneous observations. The species, site, location, habitat, microhabitat, date, time, behaviour and comments were recorded for all miscellaneous observations

## **2.12 Human Observations**

Human observations were recorded in all sites during area and quadrat surveys. The aim was to gain an insight into human usage of open spaces within the I.G.W.

The specific questions were:

- (1) What activities do people do within the I.G.W.?
- (2) What is the purpose of people's activities within the I.G.W.?
- (3) How can human-usage of sites be incorporated into conservation strategies for birds and reptiles within the I.G.W.?

The site, number, sex, age, activity, perceived purpose of activity and number of repeat observations were recorded for all human observations. Data was recorded miscellaneously.

### 2.12.1 *Age*

The age of people was estimated and categorised into 5 classes: 0-12, 13-19, 20-39, 40-59, 60 years.

### 2.12.2 *Activity*

The observed activity of people was classified into 5 categories: walking, walking dog/s, cycling, jogging and other activities.

### 2.12.3 *Perceived Purpose of Activities*

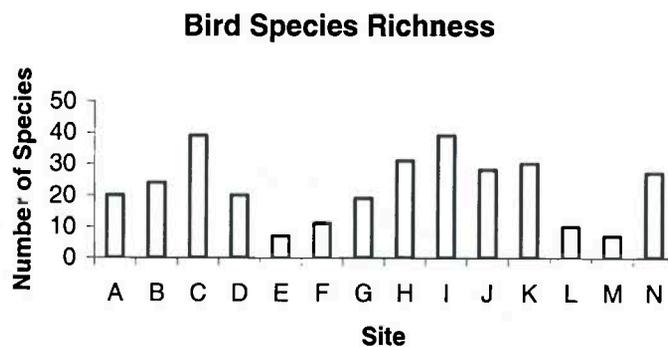
The perceived purpose of people's activities was classified into 5 categories: transiting, fitness, recreation and other purposes.

## CHAPTER 3: BIRDS AND REPTILES OF THE Iramoo Green Web

### 3.1 Bird Results

Sixty-seven bird species were recorded in the I.G.W from all survey methods including: 8 Raptors, 23 Passerines, 8 Cockatoos, Parrots and Lorikeets, 26 Waterbirds, 1 Pigeon and 1 Kingfisher. See Appendix B, table B1. for list of bird species recorded.

Bird species richness per site varied from 7 to 39 with Site C (n=39) and Site I (n=39) the richest followed by Site H (n=31), Site K (n=30), Site J (n=28), Site N (n=27), Site B (n=24), Site A (n=20), Site D (n=20), Site G (n=19), Site F (n=11), Site L (n=10), Site E (n=7), and Site M (n=7). Figure 3.1 graphs the bird species richness for each site.



(Figure 3.1) Bird species richness for each site.

Thirty species were recorded in all 3 Rounds consisting of:

**1 Raptor:** Black-shouldered Kite (*Elanus axillaris*);

**14 Passerines:** Welcome Swallow (*Hirundo neoxena*) Richard's Pipit (*Anthus novaeseelandiae*), Willie Wagtail (*Rhipidura leucophrys*), Clamorous Reed-Warbler (*Acrocephalus stentoreus*), Golden-headed Cisticola (*Cisticola exilis*), Superb Fairy-

wren (*Malurus cyaneus*), Yellow-rumped Thornbill (*Acanthiza chrysorrhoa*), Red Wattlebird (*Anthochaera carunculata*), White-plumed Honeyeater (*Lichenostomus penicillatus*), New Holland Honeyeater (*Phylidonyris novaehollandiae*), Australian Magpie-lark (*Grallina cyanoleuca*), Australian Magpie (*Gymnorhina tibicen*), Australian Raven (*Corvus coronoides*), Little Raven (*Corvus mellori*);

**1 Cockatoo, Parrot and Lorikeet:** Galah (*Cacatua roseicapilla*);

**13 Waterbirds:** Hoary-headed Grebe (*Poliiocephalus poliocephalus*), Little Pied Cormorant (*Phalacrocorax melanoleucos*), Little Black Cormorant (*Phalacrocorax sulcirostris*), White-faced Heron (*Egretta novaehollandiae*), Australian White Ibis (*Threskiornis molucca*), Black Swan (*Cygnus atratus*), Pacific Black Duck (*Anas superciliosa*), Chestnut Teal (*Anas castanea*), Dusky Moorhen (*Gallinula tenebrosa*), Purple Swamphen (*Porphyro porphyrio*), Eurasian Coot (*Fulica atra*), Masked Lapwing (*Vanellus miles*), Silver Gull (*Larus novaehollandiae*);

**1 Pigeon:** Crested Pigeon (*Ocyphaps lophotes*).

Forty-two bird species were recorded during Round 1, 38 species during bird area surveys and 4 miscellaneous, consisting of 3 Raptors, 19 Passerines, 1 Cockatoo, Parrot and Lorikeet, 17 Waterbirds, 1 Kingfisher and 1 Pigeon.

Fifty bird species were recorded during Round 2, 40 species during area surveys and 10 miscellaneous, consisting of 6 Raptors, 17 Passerines, 5 Cockatoos, Parrots and Lorikeets, 21 Waterbirds and 1 Pigeon. Nine species recorded in Round 1 were not recorded in Round 2 however 17 new species were recorded.

Forty-seven bird species were recorded during Round 3 with 5 Raptors, 17 Passerines, 5 Cockatoos, Parrots and Lorikeets, 1 Pigeons, and 19 Waterbirds. Forty species recorded during Round 3 were also recorded in Round 2 and 31 species recorded in Round 3 were recorded in Round 1. Nine species recorded in Round 2 were not recorded in Round 3 however 5 new species were recorded.

Thirty-seven bird species were recorded from the 15 sites sampled by incidental surveys including 3 new species: Intermediate Egret (*Ardea intermedia*), Yellow-billed Spoonbill (*Platalea flavipes*) and Crimson Rosella (*Platycercus elegans*). See Appendix B, table B8. for results of Incidental bird survey results.

In the present study bird species were broadly classified by habitat preferences into 4 assemblages: urban habitat assemblage, artificial lake assemblage, nomadic assemblage and natural habitat assemblage. These are broad classifications and there is considerable overlap with some species classified into more than one assemblage. See Appendix B for a species list of each assemblage.

## **3.2 Bird Quadrat Surveys**

### *3.2.1 Bird Grassland Quadrats*

A total of 221 individuals from 17 bird species were recorded during the grassland quadrat surveys. The five most abundant species were Welcome Swallow (n=69), Richard's Pipit (n=40), Golden-headed Cisticola (n=28), Superb Fairy-wren (n=19) and Yellow-rumped Thornbill (n=17).

The species recorded from the most quadrats were Golden-headed Cisticola (7 quadrats), Welcome Swallow (6 quadrats), Richard's Pipit (5 quadrats,) Australian Kestrel (5 quadrats), Black-shouldered Kite (4 quadrats) and Willie Wagtail (4 quadrats). Table 3.1 lists the number and proportion of each species recorded in grassland quadrats.

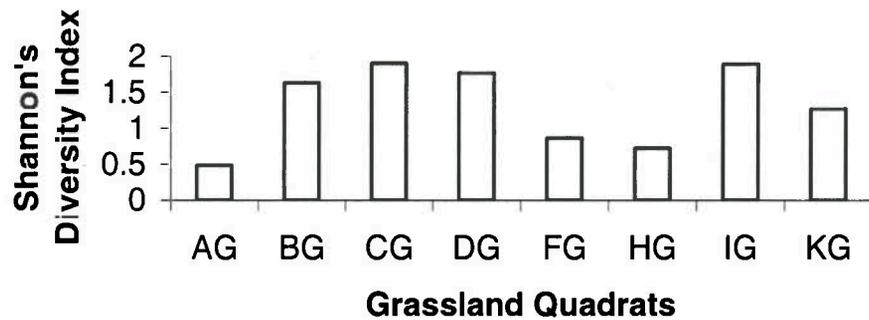
(Table3.1) Number and Proportion of Bird Species Recorded in Grassland Quadrats.

Species	Number Recorded	Proportion (%)
Welcome Swallow	69	31.22
Richard's Pipit	40	18.09
Golden-headed Cisticola	28	12.66
Superb Fairy-wren	19	8.59
Yellow-rumped Thornbill	17	7.69
Willie Wagtail	12	5.42
Australian Magpie	7	3.16
Black-shouldered Kite	7	3.16
Australian Raven	6	2.71
Australian Kestrel	5	2.26
Australian Magpie-lark	3	1.35
Little Eagle	2	0.90
Masked Lapwing	2	0.90
White-faced Heron	1	0.45
Australian Hobby	1	0.45
Dusky Woodswallow	1	0.45
Brown Falcon	1	0.45

### 3.2.1.1 Species Diversity

Species diversity varied from a high of 1.903 in quadrat CG to a low of 0.482 in quadrat AG. However, the diversities for quadrats embedded in the large sites, specifically AG and IG, are probably not true reflections of the bird species diversity of the grasslands in these sites because area-proportionate sampling was not used.

## Species Diversity of Bird Grassland Quadrats



(Figure 3.2) Shannon's diversity of each Bird Grassland Quadrat.

### 3.2.1.2 Habitat Associations

Due to the small data set no confirmed associations between species diversity and habitat variables could be determined. However there does seem to be an increase in bird species diversity when the overall height of the grass (vegetation height 1) is around 40cm. An increase in the score for the Spanish Artichoke (*Cynara cardunculus*) also seems to correspond to an increase in species diversity and the influence of this type of habitat structural feature on species diversity warrants further investigation. Appendix B, table B16 Grassland Quadrat habitat variables.

### 3.2.1.3 Statistical Analysis

A one-way Analysis of Variance comparing bird species richness detected a significant difference between grassland quadrats ( $F_{7, 40} = 3.74, p < 0.05$ ). A post hoc Tukey's Test indicated a significant difference between the grassland quadrats CG and FG ( $p = 0.015$ ) and FG and IG ( $p = 0.017$ ). The isolation of quadrat FG to other grasslands is probably the reason for the significant difference.

### 3.2.2 Riparian Quadrats

A total of 554 individuals from 25 bird species were recorded during the riparian quadrats surveys. The six most abundant species were Superb Fairy-wren (n=82), Welcome Swallow (n=78), White-plumed Honeyeater (n=72), Golden-headed Cisticola (n=64), Red Wattlebird (n=58) and Clamorous Reed-Warbler (n=57).

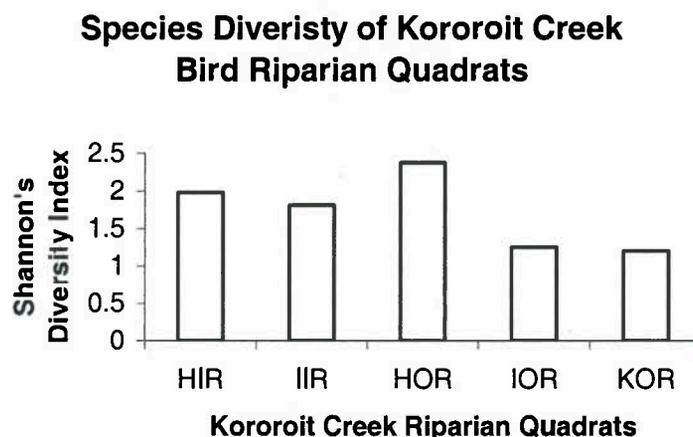
The species recorded from the most quadrats were Superb Fairy-wren (9 quadrats), Welcome Swallow (9 quadrats), White-plumed Honeyeater (9 quadrats), Golden-headed Cisticola (8 quadrats) and Clamorous Reed-Warbler (6 quadrats). Table 3.2 lists the number and proportion of each bird species recorded in riparian quadrats.

(Table 3.2) Number and Proportion of Bird Species Recorded in Riparian Quadrats

Species	Number recorded	Proportion (%)
Superb Fairy-wren	82	14.80
Welcome Swallow	78	14.07
White-plumed Honeyeater	72	12.99
Golden-headed Cisticola	64	11.55
Red Wattlebird	58	10.46
Clamorous Reed-Warbler	57	10.28
Yellow-rumped Thornbill	36	6.49
Pacific Black Duck	21	3.79
Dusky Moorhen	19	3.42
New Holland Honeyeater	12	2.16
Willie Wagtail	10	1.80
Purple Swamphen	8	1.44
Australian Raven	6	1.08
White-faced Heron	5	0.90
Australian Magpie-lark	5	0.90
Red-browed Finch	5	0.90
Little Pied Cormorant	4	0.72
Australian White Ibis	2	0.36
Brown Goshawk	2	0.36
Australian Kestrel	2	0.36
Black-shouldered Kite	2	0.36
Little Black Cormorant	1	0.18
Masked Lapwing	1	0.18
Little Eagle	1	0.18
Richard's Pipit	1	0.18

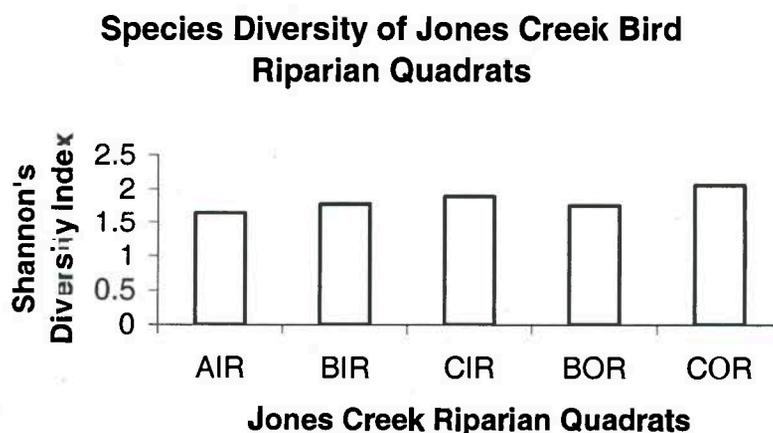
### 3.2.2.1 Species Diversity

Species diversity in the Kororoit Creek riparian quadrats ranged from 1.198 in KOR to 2.373 in HOR. Figure 3.3. graphs the Shannon's diversity for the Kororoit Creek Riparian Quadrats.



(Figure 3.3) Shannon's Diversity of the Kororoit Creek Riparian Quadrats.

Species diversity in the Jones Creek quadrats ranged from 1.762 in BOR to 2.061 in COR. Figure 3.4 graphs the Shannon's Diversity for the Jones Creek Riparian Quadrats.



(Figure 3.4) Shannon's Diversity of the Jones Creek Riparian Quadrats.

### *3.2.2.2 Habitat Associations*

There was no clear association of bird species diversity with any of the habitat variables for the riparian quadrats along Kororoit Creek. Species diversity in the riparian quadrats along Jones Creek seemed to be associated with percentage vegetation coverage and the score of Spanish Artichoke. Percentage vegetation coverage of 90% seems to correspond with an increase in species diversity with lower percentage coverage corresponding to lower species diversity. Species diversity also seems to increase as the score for Spanish Artichoke increased. See Appendix B, table B17 for the Riparian Quadrat habitat variables.

