AN AVIFAUNAL STUDY OF PIGEON VALLEY PARK AS A BIOGEOGRAPHIC ISLAND IN AN URBAN AREA WITH SPECIAL REFERENCE TO THE NATAL ROBIN (*Cossypha natalensis* Smith)

by

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ABSTRACT

Pigeon Valley Park, on Durban's Berea Ridge, is an approximately 10-ha remnant of coastal forest, which is totally surrounded by suburban housing and roads. As such it is ideal as a study area for investigating the applicability of the MacArthur-Wilson Theory of Island Biogeography (1963,1967) and Diamond's (1975) geometric reserve-design principles to fragmented Coastal Forests in Durban.

This study began in January 1989 and the results are reported as at October 1992. Field notes from as far back as 1981 were used to augment the findings of the current work.

Research focused on the forest-dwelling, Natal Robin Cossypha natalensis, and territory mapping showed that the reserve supports up to 53 individuals during the breeding season.

An annotated checklist and its comparison to historical and regional checklists revealed where localised extinctions may have occurred, and thus identifies a set of coastal forest species which are susceptible to habitat fragmentation.

Work on two potential dispersal corridors for bird movement into and out of the Valley showed that the reserve is not yet fully isolated to most species which are currently present. On the other hand, there are some forest species which have isolated populations at Pigeon Valley Park, as well as others which do not seem able to establish and maintain viable populations.

A set of 'indicator', forest bird species which are susceptible to habitat fragmentation, is defined.

Practical management suggestions with the aim of increasing the long-term viability of the area as an avifaunal preserve, are presented.

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CHAPTER ONE

INTRODUCTION

Natural areas of the world have been cleared and continue to be cleared for urbanisation, agriculture and other uses to which it has been seen fit to put them. When such removal of vegetation is not total, fragments of the original landscape will remain. Such habitat remnants have been likened to oceanic islands and have had the Equilibrium Theory of Island Biogeography of MacArthur and Wilson (1963, 1967) applied to them (henceforth referred to as the Theory). The validity of this extension is debatable for various reasons, including that the intervening habitat in the case of terrestrial islands is not as foreign to the island's biota as the sea would be to the land-dependent biota of an oceanic island. Furthermore, competitors from neighbouring habitats would not be a factor on true islands. Burgess and Sharpe (1981) suggest that previous land-use patterns would still have a residual effect on the current situation. It is nevertheless empirically evident that birds respond in predictable ways to fragmentation, 'whatever the underlying causal mechanisms prove to be' (Lynch, 1987). In the absence of any other comprehensive theories, that of MacArthur and Wilson persists as a valid starting point.

Fundamental to the Theory is an attempt to explain the observed number of species of the various taxa on sea islands. Also central is that a 'snapshot' count hides the fact that the species total is constant, but that there is a continual turnover due to colonisations and extinctions, or in other words a dynamic equilibrium. This equilibrium number according to Whitcomb *et al.* (1981) will be dictated *inter alia* by the island's productivity, habitat diversity, size and isolation.

Diamond (1975) took the principles of the Theory and proposed a set of geometric reserve-design principles:

1) A large area is better than a small area, as species richness is positively related to the area of the island. Large areas support bigger populations, which are less susceptible to extinction. Large islands present a larger target to potential colonist species dispersing randomly from the source areas. A greater area is also more likely to contain a number of different habitat types and their associated communities, and therefore more species.

2) A number of small reserves with a total area equal to one large reserve, will support fewer species. This principle is hotly debated under the SLOSS (single large or several small) acronym (Simberloff and Abele, 1982). It is true that if the small areas are each of a different habitat type, chances are that they will support more species. Such comparisons are nonsensical as the habitat variable should be kept constant in order to make direct comparisons. In a review of avifaunal studies of forest fragments in eastern North America, Wilcove and Robinson (1990) firmly state that 'many species of neotropical migrants either do not occur or show declining populations on small, isolated woodlots'. Certain species have large area requirements and are intolerant of disturbance. These species, often uncommon by virtue of their life history traits, would be excluded from any system of small reserves. Supporters of the several small reserves option, e.g. Simberloff (1982), argue that catastrophic events may be more easily contained in a system of reserves.

Another result of ecosystem fragmentation, according to Cody (1983) and Blondel (1991), is that the remaining species are to be found at unusually high densities, which may superficially increase the importance of these areas to conservation. Species richness and composition therefore need to be simultaneously assessed in any debate, and the best strategy may differ according to each unique situation.

3) Species richness is negatively related with the distance from the nearest source of potential colonists. Proximate islands are more accessible to potential immigrants, which may continuously replenish depleted and inbred populations. Brown and Kodric-Brown (1977) describe this as the 'rescue effect'.

Minimising inter-reserve distances reduces isolation and improves refuge viability, as does the provision, between isolates, of 'stepping stones' or 'corridors' of a similar habitat type.

4) Reserve shape should be as circular as possible to alleviate the peninsula effect, where distal extinctions in linear reserves are unlikely to be reversed by colonisation from a distant centre. On the other hand, long, narrow shapes have a greater perimeter to internal area ratio, which Game (1980) contends should increase the rate of immigration. This would be the case if the potential immigrant approached the refuge at something nearing a right angle to the long axis.

With reference to Diamond's first point above, the question of how big is 'enough' raises something, which as Roberts (1990) emphasises, has not been at all adequately addressed, i.e. the concepts of minimum critical areas and minimum viable populations. Lovejoy and Oren (1981) suggest an area of 10 000 km^2 for Amazonian forest. Different broad ecosystems would obviously require different areas, but this figure serves to illustrate the difficulties faced by conservationists. On isolation, smaller areas will undergo faunal (and floral) collapse, on account of the local extinction of certain fragmentation intolerant species. Lovejoy and Oren (1981) suggest that the 'decay process' needs to be studied, to see whether the species loss is random in sum and sequence, or predictable in that refugia of similar sizes will support the same species. Work done by Whitcomb et al. (1981) and Bierregaard (1990) suggests that the ultimate composition is very predictable. Whitcomb et al. (1981), in North American Deciduous Forests, found that two life-history features, neotropical migration and habitat

preference, were strong determinants of a species' ability to tolerate isolation. It is important then, when looking at a species list for an area, that not all species are treated as having equal conservation significance.

Hopkins and Saunders (1987) point out that individual reserve objectives should not be to afford protection to all species occurring locally, but rather that the reserves should be seen as part of an integrated regional system. In order to arrive at realistic objectives for a specific area, it is necessary to get some measure of the biological resources (species present) and the processes operating in the reserve. Also important to consider is the stated purpose of the area. As the raison d'être for many nature conservation areas is the preservation of threatened or scarce species, these areas are often managed with the implicit assumption that if such conservation is successful, the rest of the community should be preserved adequately.

Pigeon Valley Park (PVP) is an example of a habitat island 'in a man-dominated landscape' (Whitcomb et al. 1981). It is a 10-ha remnant of Coastal Forest (Acocks, 1975) on Durban's Berea, part of the once extensive forest tract which ranged on the eastern slopes of the Berea Ridge, from the Umgeni River in the north to the Umbilo River in the south. This patch of forest now exists as an 'island' in a 'sea' of suburban homes and roadways. As such it is separated from other similar habitat by 800 m in the case of the Shepstone Nature Reserve, just west of the University of Natal buildings, and 400 m each in the cases of the more formal Bulwer and Jubilee Parks. The nature reserve has been administered by the Natural Areas Division of the Durban Parks Department since 1981.

This area with its protected status and manageability represents a wonderful opportunity to apply the local situation to some of the plethora of research avenues emerging from the principles of the Theory and associated work on the biogeography of isolates. Many questions may be asked about Pigeon Valley Park and other

nature reserves of the D'MOSS plan (Durban Metropolitan Open Space System), with respect to species richness, diversity, community structure, resource partitioning, dispersal between refugia, minimum critical areas and viable populations. From a review of the relevant literature of biogeographical isolates, it is plain to see that research in southern Africa lags way behind most of the rest of the world, but particularly that of Holarctic systems. Important work needs to be done to provide managers with information to make good scientific decisions. In this regard this work attempts to tackle some of the basics. In particular, using the avifauna as a study group, this study aims to investigate:

a) species richness at PVP.
b) community composition at PVP.
c) dispersal of species to and from PVP, and to what extent the reserve is isolated to the various species.
d) species turnover at PVP.
e) which coastal-forest bird species are susceptible to fragmentation.
f) the population size of a selected forest-bird and its relationship to minimum critical areas and minimum viable populations.
g) the applicability of the MacArthur and Wilson theory and Diamond's geometric reserve-design principles to fragmented habitats in Durban.

While much of the land-use pattern of the central districts of Durban is already a fait accompli, there are still other areas in the eastern parts of southern Africa where forests may be vulnerable in the face of rapid population growth and its associated pressures. As a further aim it is hoped to propose a set of management proposals and guidelines for PVP and environs in order to maximise their ecological potential. It is envisaged that these suggestions could be extrapolated for use in other forested areas in fragmented landscapes.

CHAPTER TWO

STUDY AREA AND STUDY SPECIES

2.1. Introduction

The City of Durban is reputedly one of the fastest growing cities in the world, and is 'the most densely populated area of Natal' (Nicolson, 1987). This population growth is largely attributable to rapid informal urbanisation. The demand for land is enormous, putting great pressure on what remains of the natural resources. Fortunately, in 1982, at the initiative of members of the Wildlife Society of Southern Africa, planning for the co-ordinated development of Durban's natural areas began with the formation of the Metropolitan Open Space System Committee (Director of Parks, Beaches and Recreation Department, 1989). This foresight was then built on by the Durban Parks Department and the Town Planning Branch of the City Engineers' Department, who in collaboration with a team of consultants produced the Durban Metropolitan Open Space System (D'MOSS) Report.

In summary, a number of core natural areas or nodes are to be connected by corridors of natural vegetation, which in most cases follow river courses (Fig. 2:1). The system will provide for conservation, recreation and education.

2.2. Choice of study area

Of the core areas mentioned above, Pigeon Valley Park (PVP) on Durban's Berea Ridge presents a good study site (Fig. 2:2). It forms a node in the Berea extension of the Cato Manor Park (Roberts, 1990).

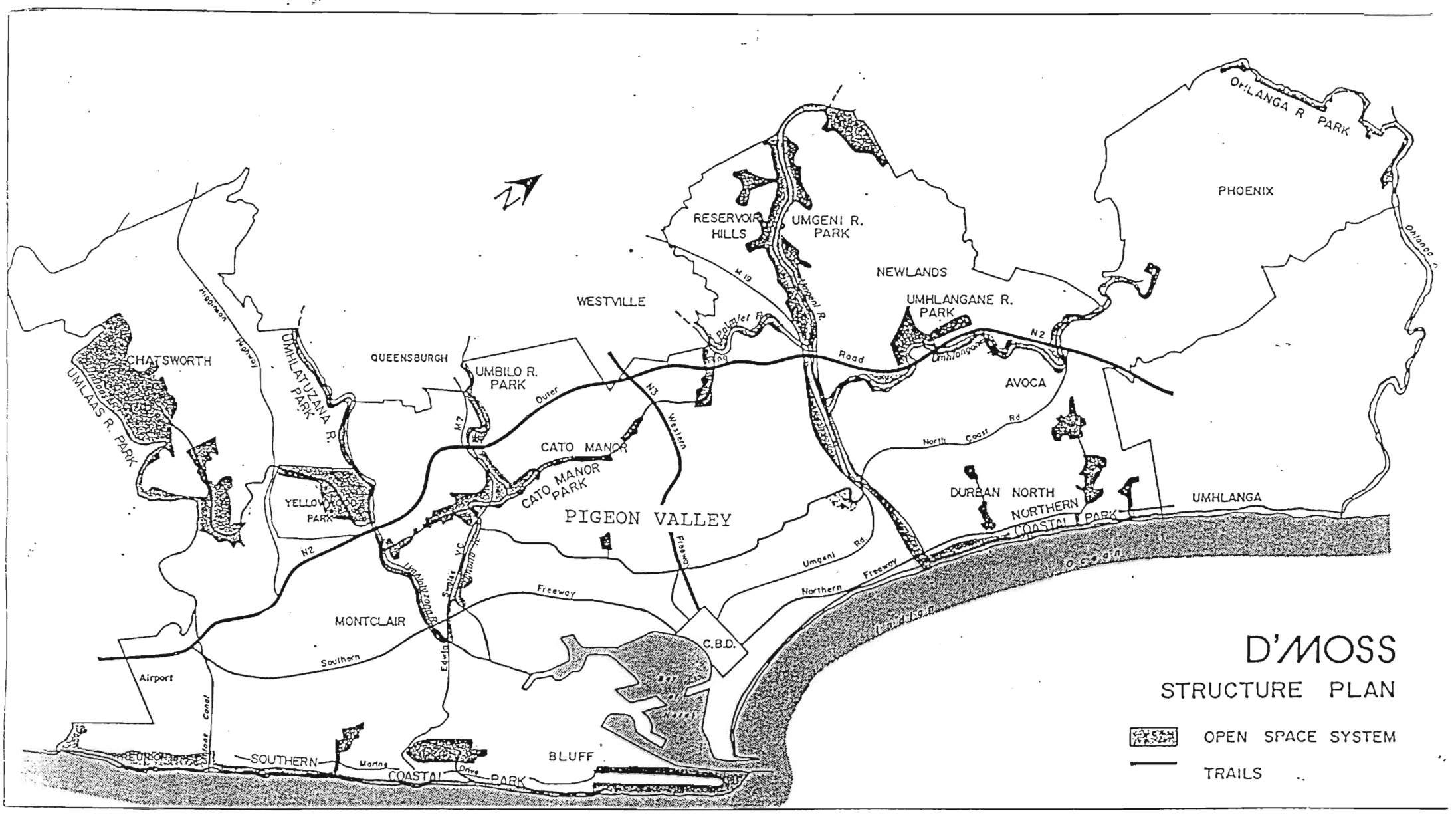


FIGURE 2:1 D'MOSS - Durban Metropolitan Open Space Structure Plan
(after Director Parks, Beaches and Recreation Dept.)

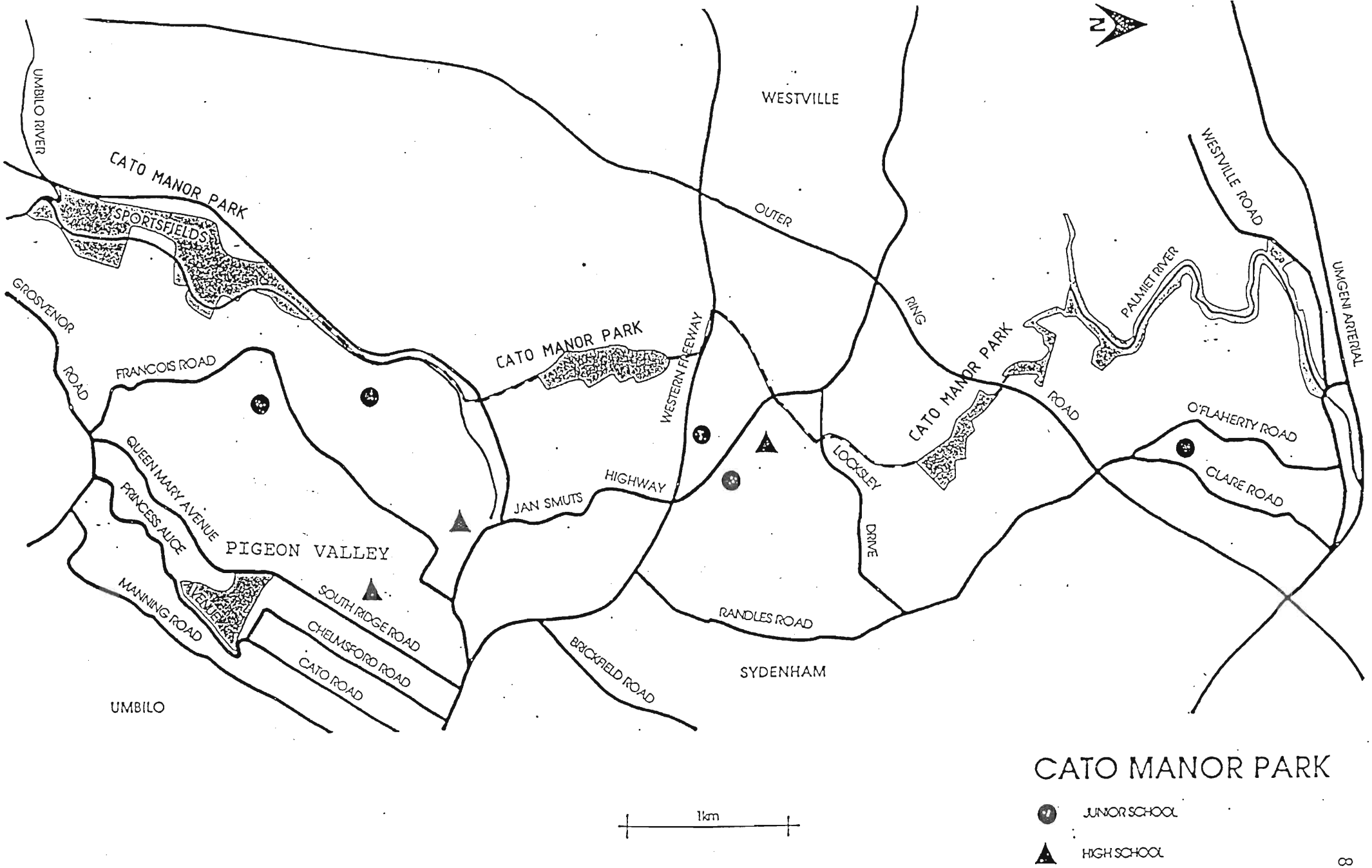


FIGURE 2:2 Proposed structure of the Cato Manor Park.
(after Director Parks, Beaches and Recreation Dept.)