### *3.2.2.3. Statistical Analysis*

A significant difference was detected by a one-way Analysis of Variance between the species richness in the riparian quadrats along Kororoit Creek ( $F_{4, 25}=5.29$ ,  $p<0.05$ ).

A post hoc Tukey's Test indicated a significant difference between quadrats HOR and IOR ( $p=0.033$ ) and between HOR and KOR ( $p=0.001$ ).

No significant difference was detected between the riparian quadrats along Jones Creek ( $F_{4, 25}=0.950$ ,  $p>0.05$ ).

### *3.2.3 Escarpment/Rocky Slope Quadrats*

A total of 163 individuals from 17 bird species were recorded during the escarpment/rocky slope quadrat surveys. The four most abundant species were Superb Fairy-wren ( $n=43$ ), White-plumed Honeyeater ( $n=26$ ), Welcome Swallow ( $n=22$ ) and Red-browed Finch ( $n=20$ ). Table 3.3 lists the number and proportion of each bird species recorded in Escarpment/Rocky Slope Quadrats.

The species recorded from the most quadrats was White-plumed Honeyeater (5 quadrats), Australian Raven (5 quadrats), Golden-headed Cisticola (5 quadrats), Welcome Swallow (4 quadrats) and Red Wattlebird (4 quadrats).

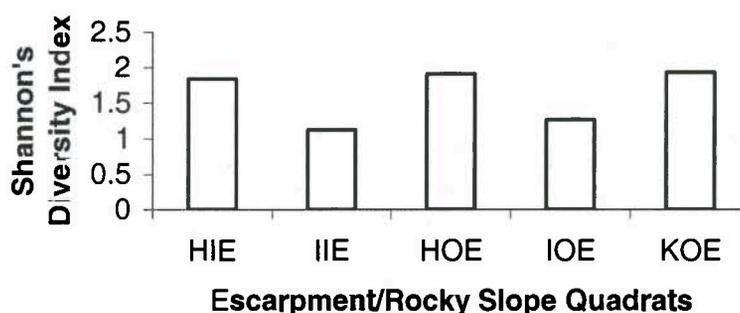
(Table 3.3) Number and Proportion of Bird Species Recorded in Escarpment/Rocky Slope Quadrats.

Species	Number recorded	Proportion (%)
Superb Fairy-wren	43	26.38
White-plumed Honeyeater	26	15.95
Welcome Swallow	22	13.49
Red-browed Finch	20	12.26
Australian Raven	12	7.36
Red Wattlebird	12	7.36
New Holland Honeyeater	8	4.90
Golden-headed Cisticola	6	3.68
Willie Wagtail	3	1.84
Black-shouldered Kite	2	1.22
Australian Magpie-lark	2	1.22
White-faced Heron	2	1.22
Brown Goshawk	1	0.61
Yellow-rumped Thornbill	1	0.61
Sacred Kingfisher	1	0.61
Richard's Pipit	1	0.61
Australian Hobby	1	0.61

### 3.2.3.1 Species Diversity

Species diversity ranged from 1.123 in IIE to 1.927 in KOE. Figure 3.5 graphs the Shannon's Diversity Index for each Escarpment/Rocky Slope Quadrat.

### Species Diversity of Bird Escarpment/Rocky Slope Quadrats



(Figure 3.5) Shannon's Diversity of each Escarpment/Rocky Slope Quadrat.

#### 3.2.3.2 Habitat Associations

The height of grass (vegetation height 2) was the only variable that seemed to correspond to species diversity. Heights greater than about 20 cm corresponded to lower species diversity. See Appendix B, table B18, for Escarpment/Rocky Slope Quadrat habitat variables.

#### 3.2.3.3. Statistical Analysis

A one-way Analysis of Variance detected no significant statistical differences between the species richness of the escarpment/rocky slope quadrats ( $F_{4, 25}=1.65$ ,  $p>0.05$ ).

### 3.3 Discussion:

The avifauna of the Iramoo Green Web (I.G.W.) is relatively species rich with 67 native species recorded in the present study. It is of interest that this species richness occurs within an urbanised area.

Birds were found to inhabit a wide variety of habitats within the I.G.W., including areas of remnant habitat where indigenous bird species still persist. Some sites were found to have few resident species but were regularly visited by foraging or transiting birds such as Little Black Cormorants (*Phalacrocorax sulcirostris*) and the Australian White Ibis (*Threskiornis molucca*).

### 3.3.1 Species Richness

It was found that an increase in the area of a site did not correspond to an increase in bird species richness rather the diversity of habitat within a site seems to influence species richness. Similar results were found by Mac Nally and Watson (1997) in their study on the effects of habitat heterogeneity on species richness in Victorian buloke (*Allocasuarina luehmanni*) forests.

In the present study, Site C (approximately 12 ha.) was found to have the same species richness as the much larger Site I (approximately 38 ha.). This may be due to the diversity of habitat in Site C including Jones Creek, a small wetland, an artificial lake, grasslands and the close proximity of the urban matrix. The diversity of habitat provides more niches for more species to occupy, corresponding to a higher species richness (Bennett, 1990).

In Site I, the waterholes and River Red Gums (*Eucalyptus camaldulensis*) along Kororoit Creek are a focal point for birds. Mc Millan *et al.* (2003) listed the River Red Gums as Regionally-significant due to their habitat value. Larwill *et al.* (1993) suggested that the creek functions as a habitat corridor for birds and the findings of the present study support this view. The creek in this site seems to be used as a 'bird highway' by waterbirds transiting to the artificial lakes in Cairnlea. On one occasion

27 Little Pied Cormorants were observed in a 10 minute period transiting along the creek.

The artificial lakes located in the central region of the study area provide habitat for a variety of waterbird species including the Great Egret (*Ardea alba*), which is listed as vulnerable by the Department of Sustainability and Environment (McMillan *et al.*, 2003).

A large proportion of most natural sites consist of edge habitat. Various species appear to prefer edges including the Superb Fairy-wren (*Malurus gramineus*). Howe (1986) classified this species as an edge and open country species and their abundance and distribution in the study area supports this view. A study by Catterall *et al.* (1991) on habitat use by birds in Brisbane found that edge species were usually large and/or open ground feeders. The findings of the present study were similar with large birds of the urban/modified habitat assemblage such Australian Magpie-larks (*Grallina cyanoleuca*) and Australian Magpies (*Gymnorhina tibicen*) commonly occurring at the edges of natural sites.

### 3.3.2 Species Composition

Modified sites were generally dominated by synanthropic species of the urban/modified habitat assemblage such as Willie Wagtails (*Rhipidura leucophrys*), Australian Magpie-larks and Australian Magpies, and exotic species such as House Sparrows (*Passer domesticus*), Common Starlings (*Sturnus vulgaris*) and Common Mynas (*Acridotheres tristis*) (Donnelly and Marzluff, 2004). Donnelly and Marzluff (2004) had similar findings in their study of reserve size and urban bird conservation in Seattle, Washington, U.S.A. In that study they found that synanthropic species

(native and exotic) increased with urbanisation due to the abundant food resources and nesting sites.

The species composition of natural sites was found to consist mainly of species from the natural habitat assemblage and urban/modified habitat assemblage. The proximity of the site to the urban matrix, diversity of habitat within the site and the area of the site all seemed to influence the extent to which either of these assemblages dominated a site (Marzluff and Ewing, 2001). The species composition of sites also seems to be influenced by the abundance of exotic vegetation and this is consistent with the Donnelly and Marzluff (2004) study. They found that synanthropic species increased as exotic vegetation increased in sites and native species decreased. In the present study areas of natural sites dominated by exotic vegetation such as African Box-thorns (*Lycium ferocissimum*) had a high abundance of exotic birds such as European Goldfinches (*Carduelis carduelis*) and Common Starlings.

The diversity of raptors is of interest with 8 species recorded. Raptors seem to prefer the grassland habitat of natural sites for foraging with 71 % of foraging events occurring over grasslands. On occasion, some sites were visited by a number of raptor species in short time periods. For example, the presence of Black-shouldered Kites (*Elanus axillaris*) and Australian Kestrels (*Falco cenchroides*) was sometimes within 10 minutes of each other. This suggests habitat partitioning (Aumann, 2001).

In a study of foraging behaviour of raptors in the Northern Territory, Aumann (2001) found that even though most species operated in a wide variety of habitat that differed in vegetation structure and composition, that habitats were still partitioned between

species. Partitioning of grasslands was observed in the present study between Black-shouldered Kites, which would operate over long grass, and Australian Kestrels, which operated in areas of short grass (Olsen *et al.*, 1993).

Aumann (2001) summarised that raptors operating in the same area not only partitioned the habitat but also food resources and differed in foraging methods and time of foraging. The partitioning of habitat by raptors needs to be considered in the management of sites if some raptors species are to persist in the I.G.W.

### 3.3.3 Seasonal Variations

The bird species richness of the I.G.W. no doubt varies with the seasonal abundance of food such as nectar, insects and mammalian and avian prey. Surveying birds at different times of the year or between years may reveal a poorer or richer species list than indicated by the present study (Recher and Davis, 2002). Approximately 25 birds species were found to be resident in the I.G.W. and the remainder are either visiting migratory or nomadic species.

The seasonal fluctuations of birds were most notable in early summer when there was an influx of species into the I.G.W. For example, no lorikeets were recorded in Round 1, however in Round 2 and 3 Rainbow Lorikeets (*Trichoglossus haematodus*) and Purple-crowned Lorikeets (*Glossopsitta porphyrocephala*) were abundant in the area. This was probably due to the abundance of flowering eucalypt trees in the urban matrix (Recher and Davis, 2002). Likewise, some raptors such as Little Eagles (*Hieraaetus morphnoides*), Australian Hobbies (*Falco longipennis*) and Brown Goshawks (*Accipiter fasciatus*) were absent during Round 1 but were observed in

Round 2 and 3 (Aumann, 1993; Olsen, 1995). The arrival of Little Eagles was probably timed to coincide with the availability of juvenile rabbits (*Oryctolagus cuniculus*) that were born in early spring (Olsen *et al.*, 1993)

Other species that appear to be seasonal visitors to the I.G.W. are the Dusky Woodswallow (*Artamus cyanopterus*), White-winged Triller (*Lalage sueurii*) and Black-faced Cuckoo-shrike (*Coracina novaehollandiae*). Recher and Davis (2002) found that these 3 species were amongst 25 % of bird species present in Salmon Gum (*Eucalyptus salmonphloia*) woodland in Western Australia that were nomadic or migratory and that aggregate wherever food was abundant.

#### 3.3.4 Additional Bird Species

A number of species that have previously been recorded in the I.G.W. were not recorded in the present study. For example, the Stubble Quail (*Coturnix pectoralis*) and Barn Owl (*Tyto alba*) have previously been recorded in Site A and Flame Robins (*Petroica phoenicea*) are known to be autumn visitors to this site (O'Shea, 1996; S. Parker, pers. comm.). Southern Boobooks (*Ninox novaeseelandiae*) are likely to occur in the I.G.W. and probably shelter in trees located in residential gardens. The Nankeen Night Heron (*Nycticorax caledonicus*) was another unrecorded species but reportedly occurs in Site H (McMillan *et al.*, 2003).

#### 3.3.5 Conservation

Conservation efforts should be focused on species of the natural habitat assemblage, specifically grassland birds, which are reliant on natural sites. The species from the other assemblages will probably occur within the I.G.W. regardless of the condition of natural sites because most rely on modified habitat.

### 3.4 Results: Reptiles

Seven terrestrial reptile species were recorded from the 9 sites sampled by reptile area surveys and 2 of these species were also recorded miscellaneously in 2 other sites. Additionally 1 freshwater species, Eastern Long-necked Tortoise (*Chelodina longicollis*) was recorded miscellaneously in Site K.

All 7 species were recorded in Round 1 and consisted of :

**1 Gecko:** Marbled Gecko (*Christinus marmoratus*);

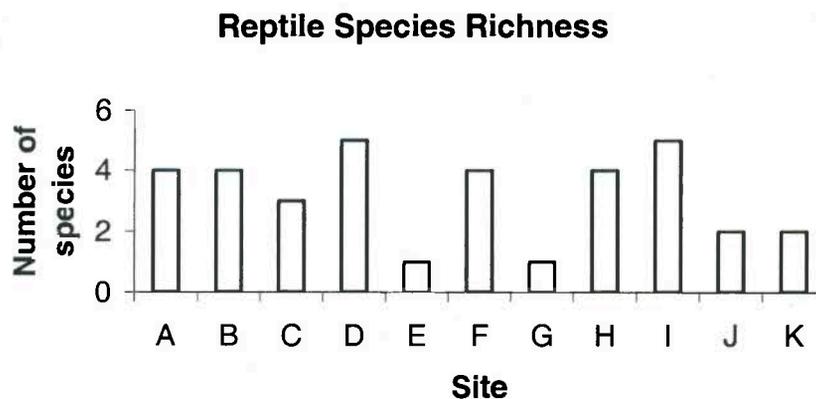
**1 Legless Lizard:** Striped Legless Lizard (*Delma impar*);

**3 Skinks:** Cunningham's Skink (*Egernia cunninghami*), Tussock Skink (*Pseudemoia pagenstecheri*), Eastern Blue-tongue-Lizard (*Tiliqua scincoides*) and

**2 Elapid:** Eastern Tiger Snake (*Notechis scutatus*) and Eastern Brown Snake (*Pseudonaja textilis*).

Figure 3.6 graphs the reptile species richness for each site.

Four species were recorded in Round 2 consisting of Marbled Gecko, Cunningham's Skink, Tussock Skink and Eastern Blue-tongue Lizard.



(Figure 3.6) Reptile Species Richness for each site.

Five species were recorded in Round 3 consisting of Marbled Gecko, Tussock Skink, Eastern Blue-tongue Lizard, Eastern Tiger Snake and Eastern Brown Snake.

Four reptile species were recorded during Incidental Surveys in 8 Incidental Sites consisting of: Marbled Gecko, Tussock Skink, Eastern Blue-tongue Lizard and Eastern Tiger Snake. The species recorded from the most sites was the Eastern Blue-tongue Lizard (7 sites) followed by Tussock Skink (5 sites), Marbled Gecko (4 sites) and Eastern Tiger Snake (1 site). See Appendix, table B1, for results.

Only 3 species of reptile were recorded in reptile quadrat surveys from 30 individuals. The small data set prevented any statistical analysis from being performed.

#### 3.4.1 *Grassland Quadrats*

Two reptile species were recorded in grassland quadrats: Striped Legless Lizard (n=3) and Tussock Skink (n=13). Striped Legless Lizards were recorded in quadrats AG (n=2) and DG (n=1). Additionally the sloughed skins of Striped Legless Lizards were recorded in AG (n=1), B G (n=1) and I G (n=2). Tussock Skinks were recorded in quadrats AG (n=5), BG (n=3), DG (n=1), FG (n=2) and HG (n=2).

The mean temperature recorded during reptile grassland quadrat surveys was 18.26°C (range 12.00-26.40°C).