The Reserve has, since 1936, been protected as a park by the Durban City Council (Juta, 1988). The area has been managed by the Natural Areas Division of the Durban Parks Department, since 1981, with an intensive programme of alien plant removal initially clearing extensive tracts. The reserve lies in close proximity to the University of Natal's Durban campus, and is bounded by King George V Avenue, Princess Alice Avenue and Bowes-Lyon Avenue.

In addition to PVP itself, this study also investigated aspects of the surrounding suburban matrix (henceforth referred to as the study area, which includes PVP). The boundaries of the study area were arbitrarily delimited by numbers L37, L39, N37 and N39 of the City of Durban series of orthophoto maps, which were photographed in 1985, and printed at a scale of 1: 2000 by the City Engineer's Department (Fig. 2:3).

2.3. Description of study area

2.3.1. Land-use pattern

Pigeon Valley Park is a remnant of the extensive Coastal Forest (Acocks, 1975) which once covered the eastern slopes of the Berea Ridge. Logging for timber and firewood and clearing for housing after the Europeans arrived in Natal spelt doom for this forest and others. Pigeon Valley Park and Burman Bush, which overlooks the Umgeni River, are the only two significant forest tracts remaining on Durban's Berea. Scattered forest giants in gardens and parks bear testimony to this clearing.

The current land-use pattern for the study area was determined by measuring the total mass of the four abovementioned orthophotos (118 g), which represented 514 ha on the ground. The orthophotos were then cut up according to defined land-use

FIGURE 2:3 1:15000 Cadastral map showing the greater study area (as delimited by the City of Durban 1:2000 orthophotos, L37, N37, L39, N39) and the position of the gardens discussed in 5:4.

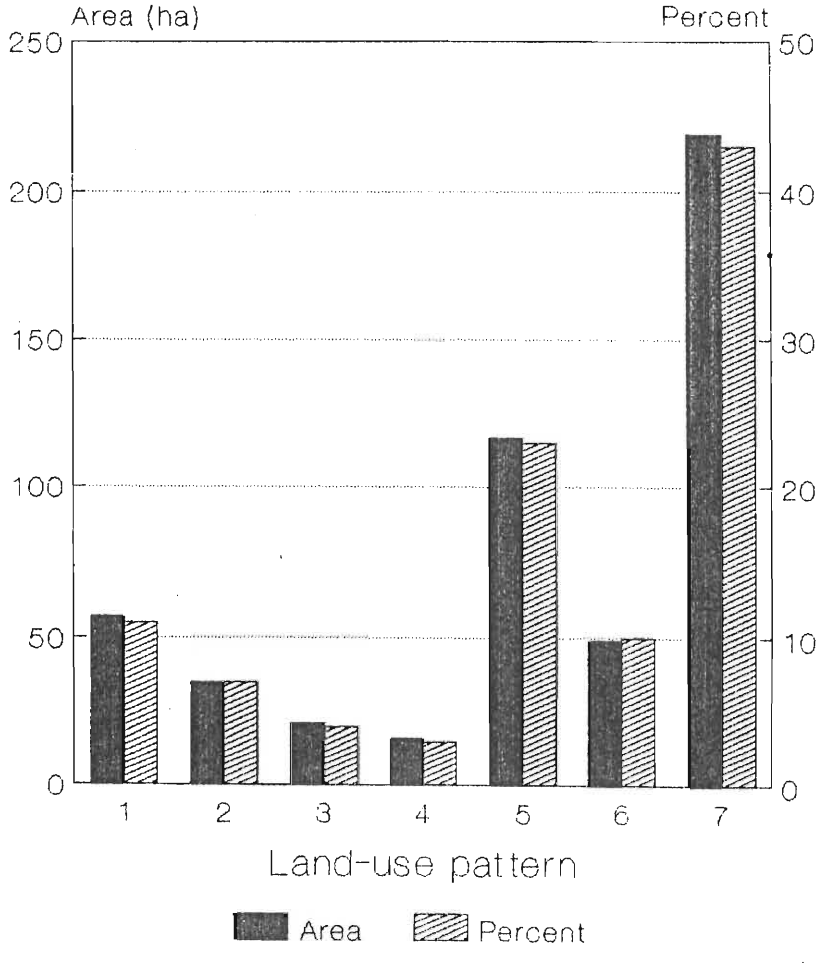
KEY:

- Study Area boundary.
- 223 Brand Rd.
- Mooredene, 25 Glengariff Place.
- 426 Frere Rd.
- 48 Clair Ave.
- Barrington, 60 South Ridge Rd.
- Glenridge Gdns., 61 South Ridge Rd.

types (see below), the pieces were then massed and the area of each calculated as fractions of 514 ha (Figure 2:4).

Figure 2:4 Land-use pattern in the study area, as at 1985, by area and percentage of total.

Note: 1-Institutional, 2-Commercial, 3-Formal Parks, 4-Conserved areas, 5-Informal open space, 6-Reservoirs and fields, 7-Residential.



Total area = 514 ha

Land-use types were defined as:

1. Institutional: Schools and Natal University. Clustered buildings with often significant vegetation cover over the rest of the grounds.
2. Commercial: Shops, shopping centres, offices, etc.
3. Formal parks: Usually with large specimen trees with mown lawns. Very little shrubbery or groundcover.
4. Conserved areas: Pigeon Valley Park and the Shepstone Nature Reserve.
5. Informal open space: Areas which are well vegetated, usually with a high proportion of secondary alien vegetation.
6. Reservoirs and fields: Includes school and university sportsfields and consisting of short, cropped grass cover.
7. Residential: Houses, duplexes and flats, etc., with varying amounts of vegetation. Lawns are almost always present.

2.3.2. Climate

The climate is humid subtropical, and at 29° 52'S and 30° 59'E the Park lies at a sub-tropical latitude. It appears on 2930DD-Durban of the 1: 50 000 topocadastral map series published by the Chief Director of Surveys and Mapping. The buffering influence of the warm Agulhas Current dictates a mild winter and a warm to hot summer (Preston-Whyte, 1980). The mean annual temperature in Durban is 20,5°C, and the mean daily range in temperature is greater in winter than summer, as the cooler months are largely free of the moderating influence of cloud cover. In summer, northeasterly winds reduce potentially very hot weather.

Humidity is highest in February and lowest in July. Due to the continuous moisture input of the sea, diurnal and annual humidity variation follows that of temperature fairly closely. The range of relative humidity is greatest in winter.

The area falls under a summer-rainfall regime with 60% of the rainfall falling in the months November to March. Mean annual rainfall is 1100 mm for the period 1982-1992 (figures supplied by Durban Botanic Gardens), this falling mainly as gentle evening showers. The area receives no frost. At PVP two small artificial ponds and a leaking water pipe represent permanent water sources, while birdbaths, holes in trees and rain puddles are more ephemeral supplies.

The altitude at PVP ranges from about 65 m a.s.l. in the east to 110 m a.s.l. in the west.

2.3.3. Vegetation

The past management strategy of clearing much of the undergrowth at PVP, is reflected in the mown areas (especially up the central stormwater course), numerous paths and the youth of the many regenerating forest gaps. The main vegetation type is Coastal Forest (Acocks, 1975), with a noticeable difference in floristics and physiognomy between the south- and north-facing slopes of the Valley. Dominant tree species of the south-facing slope (which was the more intensively studied) include, Celtis mildbraedii, Chaetacme aristata, Chrysophyllum viridifolium and Margaritaria discoidea. The understorey community has high proportions of Psychotria capensis, Rothmannia globosa and Maerua racemulosa. The herbaceous layer consists mostly of Isoglossa woodii. Gaps are colonised mainly by the pioneers Trema orientalis, Albizia adianthifolia and Bridelia micrantha.

All common names of trees mentioned in the text are given as per Coates-Palgrave (1983).

The most proximate patches of similar vegetation are (see Fig. 2:3):

1) Bulwer Park - a formal park (6,6 ha) with mown lawns and large specimen trees, both indigenous and exotic. The indigenous species are largely representatives of Coastal Forest. Some recent underplanting with indigenous species has been carried out by the park superintendent. This park is 'linked' ecologically to PVP only by private gardens and fairly wide (10 m) road islands, which have been planted with indigenous material by the Durban Parks Department and a local school.

2) Jubilee Gardens - a combination of a formal park (±1,3 ha) with large trees and mown lawns and informal, mostly peripheral shrubbery and undergrowth. There are a number of other small patches of semi-natural vegetation throughout the University grounds. Interchange of species between Jubilee Park and PVP may only occur through residential gardens.

3) Shepstone Nature Reserve - an area of 6,5 ha of regenerating coastal forest (5 ha) and a grassland spur (1,5 ha). Infestations of alien plants threaten its integrity as a natural area.

2.4. Choice of study species

It was originally intended as part of this study to gather population data on a small group of bird species which may loosely be defined as 'forest birds'. These population data were to be used as a first step in the investigation of the concepts of minimum critical areas and minimum viable populations, and there relationship to small coastal forest isolates.

Definition in the first place of what constitutes a forest proves difficult, as Shugart (1990) points out. Separation from other woodlands is 'to some degree arbitrary'. He goes on to suggest that 'a forest is a system in which trees are sufficiently close to form a canopy'. This definition, which neglects the undergrowth element, would classify much of Bulwer Park as forest. Such a forest would exclude the ground-foraging guild of

forest birds.

In addition, Oatley (1989) outlines the difficulties in identifying what is a forest bird. He mentions that non-forest species may occasionally use forests, particularly the canopy. Furthermore, in winter, forest species may move into other woodland and gardens. Indeed, if one were to restrict 'forest birds' to those totally confined to the forest-interior, very few if any would qualify for this label. Oatley (1989) identifies 46 South African forest bird species on the criterion that they are those which are 'largely dependent on forest ecosystems for their survival'. He does not quantify his results, and so it may be assumed that his list is subjective and indeed, as such, it raises many questions. In my opinion he includes species which could also be considered forest-edge species, e.g., Buffspotted Flufftail Sarothrura elegans, Barratt's Warbler Bradypterus barratti, Bleating Warbler Camaroptera brachyura and Forest Canary Serinus scotops. These and others may often be found in gardens and in small bushclumps or trees separate from the main forest. On the other hand, it can be argued that other species, such as the Natal Robin Cossypha natalensis, Grey Sunbird Nectarinia veroxii and Terrestrial Bulbul Phyllastrephus terrestris should also be included on the list. Their inclusion can be justified by using Oatley's (1989) own criterion, as the conservation of the preferred habitat, in the study area, of all three would involve the protection of forest.

The applicability of the territorial mapping technique (see Chapter 3.2.) for censusing bird species is restricted to 'the stationary part of non-colonial passerine and passerine-like bird populations during the breeding season' (International Bird Census Committee, 1969). Scrutiny of the reserve checklist (Appendix 1) and using the abovementioned criterion produced a shortlist (Table 2:1) from which four possible candidates for study (Natal Robin, Terrestrial Bulbul, Squaretailed Drongo Dicrurus ludwigii and Bleating Warbler) were chosen. Work then

began on censusing all four, but later due to the difficulty of concentrating on both terrestrial and arboreal species, the aerial feeding Squaretailed Drongo was dropped. Further, on account of the very dense nature of the vegetation and the frustrations experienced in getting useful observations, it was decided that to focus on one species, the Natal Robin, would produce the best results.

Table 2:1 List of species considered for study at PVP, and where applicable, the reasons for omitting them.

SPECIES	REASONS FOR OMISSION
Tambourine Dove *	Observation/nest finding difficulties
G/rumped T. Barbet *	Difficulty in observing tarsal rings
G/tailed Woodpecker	Difficulty in observing tarsal rings
Squaretailed Drongo *	Not used but potential study species
Terrestrial Bulbul	Not used but potential study species
Sombre Bulbul	Canopy dweller/observation difficult
Barthroated Apalis *	Not used but potential study species
Bleating Warbler *	Not used but potential study species
Cape Batis *	Population too small?
Southern Boubou	Observation/nest finding difficulties
Puffback	Canopy dweller/observation difficult
Grey Sunbird	Territoriality complex/patchy feeding
Olive Sunbird *	Territoriality complex/patchy feeding
Collared Sunbird *	Territoriality complex/patchy feeding
Forest Weaver *	Population too small?

Note * - denotes those species which Oatley (1989) included on his list of 46 South African forest bird species.

CHAPTER THREE

STATUS OF THE NATAL ROBIN AT PIGEON VALLEY PARK

3.1. Introduction

The Natal Robin is the second most widespread member of the genus, after the Heuglin's Robin (C. heuglini). In South Africa it occurs in a discontinuous range from just south of East London, through to the Transkei and coastal Natal, Mozambique and the eastern and northern Transvaal. Extralimitally, it is found northwards as far as the central and eastern Afrotropics (Clancey, 1990). Within this broad distribution the species is mainly confined to forests with well developed undergrowth, where it forages in the leaf-litter. Locally, it favours areas with the undergrowth dominated by Isoglossa woodii, an acanthaceous herb. This plant has a lifespan of about seven years, after which it flowers en masse, sets seed and dies, leaving the lowest strata of the forest bare. This does not render the habitat unfavourable to Natal Robins.

According to Clancey (1990) the species can be separated into eight subspecies, of which two, C. n. egregior and C. n. natalensis, occur in South Africa. He states that the former breeds on the eastern Cape coast to the Transkei, while it winters further north on the Natal, Zululand and southern Mozambique coasts. The latter breeds in Natal, Zululand, eastern and northern Transvaal and southern Mozambique. In this subspecies there is a marked exodus from the south of the range to lowland Mozambique during the dry winter season.

In the study area the species is most common at PVP, while there are fair numbers at the Shepstone Nature Reserve. Large gardens

in fairly close proximity to the core areas and with sufficient cover are also used. Smaller gardens and those which are further from the core populations have this species only a stopover visitor, provided there is sufficient cover to attract it.

It is a feature of fragmented refugia that populations of species will be isolated from other populations of the same species to a greater or lesser degree. Should a population be totally isolated, its survival will be dependent on the population size, endogenous recruitment and its ability to withstand genetic, reproductive and environmental stochasticity (Shaffer, 1987).

Natal Robins are not isolated at PVP, but it is a useful exercise to determine the number of individuals resident, and to theorise about the species' long-term survival prospects at this Reserve. This species was therefore selected (see 2.4.) in a first attempt to investigate aspects of minimum viable populations and minimum critical areas for coastal forest birds in Durban.

3.2. Census method

The labour-intensive territorial mapping technique was chosen for the censusing of Natal Robins. This method gives a measure of absolute abundance of breeding birds. There are a number of alternative methods, but this is the commonly accepted standard for comparison (Whitcomb *et al.*, 1981). Franzreb (1981) especially recommends the technique for densely vegetated habitats and for the ground-foraging guild, where, because of detectability problems, the method is superior to the variable-strip transect method. Dense vegetation (mainly of the herb *Isoglossa woodii* and various lianes) and resultant poor visibility, both in terms of low light levels and effective observation distances, soon put paid to the plan of covering the entire forested area of the Valley. The census plot was then roughly halved to focus effort on the south-facing slope with its large climax trees. The public walking trail which roughly bisected the study area proved invaluable as an observation

transect. Following a bird through the undergrowth was almost impossible, with the noise made when clambering over creepers and treading on leaf-litter chasing the bird off.