##### 3.4.1.1 *Habitat Associations*

Striped Legless Lizard and Tussock Skink were both recorded in quadrats AG, BG (sloughed skin) and DG and these differ in grassland composition. Quadrats AG and DG have large patches of Kangaroo Grass (*Themeda triandra*) whereas quadrat BG is dominated by Serrated Tussock (*Nassella trichotoma*). This confirms that Striped Legless Lizards and Tussock Skinks do occur in both native and exotic grassland.

There was no clear relationship between the habitat variables between these quadrats however AG and BG were similar in percentage vegetation cover; AG (82%) and BG (86%), and percentage litter cover; AG (11%) and BG (10%). The percentage vegetation in DG was about 50% and percentage litter cover was about 28%.

Evidence of Striped Legless Lizards was also recorded in the quadrat IG and the percentage vegetation cover was about 53% and percentage litter cover about 11%. Percentage bare soil was high in this quadrat at about 35%. Tussock Skinks were recorded in the quadrats FG and HG and these quadrats had a similar percentage vegetation cover of 64% and 60% respectively.

No reptiles were recorded in the quadrat KG. This quadrat had the lowest percentage vegetation cover of about 46%, percentage litter cover of about 3% and percentage bare soil of about 45% of all grassland quadrats. The litter depth was also the lowest at 0.15 cm compared to 1.43 cm, 1.18cm and 3.62cm in quadrats AG, BG and DG respectively. Kangaroo Grass is present in this quadrat though in low densities.

#### 3.4.2 *Riparian Quadrats*

Three reptile species were recorded in riparian quadrats: Striped Legless Lizards (n=2), Tussock Skinks (n=6) and Eastern Blue-tongue Lizard (n=1). Striped Legless Lizards were recorded in quadrat AIR (n=2). Tussock Skinks were recorded in quadrats CIR (n=5) and Site IIR (n=1). The single Eastern Blue-tongue Lizard was recorded in quadrat HOR. The mean temperature recorded during reptile riparian quadrat surveys was 17.57°C (range 12.50-26.40°C).

#### *3.4.2.1 Habitat Associations*

The 2 Striped Legless Lizards that were recorded in quadrat AIR were in close proximity to exotic trees (<2m). This quadrat was infested with exotic grasses such as Toowoomba Canary Grass (*Phalaris aquatica*) and had a percentage vegetation cover of about 82% and percentage litter cover of about 17 %.

Tussock Skinks were recorded in quadrat CIR but not in COR. The percentage vegetation cover was similar in these quadrats; CIR (80.50%) and COR (90.50%), but the percentage litter cover was different; CIR (16%) and COR (8.50%).

#### *3.4.3 Escarpment/Rocky Slope Quadrats*

Only 1 species of reptile species was recorded in escarpment/rocky slope quadrats: Tussock Skink (n=5). This species was recorded in quadrats HIE (n=1), IIE (n=1), HOE (n=2) and IOE (n=1). The mean temperature during reptile escarpment/rocky slope quadrat surveys was 18.11°C (range 11.00-29.00°C).

##### *3.4.3.1 Habitat Associations*

There was no clear association between Tussock Skinks and habitat variables in the escarpment/rocky slope quadrats. However, all 4 of the quadrats where they were recorded had a litter depth >1 cm whereas they were absent from KOE which had a litter depth <1 cm. This warrants further investigation.

### **3.5 Discussion: Reptiles**

The present study has shown that despite threatening processes such as loss of habitat and fragmentation, that reptiles are persisting in the Iramoo Green Web (I.G.W.). The

reptile fauna of most sites was generally depauperate with low abundances however some sites were species rich with high abundances.

### 3.5.1 Species Richness

It was found that reptile species richness in natural sites is generally influenced by the diversity of habitat rather than by the size of a site. Similar results have been found in other studies (Jellinek *et al.*, 2004; Mac Nally and Brown, 2001). In a study on lizard communities in urban fragments in Hobart, Tasmania, Jellinek *et al.* (2004) found that species richness was not influenced by fragment size but rather environmental variables, specifically vegetation variables. The results of the Jellinek *et al.* (2004) study showed that species richness was positively correlated with vegetation diversity.

In the present study, 5 species were recorded in Site D (approximately 8 ha.) including 3 species that were abundant: Marbled Gecko (*Christinus marmoratus*), Tussock Skink (*Pseudemoia pagenstecheri*) and Eastern Blue-tongue Lizard (*Tiliqua scincoides*). In comparison 3 species with low abundance were recorded in Site C (approximately 12 ha.). Habitat in Site D includes patches of indigenous Kangaroo Grass (*Themeda triandra*), abundant basalt rocks and large amounts of human-generated rubbish. Habitat features such as these have been shown to correlate with an increase in reptile diversity (Hadden, 1992; Hoser, 1996). In contrast, Site C consists almost entirely exotic vegetation with small patches of Kangaroo Grass. Exotic vegetation has been shown to correlate with a decrease in species richness (Hadden and Westbrooke, 1996; Jellinek *et al.*, 2004). Another example of a species rich area is a small patch of grassland (approximately 0.25 ha.) in Incidental Site 6 where 4

species were recorded; Marbled Gecko, Tussock Skink, Eastern Blue-tongue Lizard and Eastern Tiger Snake (*Notechis scutatus*).

Site K is an exception to these findings. On first inspection this site was expected to have high species richness due to the apparent intactness of habitat including patches of Kangaroo Grass and an abundance of basalt rocks, however, only 2 species were recorded: Cunningham's Skink (*Egernia cunninghami*) and Eastern Blue-tongue Lizard. In the past, Striped Legless Lizards (*Delma impar*) have been recorded at this site and residents have sighted large elapids (Context Pty. Ltd., 2002; B. Mason, pers. comm.) The low species richness may be due to past disturbances to vegetation and soil. Many of the basalt boulders have been ripped by earth moving machinery and rocks from other areas have been dumped on site (Context Pty. Ltd., 2000). This has probably resulted in the destruction of the microhabitats of some species. Hadden (1992) listed vegetation and soil disturbance as a threat to Striped Legless Lizards.

### 3.5.2 Species Composition

It is clear that the reptile fauna of each site is a sub-set of the original pre-European settlement assemblage and that the present species composition is to some extent a reflection of the disturbance to the microhabitats of species (Jellinek *et al.*, 2004; Mac Nally and Brown, 2001).

The most wide spread reptile species in the I.G.W. is the Eastern Blue-tongue Lizard and this can be attributed to several characteristics of this species

The habitat in modified sites such as Site G and J has been dramatically altered and is essentially parkland with mown grass, patches of vegetation and sometimes rubbish piles. The species composition consists of Eastern Blue-tongue Lizards and Eastern

Brown Snakes (*Pseudonaja textilis*). These 2 species are generalists that are able to exploit a variety of resources in altered habitat (Mac Nally and Brown, 2001).

Eastern Blue-tongue Lizards are a characteristic generalist species that have low spatial requirements (Koenig *et al.*, 2001; Smith *et al.*, 1996). Eastern Blue-tongue Lizards are the most wide spread reptile species in the I.G.W. and this can be attributed to several characteristics that were investigated by Koenig *et al.* (2001). Koenig *et al.* (2001) conducted a study on how Eastern Blue-tongue Lizards survive in suburban habitat in the Sydney region and found that their persistence was due to several factors including; (1) their readiness to use 'artificial' shelter sites, (2) their rapid growth, early maturity and large litters, and (3) they have a long life span (30 years in captivity). Findings in the present study confirm that this species utilises a wide variety of 'artificial' shelter sites including plastic sheets, car panels and the lids from paint cans. The isolation of individuals in modified sites may prevent recruitment, however adults may persist for a long time (Koenig *et al.*, 2001).

The occurrence of Eastern Brown Snakes in these sites is possibly due to the presence of introduced house-mice (*Mus musculus*) that are the primary prey of this species (Shine, 1991). Pigeons and chickens are kept in some of the backyards that back onto Site G and these may attract house-mice that in turn attract Eastern Brown Snakes.

Most of the natural sites have large areas of degraded habitat that are typically infested with exotic weeds such as Spanish Artichoke (*Cynara cardunculus*), Serrated Tussock (*Nassella trichotoma*) and Toowoomba Canary-grass (*Phalaris aquatica*) and have large areas of bare soil. This habitat was found to have a species

composition consisting of Tussock Skinks, Eastern Blue-tongue Lizards and sometimes Marbled Geckos, Striped Legless Lizards and Eastern Tiger Snakes. Tussock Skinks were abundant in degraded habitat that was dominated by exotic vegetation and this is consistent with other studies (Hadden, 1998; Sullivan, 1999). A study of Tussock Skinks by Sullivan (1999) found that this species preferred exotic grassland habitat however this was possibly due to the recent senescence of Kangaroo Grass in the study site.

The occurrence of Marbled Geckos beneath rocks or amongst rubbish piles in degraded habitat suggests that this species can persist in altered habitat if surface debris are available for shelter. This is supported by anecdotal reports that this species inhabits the urban matrix in the study area (M. O'Shea, pers. comm.)

The presence of Striped Legless Lizards in degraded habitat infested with exotic weeds is consistent with other studies (Hadden, 1992; Hadden, 1998; O'Shea, 1996). O'Shea (1996) recorded large numbers of Striped Legless Lizards in Serrated Tussock adjacent to Kangaroo Grass. Striped Legless Lizards are grassland specialists that require a vegetation cover dominated by tussocks, specifically Kangaroo Grass, and their persistence in degraded habitat is possibly due to the structural similarities of exotic tussock species and Kangaroo Grass (Hadden, 1998).

The vegetation in these habitats have structural similarities to indigenous vegetation such as tussocks, however there is generally a decrease of habitat heterogeneity associated with exotic weed infestation and this decreases the available microhabitats for reptile species (Jellinek *et al.*, 2004). The replacement of indigenous vegetation

with exotics may also decrease invertebrate diversity which can possibly deny reptiles species of specific prey items (Hadden, 1992). Jellinek *et al.* (2004) suggests that in the long-term, weed infestations of fragments may cause local extinctions of some reptile species.

Natural sites that retain remnant vegetation dominated by Kangaroo Grass and a high percentage rock cover were generally found to have the most intact reptile assemblage consisting of Marbled Geckos, Striped Legless Lizards, Tussock Skinks, Eastern Blue-tongue Lizards and possibly Cunningham's Skinks, Eastern Brown Snakes and Eastern Tiger Snakes. This is consistent with other studies (Brown and Bennett, 1995; Hadden, 1992). Brown and Bennett (1995) found that the occurrence of reptiles in the Murray Darling Basin area in Victoria was correlated with habitats with remnant vegetation that retained structural diversity. Hadden (1992) found that percentage rock cover was positively correlated with reptile species richness in remnant native grassland in Victoria. Remnant habitat generally retains variety microhabitats that allow more reptile species to persist in fragments (Jellinek *et al.*, 2004; Mac Nally and Brown, 2001).

### 3.5.3 Additional Species

Previous studies, anecdotal reports, data bases and the species lists for adjacent areas suggests that the terrestrial reptile species list compiled in the present study for the I.G.W. is incomplete. At least 6 additional species may occur within the I.G.W.: Eastern Striped Skink (*Ctenotus robustus*), Southern Water Skink (*Eulamprus tympanum*), White's Skink (*Egernia whitii*), Garden Skink (*Lampropholis guichenoti*), Bouganville's Skink (*Lerista bougainvillii*) and Little Whip Snake

(*Parasuta flagellum*) (C. Hocking, pers. comm; Larwill *et al.*, 1993; Mc Millan *et al.*, 2003; O'Shea, pers.comm.).

The apparent absence of Little Whip Snakes from the study area is of concern as this species has previously been sighted in Site A (M. O'Shea, pers. comm.). A possible decline in the numbers of Tussock Skinks, which are probably the primary food of this species in the area, may have resulted in local extinction (Shine, 1991; Sullivan, 1999). Sullivan (1999) suggested that the current status of Tussock Skinks as common might need to be revised.

Potential habitat for each of these species exists within the study area and was extensively searched during area surveys. However, despite the apparent suitability of habitat and the extra effort devoted to locating the above 6 species none were recorded. Some species were apparently absent from sites where they have previously been recorded including Striped Legless Lizards in Site K (discussed above) and Cunningham's Skinks and White's Skinks in Site A (Context Pty. Ltd. 2000; C. Hocking, pers. comm.; Larwill *et al.*, 1993).

Cunningham's Skinks and White's Skinks prefer rocky outcrops and this habitat is naturally scattered in the study area. Fragmentation has isolated the existing rocky outcrops and this may have caused site extinction of these two species in some sites. Reptile species with specialist requirements such as Cunningham's Skinks and White's Skinks that prefer rocky habitat, are more vulnerable to fragmentation due to the disruption of dispersal (Mac Nally and Brown, 2001)

The low number of elapids recorded maybe due to either their rareness in the area or their ability to remain undetected. Most snakes are inactive most of the time so the chances of encountering active snakes are low (Shine, 1991). Snakes that are active usually flee or rely on crypsis when humans approach (Whitaker and Shine, 1999). This behaviour was observed in the present study when some snakes were heard fleeing into vegetation or rocks before they could be identified.

Whitaker and Shine (1999) conducted a study on the factors that influence encounters with Eastern Brown Snakes in the Murrumbidgee Irrigation Area of south-eastern New South Wales. They found that encounters were influenced by many factors including weather conditions, time of day, season and the shade of the observers clothing. During the Whitaker and Shine (1999) study, even experienced researchers had difficulty detecting telemetrically monitored snakes.

These characteristics of Eastern Brown Snakes are possibly shared by other large elapids such as Eastern Tiger Snakes and this makes detecting these species very difficult (Shine, 1991). Whitaker and Shine (1999) suggest that the cryptic behaviour of Eastern Brown Snakes could give the impression that they are rare in an area. It possible that Eastern Brown Snakes and Eastern Tiger Snakes are widespread in the study area however further research is required to investigate their status in the I.G.W.

#### *3.5.4 Conservation*

Conservation efforts for reptiles in the I.G.W. should be focused on the management and restoration of reptile assemblages in natural sites. Strategies should include maximising habitat diversity and increasing connectivity between sites.



(Figure 3.7) Marbled Geckos, Tussock Skinks, Eastern Blue-tongue Lizards and an Eastern Tiger Snake were recorded in the small patch of grassland between the sugar gums (*Eucalyptus cladocalyx*) and hill.

### 3.6 Revegetation Zone Bird Survey Results

A total of 245 individuals from 12 species of birds were recorded in revegetation zones. Fifty-seven percent were White-plumed Honeyeaters (*Lichenostomus penicillatus*), (n=140), 23 % Red Wattlebirds (*Anthochaera carunculata*) (n=57), 7% Welcome Swallows (*Hirundo neoxena*) (n=16) and 6% Purple-crowned Lorikeets (*Glossopsitta porphyrocephala*) (n=14). The species recorded in the most revegetation zones was the White-plumed Honeyeater and Red Wattlebird (11 revegetation zones) followed by the Welcome Swallow (6 revegetation zones) and Purple-crowned Lorikeet (5 revegetation zones). The highest number of species recorded in a revegetation zone was 5 (4 revegetation zones) followed by 4 (2 revegetation zones). The lowest number of species recorded in a revegetation zone was 2 (3 revegetation zones). See Appendix B, table B10, for results.

### 3.6.1 *Habitat Scores*

The revegetation zones with the highest total scores for the 5 habitat characteristics; trees, shrubs, groundcover, litter and vegetation density, also had the highest number of species recorded. Revegetation zone 6 had a perfect score of 15 and 5 bird species recorded. Revegetation zone 3 had a score of 14 and 4 bird species recorded. Revegetation zone 7 and 9 both had scores of 13 and 5 bird species recorded.

Revegetation zones with the lowest scores also had the lowest species number recorded. No.1 and 2 had scores of 4 with 2 species recorded. Revegetation zone 12 also had a score of 4 with 3 bird species recorded. Revegetation zones with the heterogeneous qualities of a mosaic including patches of vegetation density with a mix of tree species that are multi-aged, a mix of shrub species and patches of ground layer and litter seems to correspond to an increase in bird diversity. Revegetation zones that are generally homogenous with dense vegetation including trees and shrubs with no mix of species and not multi-aged seems to correspond to a decrease in bird species diversity. See Appendix B, table B11, for habitat score results.

### **3.7 Discussion: Revegetation Zone Bird Surveys**

The blocks of revegetation surveyed in the present study are considered to be of low conservation value for birds as the data suggests that only common species use the zones. This is consistent with other studies including (Kimber *et al.* 1999). Kimber *et al.* (1999) conducted a study on the habitat value of revegetation for wildlife and found that mainly common generalist species used revegetation zones. However, despite the low conservation value of the revegetation zones, they are important for

providing habitat to common bird species such as White-plumed Honeyeaters that have aesthetic value and give people a feeling of connectedness with nature.

It seems common practice to mass plant revegetation zones in the I.G.W. with little consideration given to the requirements of indigenous bird species (Kimber *et al.*, 1999). The majority of revegetation zones are densely vegetated and provide habitat for only a few common species including White-plumed Honeyeaters, Red Wattlebirds and the exotic Common Blackbird (*Turdus merula*). To increase bird species diversity revegetation zones should be planted in a mosaic with a greater structural complexity and floristic diversity (Kimber, *et al.*, 1999). A mosaic would have varying densities of vegetation with a mix of trees, shrubs and ground layer species that are multi-aged.

Bird species have different preferences for nesting and foraging sites so varying densities of vegetation would provide habitat for more species. Revegetation zones that are dense would provide habitat to only those species that prefer this type of habitat.

A mix of plant species would provide a mix of resources for more bird species at different times of the year (Kimber *et al.*, 1999). For example, a revegetation zone that has various species of plants that produce fruit, nectar and seeds would attract a higher diversity of birds than a revegetation zone that has plants that just produce nectar (Kimber *et al.*, 1999).

If increasing bird diversity is to be an aim of a revegetation zone then careful planning is needed to ensure that in the long-term a mosaic habitat is the result. The spatial

requirements of individual plants needs to be considered in the planning stage to prevent detrimental effects in the long-term. For example, planting acacia trees too close together could result in a revegetation zone that is too dense for most bird species. With proper planning and careful selection of plant species the blocks could also benefit less common bird species such as Little Grassbirds (*Megalurus gramineus*), that are of conservation value in the I.G.W. by providing 'stepping stones' that would allow birds to move between sites.

## **CHAPTER 4: CONSERVATION OF BIRDS AND REPTILES IN THE IRAMOO GREEN WEB**

### **4.1 Strategic Planning**

The conservation of birds and reptiles in the I.G.W. needs to be strategically planned and managed in conjunction with an overall strategy of conserving and restoring remnant grassland, riparian and escarpment/ rocky slope flora and fauna communities. Conservation strategies should focus on natural sites that have existing remnant flora and fauna communities and that have the potential for these communities to be reintroduced. Conservation efforts need to be a combination of restoration and management for both sites and species (Hadden, 1992).

At the outset several key components are essential for the success of conservation including:

- Management Committee for strategic planning and coordination of conservation projects (Bush *et al.*, 2003).
- Community Education to inform the community about the local conservation issues.
- Volunteer Conservation Group to undertake conservation tasks that are manpower and labour intensive.

### **4.2 Restoration**

The aim of restoration is to enhance or establish a minimum viable population (M.V.P.) of a species so that it can persist in the long term with the ability to undergo adaptive evolution (Montalvo *et al.*, 1997; Smallwood, 2001). The demographic unit

of the M.V.P. can vary from a single pair to a metapopulation and depends on the species and available space and habitat.

Restoration and conservation of birds and reptiles will require different strategies because birds are highly mobile whereas reptiles are generally sedentary and are confined to sites (Scott *et al.*, 2001).

Birds require passive management, mainly the enhancement of the habitat value of sites. Reptiles require active management to offset the effects of decreasing population viability in fragmented sites and a translocation program is essential. However, detailed information is needed for translocation to be successful, including the determination of the age, sex and number of each species to be translocated and the carrying capacity of sites for each species.

#### 4.2.1 *Habitat Recreation*

The small size of most sites requires that restoration maximises the available habitat for birds and reptiles. A possible way that restoration of habitat could be maximised in sites is to recreate stony knolls. These could be positioned in areas of sites that are the most degraded or strategically positioned to enhance movement of fauna between sites. There are numerous piles of displaced basalt rocks in the I.G.W. and these could be a valuable resource for creating habitat.

The vegetation communities associated with stony knolls may provide specific habitat that is otherwise absent in the surrounding grassland for indigenous bird species.

The trees and shrubs planted on a stony knoll may provide the structural diversity required by some bird species for feeding, nesting and shelter. For example, bird

species such as Red-browed Finches usually nest in spiky shrubs and the planting of Hedge Wattles (*Acacia paradoxa*) on stony knolls may provide this requirement (Strahan, 1996). Stony knolls could also be used as 'stepping stones' for bird species moving between sites (Marzluff and Ewing, 2001).



(Figure 4.1) Vegetation on stony knoll could provide habitat to indigenous bird species.

The careful positioning and placement of basalt rocks in a stony knoll could recreate the specific microhabitats for some reptile species. For example, flat rocks are used as shelter sites by Marbled Geckos (*Christinus marmoratus*) and the crevices between boulders could provide shelter for Cunningham's Skinks (*Egernia cunninghami*).

Basalt rocks could also be lightly embedded and scattered in grassland habitat. Hadden (1992) found that rock cover in remnant grasslands was positively correlated with reptile species richness. Rocks are used by reptiles for a variety of purposes including breeding, shelter and as basking sites (Hadden, 1992). The most likely species to use rocks in the grasslands would be Striped Legless Lizards (*Delma*

*impar*), Tussock Skinks (*Pseudemioa pagenstecheri*) and Eastern Blue-tongue Lizards (*Tiliqua scincoides*).



(Figure 4.2) Basalt boulders and rocks could provide habitat for reptiles.

#### 4.2.2 Revegetation

Revegetation of sites with indigenous plants is important for the restoration and enhancement of indigenous vegetation communities but also for providing habitat for indigenous fauna including birds and reptiles (Bush *et al.*, 2003; Kimber *et al.*, 1999).

Revegetation could benefit birds and reptiles in two main ways (Kimber *et al.*, 1999):

##### (1) Direct Benefits

- Increase suitable habitat in sites;
- Improve the existing habitat in sites; and
- Increase the connectivity between sites.

##### (2) Indirect Benefits

- Provide a buffer to edge effects
- Stabilise the site from disturbance such as soil erosion.

Many of the sites are infested with weeds such as Chilean Needle Grass (*Nassella neesiana*), Serrated Tussock (*Nassella trichotoma*) and Toowoomba Canary-grass (*Phalaris aquatica*). Revegetation would replace weedy areas with a simplified version of the original vegetation (Bush *et al.*, 2003). The initial aim would be to establish keystone species such as Kangaroo Grass (*Themeda triandra*) in grasslands and Common Tussock Grass (*Poa labillardierei*) in riparian habitat by direct seeding and planting (Bush *et al.*, 2003). Once established other species of plants such as forbs and shrubs specific to each community could be selectively planted in the inter-tussock spaces.



(Figure 4.3) River Red Gum (*Eucalyptus camaldulensis*) could be planted along Kororoit Creek and Jones Creek.

A mosaic of vegetation with structural complexity and floristic diversity would be the overall aim to provide variety of niches for not only bird and reptile species, but also invertebrates to occupy (Hadden, 1992; Hadden, 1998; Kimber *et al.*, 1999). The species selected for planting should have certain attributes that benefit birds and reptiles such as providing shelter and food resources such as seeds and fruit. See Appendix C, table C1 for a list of suitable plant species.

The Iramoo Nursery at Victoria University, St. Albans campus may provide a source of indigenous plants however, the costs of revegetation may prohibit large areas from being revegetated (See Appendix C, table C2, for the Iramoo Nursery species list). For example, it would cost approximately \$20 to establish Kangaroo Grass in 1 square metre of grassland (B. Mason, pers. comm.).

#### 4.2.3 *Links and Connections*

The potential for links between sites is limited because the urban matrix surrounds most sites. Various permanent barriers of the urban matrix such as roads, paths and buildings, may disrupt the movement of birds and totally prevent any movement of reptiles between sites.

The location of some incidental sites may be important links for connecting sites. For example, Incidental Site 15 is adjacent to the Orica Complex and this area is possibly a major entry point for birds that disperse from the surrounding grasslands into Site H and I.

It may be possible to link some sites to create clusters of sites. Possible clusters include Site C and D, and Site E (grassland in centre of site) and F. However, the links between these sites are narrow. For example, the width of the corridor between Site C and D is only 40 m. Revegetated with indigenous grasses such as Kangaroo Grass and Common Tussock Grass as well as the recreation of rocky outcrops, these links may facilitate the movement of reptiles between sites.



(Figure 4.4) Corridor that may link revegetated grassland in Site E to Site F.

Underpasses could be used to link habitats that are isolated within sites, such as narrow strips of grassland along Jones Creek are separated from a larger grassland by a path. Underpasses could be low to simulate a depression, and be vegetated with indigenous grasses that could enable reptiles to move between habitat patches. However, the success of underpasses varies there is a need for more research on its viability in the study area (Goosem *et al.*, 2001).

### **4.3 Management**

The present study identified a number of threats to the conservation of birds and reptiles in the I.G.W. including:

- Habitat destruction
- Habitat fragmentation
- Exotic predators
- Exotic vegetation
- Poaching of reptiles

For conservation of flora and fauna to be effective, management of sites must mitigate these threatening processes.

Management of sites for birds and reptiles should include:

- Maintaining the structural and floristic diversity of indigenous vegetation in sites and links.
- Prevent exotic birds from using nest sites (eg. hollows).
- Controlling and eradicating exotic vegetation.
- Controlling exotic predators.
- Fire management of sites with burns every 2-5 years in patches (Hadden, 1992).
- Maintenance of buffer zones around sites.
- Removal of rubbish.

## **CHAPTER 5: CONCLUSIONS**

### **5.1 Hypotheses results:**

- Bird and reptile species richness is generally influenced by the diversity of habitat within a site.
- Bird species composition is generally influenced by the available habitat and the proximity to the urban matrix.
- Reptile species composition is influenced by the extent of habitat alteration.
- Blocks of revegetation are mainly used by common native bird species and have low conservation value for indigenous bird species.
- Human usage of sites is mainly passive recreation with walking and walking dog/s the most frequently recorded activity.

### **5.2 Other Conclusions:**

- At least 67 native bird species and 8 reptile species occur within the Iramoo Green Web.
- Approximately 25 native bird species are resident in the Iramoo Green Web, the remaining species are visiting migrants or nomads.
- Reptiles are persisting in the Iramoo Green Web however they are at risk from a number of threatening processes.
- Habitat consisting of remnant vegetation and rocks have high reptile species richness.
- Exotic predators are common in the sites of the Iramoo Green Web.
- Conservation should be focused on indigenous birds and reptiles in natural sites.

- Conservation of indigenous birds requires passive management.
- Conservation of reptiles requires active management.
- A management committee, community education and a volunteer conservation are essential for the long-term success of conservation in the Iramoo Green Web.

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## APPENDIX A: Photographs of Sites.



(Figure A1.) Grassland in Site A (Victoria University Grassland Reserve).



(Figure A2.) Site B with remnant grassland and Sugar Gums (*Eucalyptus cladocalyx*) in the background.



(Figure A3.) Site D with basalt rocks in the grassland. This patch of grassland is inhabited by a number of reptile species including Striped Legless Lizards (*Delma impar*).



(Figure A4.) Site F grassland. Note the cat sitting on a rock in the centre of the photograph.



(Figure A5.) Site H with waterhole in Kororoit Creek. The rocky slopes provide habitat for reptiles including Eastern Blue-tongue Lizards (*Tiliqua scincoides*) which are abundant in this site.



(Figure A6.) Habitat destruction of grasslands in Site I due to urban development. Kororoit Creek is in the foreground.



(Figure A7.) Concrete path along Kororoit Creek in Site J.



(Figure A8.) Site K with River Red Gums (*Eucalyptus camaldulensis*) lining Kororoit Creek. Basalt rocks are scattered in the grassland.



(Figure A9.) Modified habitat in Site L with remnant basalt rocks in the foreground.



(Figure A10.) Site M with Kangaroo Grass (*Themeda triandra*) in the foreground.



(Figure A11.) Site N with Straw-necked Ibis (*Threskiornis spinicollis*) in foreground on rocks.

## APPENDIX B: Results

(Table B1.) Bird and Reptile Species Recorded in the present study. (The nomenclature of bird and reptile names generally follows that used by Flegg (2002) and Wilson and Swan (2003)).