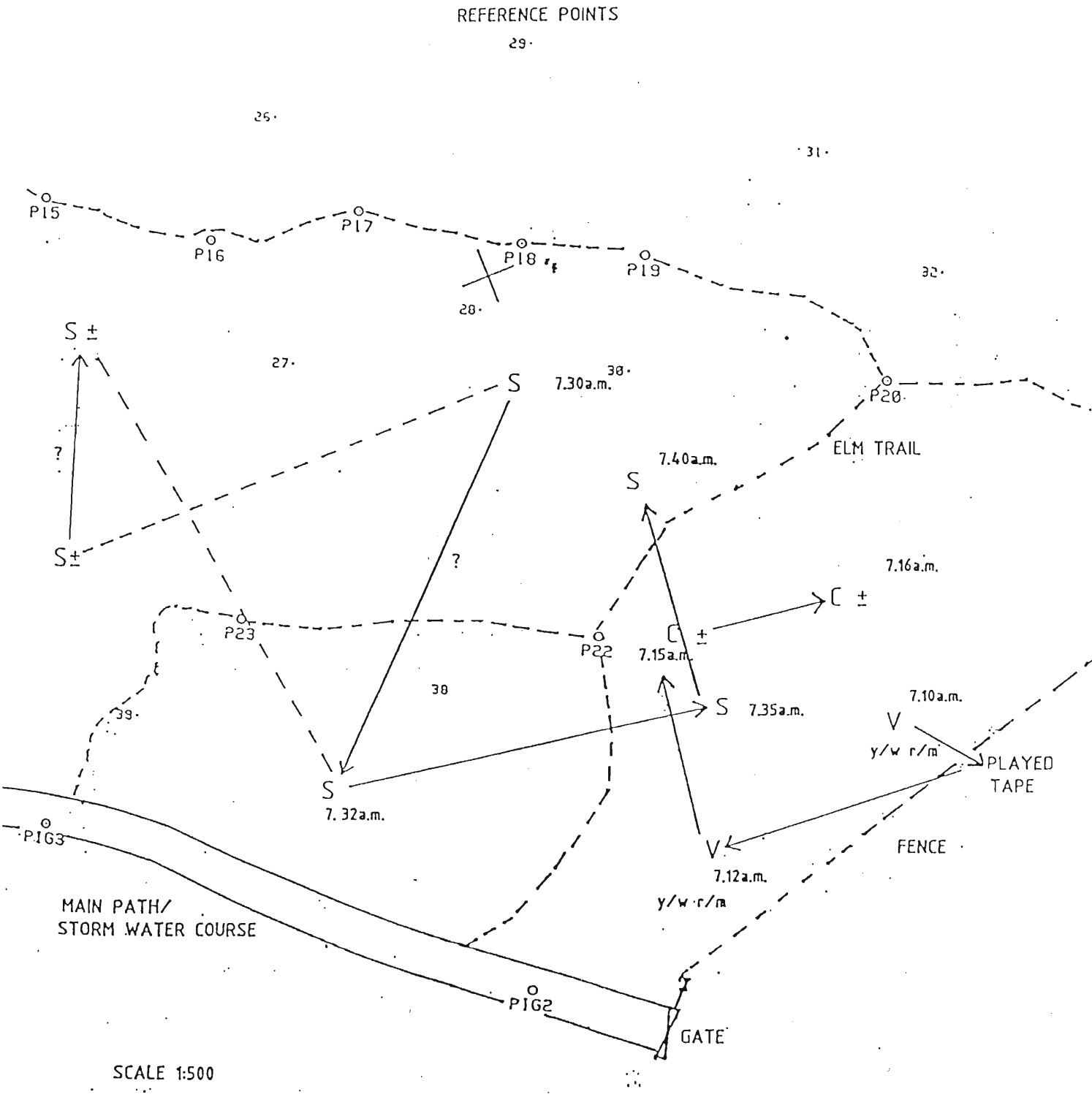
In order to make the results of this study comparable to those of international workers, the standard territorial mapping method as recommended by the International Bird Census Committee (1969) was followed as closely as possible.

The method is well suited to territorial passerines, or birds with similar dispersion mechanisms and distribution patterns. It must be noted that the method counts only stationary birds which may or may not be breeding. 'Floaters', birds which have not yet secured a territory, but live tenuously on the territories of breeders, are not censused. Colour ringing (see 3.3.) was used to identify the territorial pairs, and to reduce the possibility of perplexing registrations ('floaters'), which would make territory boundary definition more difficult. Results from the breeding season are usually most significant, as some species hold year round territories or homeranges, which often exceed breeding territories in size.

Initially (1990/1991 breeding season), an aerial photograph was cut into four A4-sized pieces, and with transparency overlays used to plot observations. This proved unsuccessful, as it was difficult to place records accurately on the photographs, because of the landscape appearing uniform from above. The following year saw an improvement, when a Durban City Engineer's landsurveying team was commissioned by the Durban Park's Department to plot the study area's boundaries, the public trail and 40 selected, labelled trees onto a 1: 500 map. This larger map was sectioned, into five portable pieces (Fig.3:1), which allowed the accurate plotting of registrations to within 2-3m.

FIGURE 3:1 SECTION OF THE CENSUS MAP SHOWING THE RESULTS OF A VISIT MADE ON 7 OCTOBER 1991

KEY : V - VISUAL CONTACT
S - AURAL CONTACT (SINGING)
S → S MOVEMENT WITH DIRECTION
S----S SIMULTANEOUS SINGING REGISTRATION
± - CONTACT WITH IMPRECISE POSITION



SCALE 1:500

7 OCTOBER 1991
CLEAR, WARM WITH A LIGHT NORTHEASTERLY WIND
START 6.40 a.m. FINISH 8.30a.m.
y/w r/m - RING COLOUR COMBINATION, YELLOW OVER WHITE RED OVER METAL

The accuracy was further improved by a good knowledge of the tree species in the reserve and the use of various landmarks, such as birdbaths, dead stumps and benches (Figure 3:1).

Table 3:1 Mapping symbols used to record registrations on the territory map - modified after the symbols proposed by the International Bird Census Committee (1969).

Symbol	Activity
V	Visual contact
S	Aural contact - singing
C	Aural contact - other
F	Feeding
Y	Feeding young
N	Carrying nesting material
I	Immature bird
V → V	Movement with direction
V---V	Simultaneous visual registration
A---A	Aggressive interaction
±	Contact with imprecise position

Contacts, visual and aural, were recorded on the census maps as registrations using modified standard international mapping symbols according to the activities of the birds (Figure 3:1 and Table 3:1). Simultaneous registrations of singing males and aggressive interactions were particularly useful in territory boundary definition. Clusters of registrations, especially of sight records of colour-ringed individuals (see 3.3.), were used for territory definition.

Dawson (1981) describes the problem of distinguishing individuals when many birds of that species are singing. This was borne out with Natal Robins, where, if more than two birds were singing at once, the ventriloquial nature of the song made the pinpointing of the singing birds well-nigh impossible. In order to increase the number of contacts, various prerecorded refrains of conspecific calls and song (Gillard, 1987; Roche, 1989; Gibbon, 1991), perceived by territory holders as a threat display, were played using methods suggested by Johnson et al. (1981). The threatened bird would respond by singing, or by approaching the 'intruder', with or without singing. Response was however surprisingly limited and confined mainly to October and November. In the dense vegetation it is possible that the birds did respond, but remained hidden. The author's experience with other robin species at other localities, is that they tend to respond very well. It was hypothesised that the poor response may have been partly due to dialectal variation. A recording was then made at Pigeon Valley Park using a TEK directional microphone. This, as well as Roche's (1989) recording, proved the most successful in getting a response from territory-holders. As territories are described as defended areas and spontaneous contacts are usually of singing or foraging birds, activities which show central tendencies, Falls (1981) argues that enticing a bird to the territory edge gives a more accurate and more efficient measure of territory size. Two drawbacks which he notes must also be mentioned. Firstly, responding birds may be enticed into an adjacent territory, and secondly, where there are no close neighbours, birds may move into unoccupied areas. Both situations would lead to exaggerated territory sizes.

As the recommendations proposed by the Committee were largely derived from Palaearctic studies, with forest work done in deciduous woodlands with relatively sparse undergrowth, it was necessary to adapt the protocol to an evergreen subtropical forest situation. The suggested 10-30 ha, for closed habitats, was reduced to 3 ha in order to cover the area in detail. The recommended scale of the visit maps was also changed from 1: 1250

- 1: 2500 to 1: 500, for more accurate plotting.