Common Name	Scientific Name	No. of sightings
<b>Bird Species List</b>		
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>	34
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	27
Australian Pelican	<i>Pelecanus conspicillatus</i>	1
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	132
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	20
White-faced Heron	<i>Egretta novaehollandiae</i>	78
Great Egret	<i>Ardea alba</i>	3
Intermediate Egret	<i>Ardea intermedia</i>	14
Australian White Ibis	<i>Threskiornis molucca</i>	36
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	80
Yellow-billed Spoonbill	<i>Platalea flavipes</i>	2
Black Swan	<i>Cygnus atratus</i>	25
Pacific Black Duck	<i>Anas superciliosa</i>	262
Grey Teal	<i>Anas gracilis</i>	10
Chestnut Teal	<i>Anascastanea</i>	38
Hardhead	<i>Aythya australis</i>	32
Australain Wood Duck	<i>Chenonetta jubata</i>	42
Black-shouldered Kite	<i>Elanus axillaris</i>	22
Brown Goshawk	<i>Accipiter fasciatus</i>	6
Wedge-tailed Eagle	<i>Aquila audax</i>	1
Little Eagle	<i>Hieraetus morphnoides</i>	22
Swamp Harrier	<i>Circus approximans</i>	1
Australian Hobby	<i>Falco longipennis</i>	19
Brown Falcon	<i>Falco berigora</i>	17
Australian Kestrel	<i>Falco cenchroides</i>	19
Dusky Moorhen	<i>Gallinula tenebrosa</i>	107
Purple Swamphen	<i>Porphyrio porphyrio</i>	42
Eurasian Coot	<i>Fulica atra</i>	99
Masked Lapwing	<i>Vanellus miles</i>	46
Black-fronted Dotterel	<i>Elsyornis melanops</i>	10
Black-winged Stilt	<i>Himantopus himantopus</i>	3
Common Greenshank	<i>Tringa nebularia</i>	1
Latham's Snipe	<i>Gallinago hardwickii</i>	3
Silver Gull	<i>Larus novaehollandiae</i>	295
Crested Pigeon	<i>Ocyphaps lophotes</i>	21
Galah	<i>Cacatua rosiecapilla</i>	95
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	5
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	139
Musk Lorikeet	<i>Glossopsitta concinna</i>	27
Purple-crowned Lorikeet	<i>Glossopsitta porphyrocephala</i>	164
Crimson Rosella	<i>Platycercus elegans</i>	1
Eastern Rosella	<i>Platycercus eximius</i>	2
Blue-winged Parrot	<i>Neophema chrysostoma</i>	3
Sacred Kingfisher	<i>Todiramphus sanctus</i>	5
Welcome Swallow	<i>Hirundo neoxena</i>	448
Fairy Martin	<i>Hirundo ariel</i>	1
Richard's Pipit	<i>Anthus novaeseelandiae</i>	83

Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	2
White-winged Triller	<i>Lalage suerii</i>	3
Grey Fantail	<i>Rhipidura fuliginosa</i>	6
Willie Wagtail	<i>Rhipidura leucophrys</i>	116
Clamorous Reed-Warbler	<i>Acrocephalus stentoreus</i>	128
Little Grassbird	<i>Megalurus gramineus</i>	5
Golden-headed Cisticola	<i>Cisticola exilis</i>	162
Superb Fairy-wren	<i>Malurus cyaneus</i>	299
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	118
Red Wattlebird	<i>Anthochaera carunculata</i>	660
Little Wattlebird	<i>Anthochaera chrysoptera</i>	6
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	524
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	45
Silveryeye	<i>Zosterops lateralis</i>	12
Red-browed Finch	<i>Neochmia temporalis</i>	94
Dusky Woodswallow	<i>Artamus cyanopterus</i>	5
Australian Magpie-lark	<i>Grallina cyanoleuca</i>	102
Australian Magpie	<i>Gymnorhina tibicen</i>	115
Australian Raven	<i>Corvus coronoides</i>	168
Little Raven	<i>Corvus mellori</i>	205

#### Reptile Species List

Eastern Long-necked Tortoise	<i>Chelodina longicollis</i>	1
Marbled Gecko	<i>Christinus marmoratus</i>	73
Striped Legless Lizard	<i>Delma impar</i>	16
Cunningham's Skink	<i>Egernia cunninghami</i>	19
Tussock Skink	<i>Pseudemoia pagenstecheri</i>	111
Eastern Blue-tongue Lizard	<i>Tiliqua scincoides</i>	88
Eastern Tiger Snake	<i>Notechis scutatus</i>	6
Eastern Brown Snake	<i>Pseudonaja textilis</i>	4

#### Additional Bird Species that may also occur in the Iramoo Green Web include:

Stubble Quail	<i>Coturnix pectoralis</i>
Nankeen Night Heron	<i>Nycticorax caledonicus</i>
Southern Boobook	<i>Ninox novaeseelandiae</i>
Barn Owl	<i>Tyto alba</i>
Flame Robin	<i>Petroica phoenicea</i>

#### Additional Reptile Species that may also occur within the Iramoo Green Web include:

Eastern Striped Skink	<i>Ctenotus robustus</i>
White's Skink	<i>Egernia whitii</i>
Southern Water Skink	<i>Eulamprus tympanum</i>
Garden Skink	<i>Lampropholis guichenoti</i>
Bougainville's Skink	<i>Lerista bouganvillii</i>
Little Whip Snake	<i>Parasuta flagellum</i>

#### Exotic Bird Species List observed in the Iramoo Green Web during the present study.

Mallard	<i>Anas platyrhynchos</i>
Rock Dove	<i>Columba livia</i>
Spotted Turtle-Dove	<i>Streptopelia chinensis</i>
Skylark	<i>Alauda arvensis</i>
Common Blackbird	<i>Turdus merula</i>
Song Thrush	<i>Turdus philomelos</i>
European Goldfinch	<i>Carduelis carduelis</i>
European Greenfinch	<i>Carduelis chloris</i>
House Sparrow	<i>Passer domesticus</i>
Common Starling	<i>Sturnus vulgaris</i>
Common Myna	<i>Acridotheres tristis</i>

## Miscellaneous Records from Present Study

(Table B2.) Frog Species Recorded in the Present Study.

Species		Location
Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>	Site J, carcass adjacent to Kororoit Ck.
Spotted Grass Frog	<i>Limnodynastes tasmaniensis</i>	Site A
Southern Toadlet	<i>Pseudophryne semimarmorata</i>	Site A, adjacent to Jones Ck.
Brown Froglet	<i>Crinia signifera</i>	Site B, adjacent to Jones Ck.
Growling Grass Frog	<i>Litoria raniformis</i>	Site I, swimming across Kororoit Ck.

(Table B3.) Mammal Species Recorded in the Present Study.

Species		Location
House Mouse	<i>Mus musculus</i>	Sites A, B, C, D, F, H, I, K and some incidental sites
Brown Rat	<i>Rattus norvegicus</i>	Sites A, C and D
Brown Hare	<i>Lepus capensis</i>	Site A
European Rabbit	<i>Oryctolagus cuniculus</i>	Sites B, D and E and some incidental sites.
Cat	<i>Felis catus</i>	Sites F, H, I, J and K
Red Fox	<i>Canis vulpes</i>	Site A, B, F, H, K and I

## Bird Assemblages

(Table B4.) Bird Species of the Urban/Modified Habitat Assemblage.

Urban/Modified Habitat Assemblage	
Rainbow Lorikeet	Superb Fairy-wren
Musk Lorikeet	Red Wattlebird
Purple-crowned Lorikeet	White-plumed Honeyeater
Welcome Swallow	New Holland Honeyeater
Willie Wagtail	Australian Magpie-lark
Australian Raven	Australian Magpie

(Table B5.) Bird Species of the Artificial Lake Assemblage.

Artificial Lake Assemblage	
Hoary-headed Grebe	Chestnut Teal
Australasian Grebe	Hardhead
Little Pied Cormorant	Australian Wood Duck
Little Black Cormorant	Dusky Moorhen
White-faced Heron	Purple Swamphen
Great Egret	Eurasian Coot
Australian White Ibis	Masked Lapwing
Straw-necked Ibis	Black-fronted Dotterel
Yellow-billed Spoonbill	Black-winged Stilt
Black Swan	Common Greenshank
Pacific Black Duck	Latham's Snipe
Grey Teal	Silver Gull

(Table B6.) Bird Species of the Nomadic Assemblage.

<b>Nomadic Assemblage</b>	
Australian White Ibis	Galah
Straw-necked Ibis	Sulphur-crested Cockatoo
Crested Pigeon	Little Raven

(Table B7.) Bird Species of the Natural Habitat Assemblage.

<b>Natural Habitat Assemblage</b>	
Little Pied Cormorant	Purple-Swamphen
Little Black Cormorant	Blue-winged Parrot
White-faced Heron	Sacred Kingfisher
Pacific Black Duck	Richard's Pipit
Black-shouldered Kite	Clamorous Reed-Warbler
Brown Goshawk	Little Grassbird
Little Eagle	Golden-headed Cisticola
Brown Falcon	Superb Fairy-wren
Australian Kestrel	Yellow-rumped Thornbill
Dusky Moorhen	Red-browed Finch

## Incidental Survey Results

(Table B8.) Bird Species Recorded in Incidental Sites.

Species	Incidental Sites														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Australasian Grebe										+	+	+			
Little Pied Cormorant											+	+		+	+
Little Black Cormorant											+				+
White-faced Heron	+									+				+	
Great Egret											+				
Intermediate Egret											+				
Australian White Ibis											+	+			
Yellow-billed Spoonbill											+				
Black Swan											+				+
Pacific Black Duck										+	+	+			
Grey Teal											+				
Chestnut Teal												+			
Australian Wood Duck											+				
Little Eagle			+				+								+
Australian Hobby			+		+									+	
Brown Falcon			+												
Dusky Moorhen											+				+
Purple Swamphen										+	+	+		+	
Eurasian Coot										+	+	+			
Silver Gull	+										+			+	
Crested Pigeon	+	+	+												
Galah			+										+	+	
Rainbow Lorikeet	+		+										+	+	
Musk Lorikeet														+	
Purple-crowned Lorikeet	+		+	+	+		+		+				+		
Crimson Rosella			+												
Blue-winged Parrot			+												
Sacred Kingfisher									+						
Welcome Swallow			+		+	+		+			+				
Richard's Pipit							+	+							
Willie Wagtail			+	+	+	+					+	+	+		
Clamorous Reed-Warbler										+	+	+			
Golden-headed Cisticola					+				+					+	
Superb Fairy-wren			+		+			+	+		+			+	+
Red Wattlebird	+	+	+	+	+	+			+		+		+	+	
White-plumed Honeyeater			+	+	+	+		+	+		+		+	+	+
Red-browed Finch															+
Dusky Woodswallow						+									
Australian Magpie-lark			+	+	+		+		+				+	+	
Australian Magpie	+	+		+	+		+	+	+				+	+	
Australian Raven				+	+		+		+		+		+	+	
Little Raven	+		+					+							

(Table B9.) Reptiles Recorded in Incidental Sites

Species	Incidental Sites														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Marbled Gecko		+			+	+		+							
Tussock Skink		+				+	+		+				+		
Eastern Blue-tongue Lizard		+		+	+	+	+		+				+		
Eastern Tiger Snake						+									

**Revegetation Survey Results**

(Table B10.) Bird Species Recorded in Revegetation Zone Surveys.

Species	Revegetation Zone												Total	Proportion
	1	2	3	4	5	6	7	8	9	10	11	12		
Purple Swamphen							1						1	0.41
Crested Pigeon						2							2	0.81
Purple-crowned Lorikeet			6	2		2	2		2				14	5.71
Sacred Kingfisher							1						1	0.41
Welcome Swallow			2	2	2	3			5	2			16	6.53
Willie Wagtail												3	3	1.22
Superb fairy-wren				2						1			3	1.22
Red Wattlebird	7	1		6	4	4	3	11	11	3	6	1	57	23.26
White-plumed Honeyeater	25	24	8	8	2	28	10	15	6		10	4	140	57.14
New Holland Honeyeater										2			2	0.81
Australian Raven			2										2	0.81
<b>Total</b>	<b>32</b>	<b>25</b>	<b>18</b>	<b>20</b>	<b>8</b>	<b>40</b>	<b>17</b>	<b>26</b>	<b>24</b>	<b>10</b>	<b>17</b>	<b>8</b>	<b>245</b>	<b>99.96</b>

(Table B11.) Habitat Scores for Revegetation Zones.

	Revegetation Zone											
	1	2	3	4	5	6	7	8	9	10	11	12
No. of species	2	2	4	5	3	5	5	2	4	5	3	3
Tree score	1	1	3	1	1	3	3	3	3	2	1	1
Shrub score	1	1	3	2	1	3	2	3	3	2	1	1
Ground layer score	1	1	3	3	1	3	3	2	3	3	3	1
Litter score	1	1	3	2	1	3	3	1	1	3	3	1
Veg. density score	0	0	2	2	1	3	2	3	2	3	0	0
<b>Total score</b>	<b>4</b>	<b>4</b>	<b>14</b>	<b>10</b>	<b>5</b>	<b>15</b>	<b>13</b>	<b>12</b>	<b>12</b>	<b>13</b>	<b>8</b>	<b>4</b>

## Bird Quadrat Statistical Analysis

(Table B12.) One-way Analysis of Variance of Bird Grassland Quadrats.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.670	7	9.566E-02	3.743	.003
Within Groups	1.022	40	2.555E-02		
Total	1.692	47			

(Table B13.) One-way Analysis of Variance of Bird Riparian Quadrats along Kororoit Creek.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.741	4	.185	5.293	.003
Within Groups	.875	25	.035		
Total	1.616	29			

(Table B14.) One-way Analysis of Variance of Bird Riparian Quadrats along Jones Creek.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.074	4	.019	.950	.452
Within Groups	.487	25	.019		
Total	.561	29			

(Table B15.) One-way Analysis of Variance of Bird Escarpment/Riparian Quadrats.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.189	4	4.726E-02	1.651	.193
Within Groups	.716	25	2.862E-02		
Total	.905	29			

## Quadrat Habitat Variables

(Table B16.) Grassland Quadrat Habitat Variables.

Site	Percentage Coverage (%)				Litter depth (cm)	Veg. Ht. 1 (cm)	Veg. Ht. 2 (cm)	No. of shrubs	Art. score
	Veg.	Litter	Bare soil	Rock					
A	82.18	10.93	6.87	-	1.43	68.21	26.59	-	-
B	85.93	10.31	3.43	0.31	1.18	20.71	34.60	-	4
C	58.75	23.12	17.50	0.62	3.87	39.18	19.59	-	5
D	50.31	28.12	12.18	10.00	3.62	42.15	16.28	-	-
F	64.00	23.00	7.50	2.81	3.64	59.78	19.26	-	-
H	59.75	35.31	1.87	3.43	2.29	60.46	11.07	38	4
I	53.43	11.25	35.31	-	0.67	45.04	20.88	12	3
K	45.93	3.43	45.31	5.31	0.15	73.56	16.29	1	-

(Table B17.) Riparian Quadrat Habitat Variables.

Site	Percentage coverage (%)				Litter depth (cm)	Veg. Ht. 1 (cm)	Veg. Ht. 2 (cm)	Art. score	No. of shrubs	Reed score	Tree 1	Tree 2	Tree 3
	Veg.	Litter	Bare soil	Rock									
AIR	82.00	17.00	-	3.18	96.45	37.42	2	-	-	46	95	-	
BIR	81.10	19.00	-	6.57	124.65	45.02	4	-	2	20	6	-	
CIR	80.50	16.00	3.50	4.86	96.10	34.75	5	-	-	-	-	-	
HIR	45.50	16.50	3.87	2.52	79.65	17.37	-	7	5	14	1	-	
IIR	87.50	12.50	-	7.02	97.62	40.27	2	1	5	-	-	1	
BOR	74.50	24.50	0.50	11.13	114.37	36.07	2	2	2	22	11	-	
COR	90.50	8.50	-	3.95	90.77	46.30	5	-	-	-	1	-	
HOR	82.00	4.50	11.50	3.25	102.02	37.02	-	13	5	1	2	2	
IOR	89.95	10.00	-	8.83	118.80	48.82	4	17	5	13	2	-	
KOR	88.50	5.50	5.00	1.56	119.85	34.07	1	3	5	1	-	-	

(Table B18.) Escarpment/Rocky Slope Quadrat Habitat Variables.

Site	Percentage coverage				Litter depth	Veg. Ht. 1	Veg. Ht. 2	Art. score	No. of shrubs	Tree 1	Tree 2	Tree 3
	Veg.	Litter	Bare Soil	Rock								
HIE	39.00	25.50	7.00	28.50	2.11	42.65	23.80	-	18	17	9	-
IIE	80.50	12.50	3.50	3.50	3.30	95.30	38.87	3	5	2	-	1
HOE	62.50	24.00	4.00	10.00	2.53	50.15	18.22	4	5	-	-	-
IOE	62.00	22.00	9.50	6.50	1.51	77.62	32.00	4	20	-	-	-
KOE	48.00	4.50	16.50	30.00	0.95	93.37	17.76	-	3	-	-	-

## Results: Human Observations

(Table B19.) Summary of Human Observation Data

Site	No.	Sex		Age					Activity					Perceived Purpose				Repeats	
		M	F	1	2	3	4	5	W	Wd	C	F	J	O	T	F	R		O
A	6	4	2	-	-	2	4	-	42	-	-	-	-	-	-	-	6	-	-
B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C	16	13	3	2	-	-	6	8	2	14	-	-	-	-	-	-	16	-	7
D	10	10	-	-	2	3	3	2	-	1	7	-	2	-	6	3	1	-	3
E	26	24	2	1	2	13	8	2	6	3	13	-	2	2	5	12	9	-	-
F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G	39	20	19	10	3	9	9	8	19	15	3	-	2	-	21	3	15	-	7
H	124	77	47	2	5	44	44	29	46	40	28	-	6	4	9	23	86	6	-
I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
J	176	85	91	19	7	78	46	26	97	60	5	4	3	7	46	12	108	10	3
K	41	24	17	2	7	17	11	4	21	13	5	1	1	-	17	1	21	2	-
L	23	14	9	-	7	6	8	2	19	1	3	-	-	-	21	-	1	1	-
M	2	1	1	-	-	1	-	1	2	-	-	-	-	-	2	-	-	-	-
N	3	3	-	-	-	-	3	-	3	-	-	-	-	-	-	-	3	-	-
<b>Total</b>	<b>466</b>	<b>275</b>	<b>191</b>	<b>36</b>	<b>33</b>	<b>173</b>	<b>142</b>	<b>82</b>	<b>219</b>	<b>149</b>	<b>64</b>	<b>5</b>	<b>16</b>	<b>13</b>	<b>127</b>	<b>54</b>	<b>266</b>	<b>19</b>	<b>20</b>

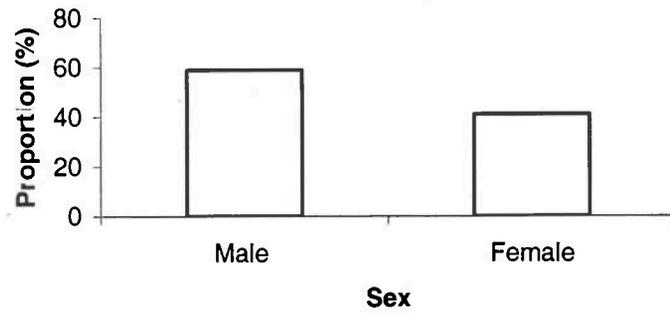
**Sex:** M=Males, F=Females; **Age:** 1=0-12, 2=13-19, 3=20-39, 5=>60; **Activity:** W=walking, Wd=walking dog/s, C=cycling, F=fishing, J=jogging, O=other activities; **Perceived purpose:** T=transiting, F=fitness, R=recreation, O=other activities

The highest count of people was in Round 2 (n=223) followed by Round 3 (n=148) and Round 1 (n=95). These differences can be attributed to the time of year that each round was conducted. For example, Round 2 was partly conducted during the summer holiday period (December-January) so it would be expected that people would have more time available for leisure activities.

### *Sex*

The overall number of human observations for the 3 survey rounds was 466 with 60% (59.01%) males and 40% (40.98%) females. The proportion of males and females remained relatively consistent for all 3 rounds.

### Sex of People

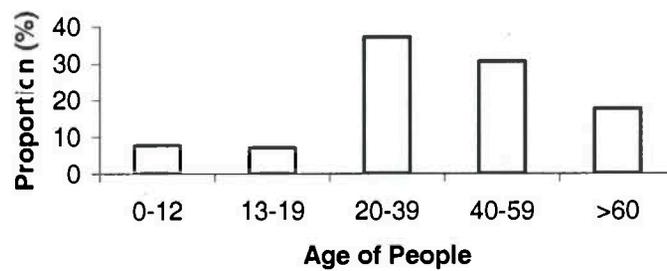


(Figure B12.) The percentage (%) of males and females observed.

### Age

The most frequently recorded age group was between 20-39 years followed by 40-59 years,  $\geq 60$  years, 0-12 years and 13-19 years.

### Age of People

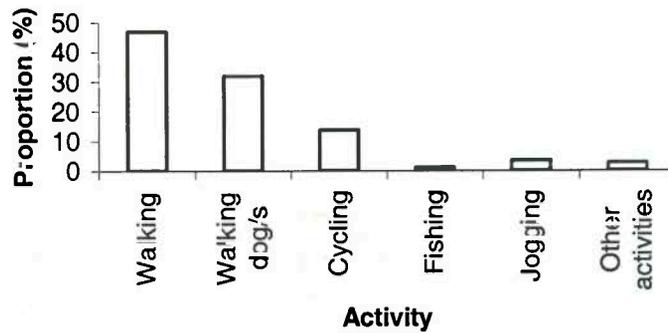


(Figure B13.) The proportion (%) of ages of people observed.

### Activity

Walking was the most frequently recorded activity closely followed by walking dog/s then cycling, jogging other activities and fishing.

### Human Activity in I.G.W.

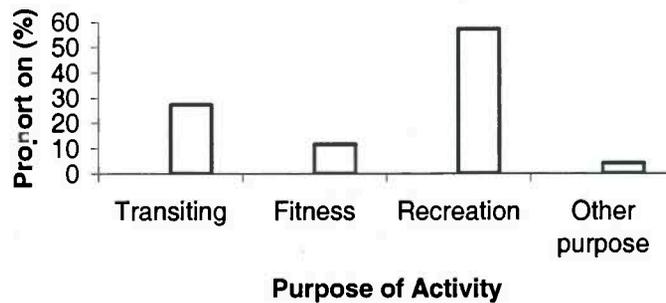


(Figure B14.) The proportion (%) of people's activities observed.

### *Perceived Purpose of Activities*

Recreation was the most frequently recorded perceived purpose of activity followed by transiting, fitness and other purposes.

### Purpose of Human Activity in the I.G.W.



(Figure B15.) The proportions of activities for people observed.

Males aged between 20-59 years, walking or walking dog/s for recreational purposes were the most frequently recorded users of the sites within the I.G.W. People less than 19 years do not seem to use the sites very frequently however the opposite may be true after school hours and on weekends when this age group has more free time.

## **Summary**

Human use of sites varies across the Iramoo Green Web (I.G.W.) and appears to depend on 3 main factors: (1) accessibility of the site, (2) landscape of the site and (3) location of the site.

### *Accessibility of Sites*

The activities of people and the purpose of those activities in sites seems partly to depend on whether paths are present in the site and if so, whether the substrate of the path is either hard (i.e. concrete) or soft (i.e. gravel). Sites with hard paths (i.e. Sites H and J) had the highest counts of people whereas sites with no paths (i.e. Sites B and F) had no people recorded. Site G had a hard path and a high count even though it was visited once in each round. Site K is easily accessed via gravel paths however sites with soil paths (i.e. Sites C and D) were found to be rarely used by people.

Observations suggest that people generally remain on hard paths and rarely stray even when a short cut offers a more direct route. However, people were more liable to take short cuts when walking on soft paths and this was regularly observed in Site K.

### *Landscape of Sites*

The landscape varies between natural sites and modified sites and within sites.

Sites that are modified are generally more frequently used than sites that are unmodified. Site G and J are both highly modified and had high counts of people whereas Site C and D consists mainly of unmodified areas and had low counts of people. In Site H people frequently use a concrete path that is parallel to Kororoit Creek and is located in the modified zone however a soft path on the opposite side of Kororoit Creek is infrequently used.

The difference in preference for modified and unmodified areas probably reflects the way people perceive potential threats in the landscape. Modified landscapes may evoke a feeling of safety in people because the potential for danger, such as encounters with snakes, could be perceived as being limited whereas unmodified areas are probably perceived by people as being potentially dangerous and so are avoided.

### *Location of Sites*

The location of sites in relation to shops and schools could account for the majority of human traffic in some sites. Sites L and M for example, are mainly used by people transiting to and from Deer Park Shopping Centre. Site J is frequently used by people transiting to the retail strip on the Western Highway and by children and parents taking their children to and from school.

People that are transiting through sites are generally more likely to take short cuts through unmodified areas and create trails and this occurs in Site K where school children have tramped trails through parts of the grassland.

### *Conclusion*

Observations of human usage of sites within the I.G.W. were a minor component of the present study and were miscellaneously recorded during area and quadrat surveys between 07.30 and 12.00 hours. This small time period for observations puts limitations on any inferences that can be made from the data because recordings were only taken in the morning during weekdays. Human use of sites during other periods of the weekday and on weekends could be very different to that recorded in the present study. The ideal would have been to conduct an extensive survey of human

usage of each site at different periods of the day including weekends throughout the year but this was not possible in the present study.

Another limitation was the difference in the number of visits to each site and the amount of time spent in each site. Some sites were visited a number of times during each round while others were visited just once so the time available for data collection varied considerably between the sites so preventing comparisons. However, despite these limitations the observations recorded in the present study do at least provide an insight into human usage of the open spaces within the I.G.W. and should be considered and be included in conservation strategies.

To cater for human activities in sites, hard paths should be constructed and positioned away from ecologically sensitive areas.

## **APPENDIX C: Conservation of Birds and Reptiles.**

### **Management Committee**

The sustainable management of the environmental values of the Iramoo Green Web (I.G.W.) including the conservation of birds and reptiles requires strategic planning and coordination. A management committee that is staffed by representatives from the main stakeholders including Brimbank City Council, Melton Shire Council, Victoria University and local community groups would enable all conservation projects to be planned and coordinated.

The main tasks of the committee could include (Bush et al., 2003):

- Strategic planning for conservation and restoration of the I.G.W. (Bush et al., 2003).
- Prioritising objectives for conservation and restoration of the I.G.W. (Bush et al., 2003).
- Ensuring that conservation and restoration projects proceed to plan.
- Coordinating specific conservation projects.
- Coordinating community education.
- Overseeing the work of volunteer conservation groups.
- Liaising with State and Federal Government agencies (Bush et al., 2003).
- Applying for funds from governments and industry (Bush et al., 2003).

The committee could also have responsibility for other aspects of the I.G.W. including the cultural and geological values. An appropriate model for the management of the I.G.W is the Merri Creek Management Committee (M.C.M.C.).

This committee has a mission statement that includes flora and fauna and the restoration of Merri Creek. The M.C.M.C. has many roles including the coordination and strategic planning of the conservation and restoration of Merri Creek and community education (Bush *et al.*, 2003).

The membership of this committee includes a number of the Shire Councils that Merri Creek flows through and the Friends of Merri Creek. An Iramoo Green Web Management Committee could liaise with the M.C.M.C. and exchange information and ideas.

### **Community Education**

Community education is essential for the long-term conservation of birds and reptiles in the Iramoo Green Web (I.G.W.). The majority of sites are composed of grassland habitat and studies have shown that people generally do not value native grasslands (Williams and Cary, 2001). Williams and Cary (2001) conducted a study in south-eastern Australia on people's attitudes to grasslands and found that native grasslands were generally perceived by people as having low aesthetic and ecological value.

Education could raise the awareness about the ecological value of native grasslands and the species such as birds and reptiles that occur in this habitat. Interpretation signs should be placed in sites to provide information on general grassland ecology including the local flora and fauna.

The Iramoo Sustainability Centre at Victoria University, St. Albans Campus, has various roles including grassland education (J. Crowe, pers. comm.). Schools and community groups visit the centre and are given a brief introduction to native

grasslands. Animals on display include Stubble Quails (*Coturnix pectoralis*) and an Eastern Blue-tongue Lizard (*Tiliqua scincoides*) (C. Wallace, pers. comm.).

The educational role of the centre should be expanded and include guided visits to significant sites in the area and have more grassland fauna on display. There is an outdoor reptile enclosure on site and species such as Cunningham's Skinks (*Egernia cunninghami*) and Tussock Skinks (*Pseudemoia pagenstecheri*) could be put on display. Preserved specimens of local fauna should also be available for visitors to handle.



(Figure CI.) Interpretation signs should be placed in sites to provide information on local flora and fauna.

### **Community Volunteer Group**

The formation of a community volunteer group that is focused on conservation activities in the I.G.W. is required to undertake a number of important tasks. The protection and management of local indigenous flora and fauna and the restoration of sites is labour and time intensive. It would be unrealistic to expect council conservation officers to undertake all the tasks required and achieve success in conserving the environmental values of the I.G.W. A partial solution would be to

form a community volunteer group. A volunteer group would offer a cost effective labour force that would enable large scale, labour and time intensive projects to be achieved. An appropriate name that could be used is the Iramoo Green Web Conservation Group. The Friends Of Kororoit Creek is a volunteer group that operates in the area however a new group dedicated to conservation in the I.G.W. is needed.

#### *Tasks of Volunteer Conservation Group*

It is essential that experts such as grassland restoration scientists be in attendance during all conservation projects to provide guidance and advice and ensure that procedures are followed correctly. A broad range of conservation management tasks could be carried out by the volunteer group including:

- Restoration of sites including revegetation and landscaping;
- Weed control;
- Rubbish removal from sites;
- Maintenance of sites; and
- Community education such as guided walks, meetings and workshops.

Possible tasks aimed specifically at the protection and management of birds and reptiles include:

- Habitat creation i.e. recreating stony knolls with basalt rocks;
- Monitoring the progress of conservation projects;
- Recording sightings of birds and reptiles;
- Conducting bird and reptile surveys; and
- Exotic bird control in sites i.e. removing nests from hollows

Apart from the main tasks undertaken by the volunteer conservation group there would also be other benefits to the overall conservation effort in the I.G.W.

including:

- Education of volunteers on local environmental issues;
- Instilling a sense of custodianship in volunteers to the local environment (Bush et al., 2003);
- Instilling a sense of responsibility in volunteers to the local environment (Bush et al, 2003); and
- Causing a 'ripple' effect through the local community by exposing people associated with volunteers to the issues concerning the local environment.

### *Equipment*

The volunteer conservation group should be properly provisioned with its own basic equipment including shovels, rakes, wheelbarrows and gloves. Sunscreen should also be made available. Other heavy or specialist equipment could be hired when needed for certain tasks.

To maintain morale and interest it is essential that volunteers have access to replenishments during activities. Catering should be provided with a basic variety of food and beverages. A barbeque at the end of the day's activities would satisfy people's hunger and also allow volunteers to socialise and forge bonds.