During the 1991/92 breeding season, 60 visits totalling 100 hours (mean = 100 minutes, σ = 51 minutes, range = 60-270 minutes) were made to PVP between 3 August 1991 and 23 May 1992. These were concentrated in the early morning and to a lesser extent in the evening, to coincide with the bird's peak activity period. It is recommended by the International Committee that the route through the study area be varied as far as possible. The only scope for this was to reverse the direction of travel along the public trail (Elm Trail), which was a somewhat limited option due to backlighting considerations, or to skirt the fringes of the plot, which was not very successful because of the dense vegetation at the forest-edge preventing observation of the interior. Due to the narrow nature of the forest strip under consideration, the stipulation that no part of the plot be more than 50 m from the census route was always adhered to. A further recommendation of the Committee is that the plot be visited at least ten times in closed habitats. It was necessary to far exceed this (60 visits) because of the often shy nature of the Natal Robin, particularly during breeding and moult, and the fact that the density of the vegetation often prevented good observations. Visits usually produced only one or two useful registrations.

The suggested guidelines of three registrations in ten visits being the minimum required for a cluster to be defined and a territory inferred, was far exceeded, as it is difficult to imagine how, at least with this species, this could be sufficient to allow any degree of confidence in plotting territory boundaries. The number of territories are then extrapolated and reported per 10 ha, or in this case for the Reserve, the standard of 40 ha and for 100 ha.

Territory areas were determined by two methods and averaged. Firstly, the empirically derived territory map was overlaid with a transparent 25 m^2 grid. The number of more than half-filled squares were then added and multiplied by 25 to give a territory

area. With the other technique, the area of the entire 1: 500 map was first calculated. The map and cut-outs of the individual territories were then massed on a Sartorius scale (accurate to a 1/100 g) and the territory areas calculated as fractions of the total mass and area.

Results were augmented by observations made in the 1990/1991 breeding season, during which the techniques for censusing Natal Robins were developed.

3.3 Ringing

Soon after initial exploratory census work began, it was realised that observations and the subsequent assigning of these to clusters, as representative of territories or homeranges, would prove difficult and fairly subjective. The possibility of a number of 'floaters ' as confounding variables, and the problem of determining to exactly which cluster a record should be allocated, suggested that the ability to recognise individuals would be invaluable. Karr (1981) advises that monitoring of banded birds serves to increase the reliability of density estimates. To this end two brightly coloured plastic tarsal rings were placed on the left leg and a coloured ring over a numbered, SAFRING, metal ring, were placed on the right leg. These four rings allowed 125 different combinations with which to mark individual birds. Black and dark green were avoided, both because they were difficult to see in the field, and because of their similarity to the more visible blue ring. Immature birds were only ringed with a SAFRING, metal ring, as it was suspected that with post-fledgling dispersal the different permutations would be quickly used up (T. Oatley pers. comm.).

A provincial ringing licence was obtained by attending a Natal Parks Board training course with Dr D.N. Johnson at the Darvill Sewerage Works in Pietermaritzburg. Mistnets with a 19 mm mesh size were chosen as the best method for capturing Natal Robins. Sixty-three ringing sessions totalling 224,5 hours (mean = 214

minutes, σ = 65 minutes, range = 60-360 minutes) were conducted, with nets erected mainly along the public trail system. Due to the density of the vegetation, only short nets (6 m) could be used off the paths. In an attempt to improve catch rates, a decoy, mounted Spotted Eagle Owl Bubo africanus (moderately successful) and a Natal Robin (unsuccessful) were placed near the nets. Playback recordings of Natal Robin song and calls were used to lure birds to the net vicinities (moderately successful). Nets were also placed near birdbaths (very successful) and in what appeared to be obvious flight paths. Angled sunlight was avoided, as this made the nets more visible. As suggested by Dawson (1981), the placement of nets was varied to prevent 'net shyness', where birds captured once seem to avoid recapture. The position of the nets was recorded on a map of the plot, and the capture of ringed and previously unringed birds was used to supplement observation data.

Ringing sessions took place mainly in the morning. Nets were set up the night before and unfurled as early as possible the following day. It was this first light period which often proved most rewarding. Initially in excess of 70 m of nets were used per session, but this was reduced to 40 m, as it was difficult to clear the nets frequently enough, especially when birds were badly entangled, or when a whole bird party was caught. The problem was compounded when a Slender Mongoose Galerella sanguineus took to attacking birds in the net.

3.4. Results and Discussion

3.4.1. Censusing difficulties

Mapping accurate territories proved extremely frustrating. During the most significant period (breeding), the birds are at their most furtive. Fortunately, when the adults begin to feed the fledged young, the begging calls of the juveniles draw attention

to them. The ventriloquial nature of the song, and to a lesser degree the commonly heard 'trree-trroo' call, makes the accurate placing of simultaneous singing registrations very difficult. Any singing at the very beginning of the breeding season needs to be checked, as it could also be coming from the nonbreeding C. n. egregior visitors, which have not yet left for their breeding grounds, while that at the end of the season could be due to the early arrival of these birds, as well as the progeny of the breeding residents learning to sing. 'Floaters' would also tend to obscure matters, thus visual records of individually marked birds become that much more important. These are hard to come by due to poor visibility within the forest-interior and the fact that when records would be most significant, the birds are at their most secretive. Males were identified by their territorial song, which Farkas (1969) in his detailed work, both in the field and in aviaries, on the ontogeny of vocalisations in the Natal Robin, restricted to this sex. He questioned an observation of Oatley's (1959), where Oatley described a territorial altercation, stating that the female bird sang. This study therefore assumed that singing birds were male, and indeed females were never observed singing. Further justification for the above assumption, is that the birds which incubated (later identifiable by colour rings) were never seen to sing, and Oatley (1959) states that 'the hen bird is responsible for incubation'. Winter records are not as significant as those from summer, because of the influx of C. n. egregior and the likelihood that territory boundaries are relaxed, with birds occupying homeranges. Birdbaths and other local attractions, such as the emergence of winged termites, seem to be areas where territory boundaries may be transgressed without harassment by the territory holder.

FIG 3:2 MAPPED TERRITORIES OF NATAL ROBINS AT PIGEON VALLEY PARK. 1991-1992 BREEDING SEASON

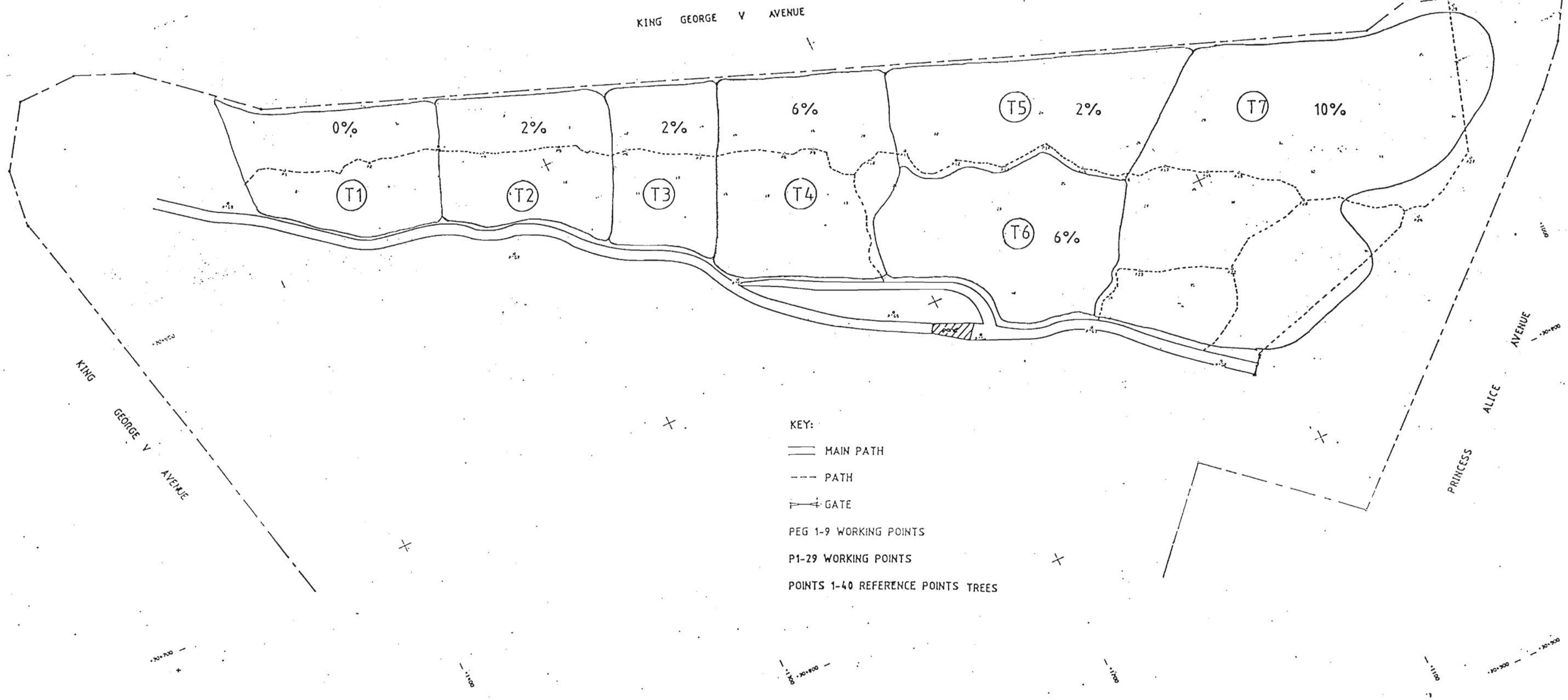
NOTE: T1 - T7 ARE TERRITORIES AS PER 3 .4 .2 .