### *Volunteers*

Volunteers could be recruited from the local community by giving educational talks to local community groups, holding information days in sites and by placing notices in the local newspapers. The Cairnlea Residents Group could be a source of volunteers as this group is concerned with issues affecting the Cairnlea Estate (J. Crowe, pers. comm.).

### *Retention of Volunteers*

Conservation of flora and fauna in the I.G.W. will require long-term management and therefore long-term involvement of volunteers. Retaining the commitment of volunteers presents a number of problems that must be addressed if the volunteer conservation group is to be effective.

From the outset volunteers must be supported and appreciated by the management committee. Efforts must be made to retain the interest and satisfaction of volunteers because enthusiasm in a volunteer group is known to diminish over time and then membership of the group begins to dwindle (Safstrom & O'Byrne, 2001). A volunteer group that has a high turnover of volunteers would lose its effectiveness due to the continual loss of skills and knowledge, even though a small group of dedicated volunteers would probably remain for the long-term. The retention of volunteers would ensure that the unique skills and knowledge associated with conservation management in the I.G.W. would remain within the group. A demoralised volunteer group could result in conservation projects becoming ineffective and a waste of limited resources.

The tasks set for the volunteer conservation group must have clear and achievable objectives. Regular meetings would allow the volunteer group to be briefed on upcoming projects and have some input into management plans. The meetings would provide an opportunity for volunteers to voice their opinions on the progress of conservation projects and any other issue concerning the volunteer group (Safstrom & O'Byrne, 2001).

A well supported volunteer conservation group could be a real asset to the protection and management of the environmental values of the I.G.W. and a key element in the conservation of its birds and reptiles.

### **Threats to Birds and Reptiles**

#### *Habitat Destruction*

Habitat destruction is probably the most serious threat to the conservation of birds and reptiles in the I.G.W. The loss of habitat denies bird and reptiles of a place to live. The actual process of destroying and altering habitat probably also kills numerous reptiles (Cogger et al., 2001).

In the present study the effects of habitat destruction were observed during the construction of artificial lakes adjacent to Jones Creek in Site C. This destroyed habitat where Golden-headed Cisticolas (*Cisticola exilis*) and Little Grassbirds (*Megalurus gramineus*) were recorded. Similarly urban development in Site I has destroyed grassland habitat where Eastern Tiger Snakes (*Notechis scutatus*) were recorded.



(Figure B2.) Habitat destruction adjacent to Jones Creek in Site C.

### *Exotic Predators*

A main concern raised in the present study was the number of exotic mammalian predators observed in sites. The two main predators were the Cat (*Felis catus*) and Red Fox (*Canis vulpes*). Additionally, a Brown Rat (*Rattus norvegicus*) was observed in Site A and the carcass of this species was recorded in Site C and Site D.

A total of 11 Cats were recorded in 5 sites: Site F (n=1), Site H (n=3), Site I (n=1), Site J (n=2) and Site K (n=4). One cat was recorded in grassland habitat and 10 in escarpment/rocky slope habitat. Cats were classified as being possibly feral or possibly domestic based on their general appearance and behaviour. Some cats were also observed sheltering between rocks in escarpments so were classified as feral. Nine of the observed cats were classified as feral and 2 as domestic. Domestic cats seemed to have strayed from their residence to make hunting forays into sites.



(Figure B3.) Cat (*Felis catus*) pictured in Site K.

A total of 12 Red Foxes were recorded in 6 sites: Site A (n=1), Site B (n=2), Site F (n=1), Site H (n=2), Site I (n=1) and Site K (n=5). Four of the foxes were recorded in grassland habitat, 2 in riparian habitat and 6 in escarpment/rocky slope habitat.

Many of the foxes were extremely bold and on a number of occasions approached the researcher. One sub-adult sat within 10m of the researcher for 20 minutes during a quadrat survey in one site.

Reptiles and ground nesting birds are at risk from exotic predators. The carcasses of a number of Eastern Blue-tongue Lizards (*Tiliqua scincoides*) were found in some sites and these were possibly killed by exotic predators. There should be more stringent enforcement of night curfews on domestic cats and day curfews may need to be introduced for the protection of native fauna.

#### *Poaching of Reptiles*

The illegal collection of reptiles seems to be a common occurrence in the I.G.W. with a number of poaching events noticed during the present study in Sites A, C, D, F, H, I

and K. Evidence of poaching includes basalt rocks that have been rolled out of position and the displacement of human generated debris such as iron sheets. The absence of individual reptiles that have been previously sighted on a number of occasions could also be a result of poaching. For example, one Marbled Gecko (*Christinus marmoratus*) was known to shelter between two sections of a discarded computer in Site D and was sighted a number of times during surveys however after one suspected poaching event the computer was found strewn in the grassland and the lizard gone.

Some sites such as Site D have an abundance of human generated debris and many of these provide shelter to reptiles. For poachers the collection of reptiles at this site would resemble an easy harvest because the time lapse between poaching events would give the opportunity for other reptiles to use the vacant shelter site before being collected.

It is suspected that children are the main instigators of reptile poaching because in some sites all manner of surface debris have been searched and displaced including those that are obviously not suitable shelter sites for reptiles. This suggests that the poachers are inexperienced and lack knowledge on where reptiles prefer to shelter. These poaching events also seem more random.

Experienced adults must have carried out some of the poaching events because multiple sites were visited during some weekends and this suggests that the poachers were organised and had access to vehicles. These more organised poachers seem to harvest the sites about every 4-6 weeks during the spring-summer period. Reptiles

that have been collected are probably destined for either the private collection of the poacher/s, sold to pet shops or sold on the black market. Striped Legless Lizards (*Delma impar*) are possibly the prime target of the organised poachers because their status as a nationally endangered species would increase their value on the black market (Cogger & Fellow, 2001).

The collection of reptiles represents a major threat to the persistence of species in sites because it is a direct removal of individuals. The populations of reptiles in the fragmented sites are probably very small and the removal of key individuals such as gravid females could reduce the viability of the population to a level that will cause inevitable site extinction. The prevention of poaching is therefore essential for the conservation reptiles in the I.G.W.

The removal of human generated debris from sites would make it difficult for poachers because reptiles would probably revert to more natural shelter sites such as grass tussocks, where they would be very difficult to detect. Basalt rocks are natural shelter sites for many reptiles so they would still be vulnerable to poachers.

Protection signs should be placed in sites stating that all flora and fauna is protected under legislation and warning that any illegal collecting will result in prosecution.

Council conservation officers should also conduct regular patrols in sites during weekdays and especially weekends to provide a visible deterrent to poaching.

(Table CI.) Indigenous Flora and Resources for Birds  
(Merri Creek Management Committee, 1994).

Common Name	Scientific Name	PG	SK	E/RS	R	Resource for birds
Berry Saltbush	<i>Atirplex semibaccata</i>		+			Berries
Running Postman	<i>Kennedia prostrata</i>		+			Insects
Common Wallaby Grass	<i>Austroanthonia caespitosa</i>	+	+			Seeds
Silky Blue Grass	<i>Dichanthium sericeum</i>		+			Seeds
Common Tussock Grass	<i>Poa labillardieri</i>	+		+	+	Seeds
Slender Spear-grass	<i>Austrostipa penicillata</i>		+			Seeds
Fibrous Spear-grass	<i>Austrostipa semibarbata</i>	+	+			Seeds
Kangaroo Grass	<i>Themeda triandra</i>	+	+	+		Seeds
Common Everlasting	<i>Chrysocephalum apiculatum</i>	+	+			Insects
Pale Flax-lily	<i>Dianella longifolia</i>	+				Seeds
Black Anther Flax-lily	<i>Dianella revolute</i>		+			Seeds
Wattle Mat-rush	<i>Lomandra filiformis</i>		+			Seeds
Spiny-headed Mat-rush	<i>Lomandra longifolia</i>		+			Seeds
Tufted Bluebell	<i>Wahlenbergia communis</i>	+	+			Insects
Gold-dust Wattle	<i>Acacia acinacea</i>		+			Insects, seeds
Nodding Saltbush	<i>Einadia nutans</i>		+	+		Berries
Ruby Saltbush	<i>Enchylaena tomentose</i>		+	+		Berries
Rosemary Grevillea	<i>Grevillea rosmarinifolia</i>		+			Shelter, nectar
Hedge Wattle	<i>Acacia paradoxa</i>		+			Shelter, insects, seeds
Sweet Bursaria	<i>Bursaria spinosa</i>			+		Insects
River Bottlebrush	<i>Callistemon paludosus</i>				+	Nectar, seeds
Turkey Bush	<i>Eremophila deserti</i>		+			Fruits
Tree Violet	<i>Hymenanthera dentata</i>		+	+		Shelter, berries
Sticky Boobialla	<i>Myoporum viscosum</i>			+		Fruits
Kangaroo Apple	<i>Solanum aviculare</i>				+	Fruits
Golden Wattle	<i>Acacia pycnantha</i>		+			Insects, nectar, seeds
Wirilda	<i>Acacia retinode</i>				+	Insects, seeds
Silver Banksia	<i>Banksia marginata</i>	+	+			Insects
Silver Wattle	<i>Acacia dealbata</i>				+	Insects
Lightwood	<i>Acacia implexa</i>		+	+		Insects, seeds
Black Wattle	<i>Acacia mearnsii</i>		+	+		Insects, seeds
Blackwood	<i>Acacia melanoxylon</i>		+			Insects, seeds
Drooping Sheoak	<i>Allocasuarina verticillata</i>		+	+		Seeds
River Red Gum	<i>Eucalyptus camaldulensis</i>				+	Shelter, insects, nectar, seeds

PG=Plains Grassland, SK=Stony Knoll, E/RS=Escarpment/rocky slope, R=Riparian

(Table C2.) Iramoo Nursery Species List.

<b>Common Name</b>	<b>Scientific Name</b>
Drooping Sheoke	<i>Allocasaurina verticillata</i>
Pale Vanilla-lily	<i>Arthropodium milleflorum</i>
Basalt Daisy	<i>Brachyscome basaltica</i>
Bulbine Lily	<i>Bulbine bulbosa</i>
Sweet Bursaria	<i>Bursaria spinosa</i>
Lemon Beauty-heads	<i>Calocephalus citreus</i>
Rough Burr-daisy	<i>Calotis scabiosifolia</i>
Common Cassina	<i>Cassina aculeate</i>
Windmill Grass	<i>Chloris truncata</i>
Common Everlasting	<i>Chrysocephalum apiculatum</i>
Small-leaved Clematis	<i>Clematis microphylla</i>
Rock Correa	<i>Correa glabra</i>
Common Billy Buttons	<i>Craspedia variabilis</i>
Bristly Wallaby Grass	<i>Danthonia setaceae</i>
Long-hair Plume Grass	<i>Dichelachne crinita</i>
Kidney Weed	<i>Dichondra repens</i>
Ruby Saltbush	<i>Enchylaena tomentose</i>
Blue Devil	<i>Eryngium ovinum</i>
River Red Gum	<i>Eucalyptus camaldulensis</i>
Hop Goodenia	<i>Goodenia ovata</i>
Pale Everlasting	<i>Helichrysum rutidolepis</i>
Scaly Buttons	<i>Leptorrhynchos squamatus</i>
Spiny-headed Mat-rush	<i>Lomandra longifolia</i>
Yam Daisy	<i>Microseris lanceolata</i>
Common Tussock Grass	<i>Poa labillardieri</i>
Showy Podolepis	<i>Podolepis jaceoides</i>
Featherheads	<i>Ptilotus macracephalus</i>
Australian Buttercup	<i>Ranunculus lappaceus</i>
Button Wrinklewort	<i>Rutidosis leptorrhynchoides</i>
Grass Trigger Plant	<i>Stylidium graminifolium</i>
Kangaroo Grass	<i>Themeda triandra</i>
Yellow Rush-lily	<i>Tricoryne elatior</i>
Spur Velleia	<i>Velleia paradoxa</i>
Slender Speedwell	<i>Veronica gracilis</i>
Native Violet	<i>Viola hederacea</i>
Grey Germander	<i>Teucrium racemosum</i>

## APPENDIX D: Bird and Reptiles of Recorded in Each Site.

### SITE A: VICTORIA UNIVERSITY GRASSLAND RESERVE

**Area:** approx. 35 ha.

#### **BIRD SPECIES: 19**

**Raptors:** Black-shouldered Kite, Little Eagle, Brown Falcon, Australian Kestrel

**Passerines:** Welcome Swallow, Fairy Martin, Richard's Pipit, Willie Wagtail, Golden-headed Cisticola, Superb Fairy-wren, Yellow-rumped Thornbill, Red Wattlebird, White-plumed Honeyeater, Australian Magpie, Little Raven

**Waterbirds:** White-faced Heron, Pacific Black Duck, Chestnut Teal, Masked Lapwing

**Cockatoos, Lorikeets and Parrots:** Purple-crowned Lorikeet

**Comments:** An issue at this site are the stands of Sugar Gums (*Eucalyptus cladocalyx*) as these are at odds with a grassland reserve. Approximately 355 Sugar Gums are present with 275 in the main stand that runs east-west. Apart from some raptors that use the trees for perch sites and Marbled Geckos (*Christinus marmoratus*) that shelter beneath shedded bark, the Sugar Gums are not used by grassland birds or reptiles. Non-grassland birds that use these trees include Red Wattlebirds (*Anthochaera carunculata*), White-plumed Honeyeaters (*Lichenostomus penicillatus*) and Purple-crowned Lorikeet (*Glossopsitta porphyrocephala*) and these species are very common in the I.G.W.

To enhance the habitat value for grassland bird species dead trees and stumps of varying heights could be retained and nesting hollows of sizes specific to the requirements of target species could be made. Blue-winged Parrots (*Neophema chrysostoma*) would be a desirable species to have nesting at this site. The hollows would have to be monitored to prevent exotic birds and insects from nesting.

#### **REPTILE SPECIES: 4**

**Gecko:** Marbled Gecko

**Legless Lizard:** Striped Legless Lizard

**Skinks:** Tussock Skink, Eastern Blue-tongue Lizard

**Comments:** The stony knoll and old stone wall located at the west end of the site could provide habitat for translocated Cunningham's Skink (*Egernia cunninghami*) and White's Skink (*Egernia whitii*) that have been displaced by urban development in the region. Both species have previously been recorded at this location however none were recorded during the present study. In the present study Marbled Geckos and Tussock Skinks (*Pseudemoia pagenstecheri*) were recorded in this habitat. This habitat is of regional conservation significance and could provide a reserved representation of a stony knoll reptile assemblage.

**MISCELLANEOUS:**

**Amphibians:** Spotted Grass Frog, Southern Toadlet

**Mammals:** Red Fox, Brown Rat, House Mouse

**SITE B: VICTORIA UNIVERSITY REMNANT GRASSLAND**

**Area:** approx. 10 ha.

**BIRD SPECIES: 24**

**Raptors:** Black-shouldered Kite, Little Eagle, Brown Falcon, Australian Kestrel

**Passerines:** Welcome Swallow, Richard's Pipit, Willie Wagtail, Clamorous Reed-Warbler, Golden-headed Cisticola, Superb Fairy-wren, Yellow-rumped Thornbill, Red Wattlebird, White-plumed Honeyeater, Australian Magpie-lark, Australian Magpie, Little Raven

**Waterbirds:** Little Pied Cormorant, White-faced Heron, Chestnut Teal

**Cockatoos, Lorikeets and Parrots:** Galah, Sulphur-crested Cockatoo, Rainbow Lorikeet, Blue-winged Parrot

**Pigeons:** Crested Pigeon

**Comments:** Small numbers of indigenous shrubs should be planted in the grassland to provide shelter and food resources for indigenous bird species.

**REPTILE SPECIES: 4**

**Gecko:** Marbled Gecko

**Legless Lizard:** Striped Legless Lizard

**Skinks:** Tussock Skink, Eastern Blue-tongue

**Comments:** Basalt rocks from two piles situated on the east side of the site could be used to recreate the rocky outcrops of a stony knoll. This could be located on the mounds at the northern end of the site.

**MISCELLANEOUS:**

**Amphibian:** Brown Froglet

**Mammals:** Red Fox, European Rabbit, House Mouse

### SITE C: JONES CREEK GRASSLANDS

**Area:** approx. 12 ha.

#### **BIRD SPECIES: 39**

**Raptors:** Black-shouldered Kite, Little Eagle Australian Hobby, Australian Kestrel

**Passerines:** Willie Wagtail, Golden-headed Cisticola, Welcome Swallow, Richard's Pipit, Australian Magpie, Yellow-rumped Thornbill, Superb Fairy-wren, White-plumed Honeyeater, Australian Raven, Clamorous Reed-Warbler, Australian Magpie-lark, Little Raven, Little Grassbird, Red Wattlebird, Grey Fantail

**Waterbirds:** Masked Lapwing, White-faced Heron, Australian White Ibis, Straw-necked Ibis, Pacific Black Duck, Grey Teal, Little Pied Cormorant, Silver Gull, Australian Pelican, Black-fronted Dotterel, Hoary-headed Grebe, Australian Grebe, Australian Wood Duck, Common Greenshank, Black-winged Stilt, Latham's Snipe

**Cockatoos, Lorikeets and Parrots:** Sulphur-crested Cockatoo, Galah, Rainbow Lorikeet, Purple-crowned Lorikeet

**Comments:** The small wetland adjacent to Jones Creek should be retained in any future development of this site as it provides habitat for waders such as Latham's Snipe (*Gallinago hardwickii*), Black-winged Stilts (*Himantopus himantopus*) and Common Greenshanks (*Tringa nebularia*).

#### **REPTILE SPECIES: 3**

**Skinks:** Tussock Skink, Eastern Blue-tongue Lizard

**Legless Lizard:** Striped Legless Lizard

**Comments:** The grassland could be linked with Site D to allow Striped Legless Lizards (*Delma impar*) to move between sites.

### SITE D: DENTON AVENUE GRASSLAND

**Area:** approx. 8 ha.

#### **BIRD SPECIES: 23**

**Raptors:** Black-shouldered Kites, Little Eagle, Australian Hobby, Brown Falcon, Australian Kestrel

**Passerines:** Welcome Swallow, Richard's Pipit, White-winged Triller, Willie Wagtail, Golden-headed Cisticola, Superb-fairy Wren, Yellow-rumped Thornbill, Australian Magpie-lark, Australian Magpie, Australian Raven, Little Raven  
**Waterbirds:** Little Pied Cormorant, Australian White Ibis  
**Cockatoos, Lorikeets and Parrots:** Rainbow Lorikeet, Purple-crowned Lorikeet

**Comments:** It may be possible to recreate a stony knoll on the central berm in this site. It could be planted with indigenous shrubs such as Hedge Wattle (*Acacia paradoxa*) and this may provide habitat to indigenous birds such as Yellow-rumped Thornbills (*Acanthiza chrysorrhoa*), which currently use Africa Box-thorns (*Lycium ferocissimum*) at this site.

#### **REPTILE SPECIES: 5**

**Gecko:** Marbled Gecko  
**Legless Lizard:** Striped Legless Lizard  
**Skinks:** Tussock Skink, Eastern Blue-tongue Lizard  
**Elapid:** Eastern Tiger Snake

**Comments:** The human-generated rubbish at this site should be removed to make it hard for poachers to collect reptiles. It should be removed in stages to prevent denying reptiles of habitat.

#### **MISCELLANEOUS:**

**Mammals:** European Rabbit, House Mouse, Brown Rat

### **SITE E: DENTON AVENUE BIKE TRAIL/GARDENS**

**Area:** approx. 14 ha.

#### **BIRD SPECIES: 9**

**Raptors:** Little Eagle, Australian Hobby, Australian Kestrel  
**Passerines:** Richard's Pipit, Golden-headed Cisticola, Superb Fairy-wren, Australian Magpie-lark  
**Waterbirds:** Straw-necked Ibis  
**Cockatoos, Lorikeets and Parrots:** Rainbow Lorikeet

**Comments:** The exotic grassland in this site is inhabited by Richard's Pipit (*Anthus novaeseelandiae*) and Golden-headed Cisticola (*Cisticola exilis*) and is regularly visited by Little Eagles (*Hieraaetus morphnoides*) and Australian Kestrels (*Falco cenchroides*).

**REPTILE SPECIES: 1**

**Skink:** Eastern Blue-tongue Lizard

**Comments:** This site has low habitat value for reptiles, however revegetation of the patch of exotic grassland situated in the centre of the site and a possible link with Site F may increase the available habitat for reptiles.

**MISCELLANEOUS:**

**Mammals:** European Rabbits

**SITE F: SUNSHINE TIP GRASSLAND**

**Area:** approx. 4 ha.

**BIRD SPECIES: 11**

**Raptors:** Black-shouldered Kite, Australian Hobby, Brown Falcon, Australian Kestrel

**Passerines:** Golden-headed Cisticola, Yellow-rumped Thornbill, Australian Magpie-lark, Australian Magpie, Australian Raven

**Waterbird:** Straw-necked Ibis

**Cockatoos, Lorikeets and Parrots:** Galah

**Comments:** The Golden-headed Cisticola (*Cisticola exilis*) is the only resident species in this site. Two pairs of Australian Ravens (*Corvus coronoides*) and 1 pair of Australian Magpie (*Gymnorhina tibicen*) reside on the edge of this site. Raptors are regular visitors to this site. To increase habitat for indigenous bird species a small number of shrubs should be planted in the north end of the site, which is degraded and infested with exotics such as Toowoomba Canary-grass (*Phalaris aquatica*).

**REPTILE SPECIES: 4**

**Gecko:** Marbled Gecko

**Legless Lizard:** Striped Legless Lizard

**Skinks:** Tussock Skink, Eastern Blue-tongue Lizard

**Comments:** Reptiles are at risk from the effects of fragmentation in this site. Introducing reptiles from nearby sites may be necessary to maintain the population viability of species.

### **SITE G: KOROROIT CREEK, ARDEER**

**Area:** approx. 7 ha.

#### **BIRD SPECIES: 19**

**Passerines:** Welcome Swallow, Willie Wagtail, Clamorous Reed-Warbler, Superb Fairy-wren, Red Wattlebird, White-plumed Honeyeater, New Holland Honeyeater, Silvereeye, Australian Magpie-lark, Australian Magpie, Australian Raven

**Waterbirds:** Little Pied Cormorant, Pacific Black Duck, Dusky Moorhen, Purple Swamphen, Silver Gull

**Cockatoos, Lorikeets and Parrots:** Rainbow Lorikeet, Purple-crowned Lorikeet

**Kingfisher:** Sacred Kingfisher

#### **REPTILES: 1**

**Elapid:** Eastern Brown Snake

### **SITE H: KORROIT CREEK ADJACENT TO WESTERN RING ROAD**

**Area:** approx. 10 ha.

#### **BIRD SPECIES: 35**

**Raptors:** Black-shouldered Kite, Brown Goshawk, Wedge-tailed Eagle, Brown Falcon

**Passerines:** Welcome Swallow, Black-faced Cuckoo-Shrike, White-winged Triller, Grey Fantail, Willie Wagtail, Clamorous Reed-Warbler, Little Grassbird, Golden-headed Cisticola, Superb Fairy-Wren, Yellow-rumped Thornbill, Red Wattlebird, White-plumed Honeyeater, New Holland Honeyeater, Red-browed Finch, Australian Magpie-lark, Australian Magpie, Australian Raven

**Waterbirds:** Little Pied Cormorant, Little Black Cormorant, White-faced Heron, Australian White Ibis, Straw-necked Ibis, Pacific Black Duck, Dusky Moorhen, Purple Swamphen, Eurasian Coot

**Cockatoos, Lorikeets and Parrots:** Galah, Rainbow Lorikeet

**Kingfisher:** Sacred Kingfisher

**Pigeon:** Crested Pigeon

**REPTILE SPECIES: 4**

**Skinks:** Tussock Skink, Eastern Blue-tongue Lizard

**Elapids:** Eastern Tiger Snake, Eastern Brown Snake

**MISCELLANEOUS:**

**Mammals:** Red Fox, Cat, House Mouse

**SITE I: ALBION EXPLOSIVES FACTORY GRASSLANDS/KOROROIT CREEK**

**Area:** approx. 38 ha.

**BIRD SPECIES: 39**

**Raptors:** Black-shouldered Kite, Brown Goshawk, Little Eagle, Swamp Harrier, Australian Hobby, Brown Falcon, Australian Kestrel

**Passerines:** Welcome Swallow, Richard's Pipit, White-winged Triller, Grey Fantail, Willie Wagtail, Clamorous Reed-Warbler, Golden-headed Cisticola, Superb-fairy Wren, Yellow-rumped Thornbill, Red Wattlebird, White-plumed Honeyeater, Red-browed Finch, Dusky Woodswallow, Australian Magpie-lark, Australian Magpie, Australian Raven, Little Raven

**Waterbirds:** Little Pied Cormorant, Little Black Cormorant, White-faced Heron, Australian White Ibis, Straw-necked Ibis, Black Swan, Pacific Black Duck, Chestnut Teal, Dusky Moorhen, Purple Swamphen, Eurasian Coot, Silver Gull

**Cockatoos, Lorikeets and Parrots:** Galah, Purple-crowned Lorikeet

**REPTILE SPECIES: 6**

**Gecko:** Marbled Gecko

**Legless Lizard:** Striped Legless Lizard

**Skinks:** Cunningham's Skink, Tussock Skink, Eastern Blue-tongue Lizard

**Elapid:** Eastern Tiger Snake

**MISCELLANEOUS:**

**Amphibians:** Growling Grass Frog

**Mammals:** Red Fox, Cat, House Mouse

## **SITE J: KORROIT CREEK ESCARPMENTS, DEER PARK**

**Area:** approx. 18 ha.

### **BIRD SPECIES: 28**

**Passerines:** Welcome Swallow, Black-faced Cuckoo-shrike, Willie Wagtail, Clamorous Reed-Warbler, Superb-fairy Wren, Red Wattlebird, Little Wattlebird, White-plumed Honeyeater, New Holland Honeyeater, Red-browed Finch, Australian Magpie-lark, Australian Magpie, Australian Raven

**Waterbirds:** Little Pied Cormorant, Little Black Cormorant, White-faced Heron, Great Egret, Australian White Ibis, Straw-necked Ibis, Pacific Black Duck, Dusky Moorhen, Purple Swamphen, Silver Gull

**Cockatoos, Lorikeets and Parrots:** Galah, Rainbow Lorikeet, Purple-crowned Lorikeet

**Kingfishers:** Sacred Kingfisher

**Pigeons:** Crested Pigeon

### **REPTILE SPECIES: 2**

**Skink:** Eastern Blue-tongue Lizard

**Elapid:** Eastern Brown Snake

### **MISCELLANEOUS:**

**Amphibian:** Eastern Banjo Frog

**Mammal:** Cat

## **SITE K: BULLUM- BULLUM ABORIGINAL PLACE**

**Area:** approx. 8 ha.

### **BIRD SPECIES: 31**

**Raptors:** Black-shouldered Kite, Australian Hobby, Brown Falcon

**Passerines:** Welcome Swallow, Richard's Pipit, Willie Wagtail, Clamorous Reed-Warbler, Golden-headed Cisticola, Superb-fairy Wren, Red Wattlebird, White-plumed Honeyeater, New Holland Honeyeater, Australian Magpie-lark, Australian Magpie, Australian Raven

**Cockatoos, Lorikeets and Parrots:** Galah, Rainbow Lorikeet, Musk Lorikeet, Purple-crowned Lorikeet, Eastern Rosella

**Waterbirds:** Little Pied Cormorant, Little Black Cormorant, White-faced Heron, Great Egret, Straw-necked Ibis, Pacific Black Duck, Dusky Moorhen, Purple Swamphen, Silver Gull

**Kingfisher:** Sacred Kingfisher

**Pigeon:** Crested Pigeon

**Comments:** Indigenous shrubs should be planted along the escarpment/rocky slope to provide habitat for indigenous birds.

#### **REPTILE SPECIES: 2**

**Skinks:** Cunningham's Skink, Eastern Blue-tongue Lizard

**Comments:** The grassland in this site should be revegetated with Kangaroo Grass (*Themeda triandra*) to cover the large areas of bare soil and provide habitat for reptiles. Some of the large basalt boulders should be removed while others should be lightly embedded in the soil to provide shelter sites for reptiles.

#### **MISCELLANEOUS:**

**Reptile:** Eastern Long-necked Turtle

**Mammals:** Red Fox, Cat, House Mouse

### **SITE L: TRANSMISSION LINE OPEN SPACE, DEER PARK**

**Area:** approx. 11 ha.

#### **BIRD SPECIES: 10**

**Raptor:** Australian Kestrel

**Passerines:** Welcome Swallow, Willie Wagtail, Red Wattlebird, White-plumed Honeyeater, Australian Magpie-lark, Australian Magpie, Australian Raven

**Waterbird:** Silver Gull

**Pigeon:** Crested Pigeon

**SITE M: PROPOSED ROCKBANK MIDDLE ROAD, ALBANVALE**

**Area:** approx. 13 ha.

**BIRDS SPECIES:** 7

**Passerines:** Welcome Swallow, Willie Wagtail, Red Wattlebird, Australian Magpie-lark, Australian Magpie, Australian Raven

**Waterbirds:** White-faced Heron

**SITE N: GLADSTONE STREET DRAIN LAKES**

**Area:** approx. 11 ha.

**BIRD SPECIES:** 28

**Raptors:** Little Eagle, Australian Hobby

**Passerines:** Welcome Swallow, Richard's Pipit, Willie Wagtail, Clamorous Reed-warbler, Australian Magpie-lark, Australian Raven, Little Raven

**Waterbirds:** Little Pied Cormorant, little Black Cormorant, White-faced Heron, Australian White Ibis, Straw-necked Ibis, Yellow-billed Spoonbill, Black Swan, Pacific Black Duck, Grey Teal, Chestnut Teal, Hardhead, Maned Duck, Dusky Moorhen, Purple Swamphen, Eurasian Coot, Masked Lapwing, Black-fronted Dotterel, Latham's Snipe, Silver Gull