TERRITORY BOUNDARIES ENCOMPASS NEARLY ALL OBSERVATIONS OF COLOUR-RINGED MALES, AND TO A LESSER DEGREE FEMALES. EXCEPTIONS ARE:

1) BIRDS TEMPORARILY EXPLOITING EMERGING TERMITE ALATES, OR USING BIRDBATHS OUTSIDE THE DEFENDED AREAS
2) BIRDS INVOLVED IN TERRITORIAL DISPUTES, WHERE INTRUDERS WERE OFTEN CHASED BEYOND TERRITORY BOUNDARIES
3) AT DAWN AND DUSK BIRDS FEED ON THE FOREST-EDGE, WHERE LIGHTING IS BETTER
4) BIRDS RANGE MORE WIDELY WITHIN THE PARK DURING WINTER MONTHS

THE PERCENTAGE FIGURES RECORDED WITHIN EACH TERRITORY REPRESENT THE PERCENTAGE OF ALL SIGHTINGS OF MALES WHICH WERE OUTSIDE THE DEFINED DEFENDED AREA

CATEGORIES 1)-3) ABOVE WERE USED TO CALCULATE PERCENTAGES AS TERRITORIES WERE DEFINED DURING THE SUMMER BREEDING SEASON



DURBAN CORPORATION

CITY ENGINEERS DEPARTMENT — GENERAL SURVEY DIVISION

PIGEON VALLEY PARK DETAIL SURVEY APPROX. SCALE 1:1500

SURVEYED BY G.K.B	PLAN No. G.S. 595
DRAWN BY G.K.B	SURVEY No. 167/1991
SCALE 1:500	APPROVED BY
	DATE SEPT. 1991

3.4.2. Population size of Natal Robins at PVP

Territory sizes ranged from 2258 m² to an exceptional 11179 m². The mean territory size was 4434 m² (Table 3:2 and Fig. 3:2). The territory areas presented probably represent a slight overestimation of actual territory sizes. Firstly, interstices between territories have not been allowed for, and secondly, on a smaller habitat scale sections of the territories are probably not actually occupied. This would be the case with forest gaps. The largest territory (T7 = 11179 m²) probably has the highest proportion of unused area, as there are big and relatively numerous forest gaps. This would however not account for more than 1000 m². There is no reason to believe that habitat quality for Natal Robins differs sufficiently between the seven territories to explain such a size range (T7 = T3 x 5). Two other possible reasons may account for the large size of territory 7. Firstly, the resident birds may only use the more distal, north-eastern section of the 'territory' as part of a homerange, thus making the actual defended area about 8750 m². Secondly, it is possible that the 2429 m² difference (11179 - 8750 m²) accommodates another small, undetected territory. This is not considered likely, although registrations attributed to 'floaters' may actually have been territory holders. Using 8750 m² for territory 7, and excluding the possibility of an eighth territory, gives a mean territory size of 4087 m².

Farkas (1969) reported a range of territory sizes from 2100 m² to 8400 m² for 14 breeding pairs observed in the Houtbos Valley and the Abel Erasmus Pass in the eastern Transvaal. Thus territory sizes in both studies were similar.

Table 3:2 Areas and means for seven Natal Robin territories at PVP, determined by the spot-mapping method.

Territory	1	2	3	4	5	6	7	Mean
Area (m^2)#1	3025	2825	2200	4000	3700	3900	11025	4342
Area (m^2)#2	3157	2877	2315	4070	3684	3964	11332	4486
Mean (m^2)	3091	2851	2258	4035	3692	3932	11179	4434

* Territory 7 is exceptionally large. Removal of this area in the calculation of the mean territory area gives a result of 3310 m^2. Reduction of the territory to 8750 m^2 (as described above) results in a mean territory of 4087 m^2.

* Using mean territory sizes, calculated as the average of the two techniques used for calculating territory area: (mean = 4434 m^2, σ = 3041 m^2, range = 2258-11179m^2).

#1 Determined by grid overlay (see 3.2.).
#2 Determined by mass (see 3.2.).

The results of the territory mapping census on the southern portion of the reserve showed that there were seven defended territories on 3,1 ha of forest (Fig. 3:2). By extrapolating these results for 9,7 ha, the estimated forested area at PVP, the predicted number of territories would be 22. There would therefore be in the region of 44 territory holding individuals in the Valley during the breeding season. Extrapolating to the international standard, 40 ha of like habitat would support 90 pairs or 180 birds. The presence of 'floaters', young birds and the winter influx of individuals of the subspecies C. n. egregior means that the estimate is at any one time a minimum figure. There is some evidence that the population of Natal Robins at PVP, during the breeding season, is made up of territory holding individuals and 'floaters' (individuals which have not been successful in securing a territory). One individual was ringed five times between March 1989 and January 1992. This male bird was first captured on three territories belonging to other

individuals, before finally securing his own. Robinson et al. (1990) state that although the percentage occurrence of 'floaters' is hard to measure, 10-30% is a reasonable range. Assuming an average of 20%, PVP has, during the breeding season, a population of 53 Natal Robins of the C. n.natalensis subspecies.

Hino (1990) presents results from large forests in Europe of four workers who determined the average breeding density of 4-5 turdine species as 89,3 pairs per 100 ha. This compares with with Natal Robins at PVP, of which there are about 226 pairs / 100 ha. Although it is recognised that it is not ideal to use extrapolations to calculate population totals, it is felt that there is a fairly even dispersion of the birds throughout the forested areas of the Park, and such extrapolations give good first estimates (see also 3.4.4.). The alternative of covering a larger area at PVP would most certainly have led to great inaccuracies.

There seems to be a low turnover of those individuals holding territories, and the territory boundaries seem stable, as three male birds were observed on the same territories for four breeding seasons.

3.4.3. Minimum viable populations and minimum critical areas

An important question in conservation biology is, 'what are the minimum conditions for the long-term persistence and adaptation of a species or population in a given place' (Soulé, 1987a)? Answers would necessarily be probabilistic, e.g. a 95% probability for 1000 years, taxon-specific and would have to take into account immediate genetic fitness and the potential for long-term evolutionary change (Soulé, 1987a). Depending on the degree of probability and the persistence time required, numerical values obtained will vary considerably (Ewens et al., 1987). If one is able to determine minimum viable populations (MVPs), predictions of minimum critical areas (MCAs) can be made

for the same species.

Frankel and Soulé (1981, cited in Shaffer, 1987) discuss 'the rule of 50', which in captive populations is quoted as the 'rule of thumb' number of individuals necessary to prevent inbreeding effects. Obviously such numbers, which are based on populations of domestic animals, are unrealistically low, and a population of this size would not be sufficient to maintain the genetic variation necessary for long-term evolutionary change in the face of changing environmental conditions. Effective population sizes of the order of several hundred would be required in the latter case (Lande and Barrowclough, 1987).

Recognising a discrete population of Natal Robins at PVP is at this point in time somewhat arbitrary. The area is not isolated in terms of this species, as adjacent large gardens and informal open space areas support individuals, the 'metapopulation' (Gilpin, 1987), which probably interact with the core populations in the Valley and at the Shepstone Nature Reserve. At present, immigrating individuals will by the 'rescue effect' (Brown and Kodric-Brown, 1977), reduce the possibility of localised extinction. These immigrating individuals 'could drastically alter persistence times' (Shaffer, 1987). However, in time, with increasing isolation of the reserve, such a population group definition will become more real. Fifty-three individuals at such an eventuality may therefore, according to the population geneticists, be sufficient to withstand short-term but not long-term genetic effects.

Shaffer (1987) graphically demonstrates that other forms of uncertainty such as environmental stochasticity and natural catastrophes are more likely to set persistence limits (see also 4.3.2. and 6.3.2.). Soulé (1987b), summarising work done on minimum viable populations, rued the fact that there 'are no simple prescriptions for calculating minimum viable populations', but suggested that vertebrate populations of a few thousand individuals would have a '95% expectation of persistence, without

loss of fitness, for several centuries'. Such low levels of risk, he states, would be acceptable for the last population of a species.

Natal Robins are not endangered, and the results of this work show that they occur at high densities at PVP. If one assumes that a MVP of 1000 individuals confers the required level of probability of persistence to this population, it can be calculated that an isolated forest reserve with a MCA of 183 ha (9,7 ha supports 53 birds) would be necessary to ensure the long-term survival of this species at PVP. Interestingly, Roberts (1990) empirically derived a MCA of 181 ha for the vegetation type occurring at PVP, i.e. Community 5: Protorhus longifolia (sapling)-Psychotria capensis Short Thicket. A fairly arbitrary and conservative 'safety factor' of 100 was used to convert MCAs calculated for plants to figures relevant to animals. Both of the abovementioned MCAs for PVP, then, are not rigorous and are to a large extent determined by what level of risk, to the robin population and the vegetation community, is considered acceptable. This 'ball park' figure for Natal Robins is useful in that it illustrates the point that MCAs for large species may be prohibitive. Shaffer (1987) states that 'as body mass increases MVP sizes decrease, but density relations are such that, the larger the body mass, the larger the MAR (what is called MCA here) necessary for the prescribed MVP'. This suggests that in the absence of dispersal between refugia and metapopulations, MCAs for species, such as Crowned Eagles Stephanoaetus coronatus and Trumpeter Hornbill Bycanistes buccinator, would be very large. The 'safety factor' of 100 proposed by Roberts (1990), is likely to be insufficient for such bird species, while it will probably suffice for small, fairly common passerines. Soulé (1987a) calls for bountiful MVPs and suggests that these be based on 'critical or keynote' target species.

3.4.4. Density Compensation

Cody (1983) outlines three factors which determine resource availability, viz. vegetation structure, abundance of food and the effects of competitors. He goes on to say that birds can live at greater densities when resources are more abundant. He, then, showed that in southern Cape forests there is a subtraction in species numbers from west to east, while total bird densities per hectare do not vary much. He concludes that in some guilds, as species are lost through isolation, densities of other species of the same guild increase in a compensatory manner (release from competitors). Blondel's (1991) work on Corsica and the French mainland gives support, in that average population densities of birds were higher on the island. Whitcomb et al. (1981) also found that with the loss of neotropical migrants from forest fragments, permanent residents and short-distance migrants increased in number. Cody (1983) records maximum densities for five turdines on his five isolates: Cape Robin Cossypha caffra 0,99 pairs / ha, Olive Thrush Turdus olivaceus 0,53 pairs / ha, Chorister Robin Cossypha dichroa 0,44 pairs / ha, Starred Robin Pogonocichla stellata 0,26 pairs / ha and Brown Robin Erythropygia signata 0,51 pairs / ha.

These 'inflated' figures still represent much lower densities than those found for Natal Robins at PVP (2,26 pairs / ha), which are of the order of twice as dense in the case of the Cape Robin, and five times as dense in the case of the Chorister Robin. It is possible that this apparently very high density is a result of the inherent abundance of food, a greater diversity of vegetation structure, no limit of nest sites, the lack of certain potential competitors or any combination thereof. The probable local extinction of the Brown Robin at PVP may account for at least some of the high density recorded for Natal Robins. Whitcomb et al. (1981) suggest that recolonisation by a species may be unlikely if the unusually high densities of possible competitors impede their re-establishment.

Such density compensation may have the positive repercussion of increasing population sizes of the remaining species, and therefore their resilience to demographic, environmental and genetic stochasticity (Simberloff and Abele, 1982).

3.4.5. Breeding

Territorial singing activity by the male begins during August and intensifies through September to December, when it starts to diminish. Nest building was observed between the end of September and the beginning of November, each nest taking less than a week to build. Natural cavities in the bole of the Thorny elm Chaetacme aristata, leaf axils of the Large-leaved dragon tree Dracaena hookeriana and the tops of dead tree stumps were the three observed nest sites (Plates 3:1 and 3:2). There would seem to be no shortage of such nest sites in PVP, thus this factor is probably not instrumental in regulating population numbers. Interestingly, Farkas (1969) reports that 32 of his 42 breeding sites were among branches of shrubs and saplings, while this was never the case at Pigeon Valley. Nests ranged between 1 m and 2.5 m from the ground. Nesting material was made up of twigs and rootlets arranged to form an open cup (Plate 3:2).

Two of the egg colours, chocolate brown and olive green, described by Maclean (1985), were observed in the five clutches found. It is possible that the different egg colours may have evolved as a strategy to avoid nest parasitism. Redchested Cuckoos Cuculus solitarius, which parasitise turdines in South Africa, lay chocolate brown eggs (Maclean, 1985). Variable egg colour may also indicate some degree of genetic variability in the population. Incubation was by the

PLATE 3:1 Natal Robin habitat at PVP showing the dominant herbaceous undergrowth, Isoglossa woodii. Large-leaved dragon trees, which are favoured nest sites are visible in the background.

PLATE 3:2 Nest of the Natal Robin in the bole of a Thorny elm.

female only. No examples of double broods were observed, and a bird which lost its eggs in mid-October did not re-lay. This was the only recorded example of nest predation, three eggs being removed from a nest without damaging it.

3.4.6 Predation

Findings from work on Barro Colorado Island and the eastern United States, summarised by Blondel (1991), suggest that isolates suffer additional exogenous predation and nest parasitism as a result of the edge effect, while endogenous predation may diminish as a result of the intolerance of some carnivores to fragmentation. Whitcomb et al. (1981) attributed the major cause for the decline in neotropical migrants in eastern North America to increased predation and brood parasitism as a result of an enhanced edge effect. Smith et al. (1991) also found that predation may have regulated breeding success in Song Sparrows Melospiza melodia on Mandarte Island.

Natal Robins and other birds at PVP probably enjoy artificially low predation pressures on adults, eggs and young. Of the seven pairs whose territories were mapped in the 1991/2 breeding season, all but one were successful in raising fledglings. The seventh clutch was lost to an unidentified predator. Snakes are very scarce at Pigeon Valley Park (only two observed in ten years, both Philothamnus spp.). Vervet Monkeys Cercopithecus aethiops are extremely adept at finding and destroying nests of various bird species, in particular those of the Nectariniidae. They are periodically culled to reduce this source of predation pressure. Redchested Cuckoos, which are recorded parasites of turdines, including Natal Robins, do not occur. Possible nest thieves include, Gymnogene Polyboroides typus, Burchell's Coucal Centropus burchellii, the bush shrikes, Vervet Monkeys, Slender Mongoose, Large-spotted Genet Genetta tigrina, snakes and humans taking eggs for egg collections. The main predator of adult birds is likely to be the African Goshawk Accipiter tachiro, which has become less common at PVP in the

last four years, as a result of displacement by the Black Sparrowhawk Accipiter melanoleucus. Cats Felis catus rarely enter the Park, and those that do are quickly eradicated.

It is interesting that the life-history traits (of single broods, open nests and nests placed on or near the ground), which Whitcomb et al. (1981) identify as those which inherently make the neotropical migrants in their studies vulnerable, are mirrored in Natal Robins. Even so, it seems that predation and brood parasitism are not major factors in the regulation of Natal Robin populations.

3.4.7. Development of the young

Incubation periods and nestling periods are 13,5-15 and 12-17 days respectively (Farkas 1969; Maclean 1985; Oatley 1959). Eggs laid on and around 5 October 1990 and 11 October 1989, as observed with two clutches, would have hatched around 19-25 October, and the young would have left the nest by about 3-9 November. A nest found on 14 November 1991, with three eggs, would follow the same pattern except shifted one month later, if one assumes that the eggs were halfway through the incubation period when discovered. This ties in well with what is observed, as it is from about mid-November that the high- pitched begging calls of fledged young become noticeable. It is then that the furtive adults once again become visible as they struggle to keep up with their offspring's demand for food. These begging calls last for about six weeks, after which they start to abate. During January the young, retaining immature dress, become increasingly independent. The adults which are largely relieved of their parental duties cease to sing and become inconspicuous once more.

3.4.8. Moult

Both age groups start to moult in January, as recorded in captured birds, and complete moulting at about the end of March. The offspring only renew their body feathers and retain their

flight feathers. At this stage they are still just identifiable by some of the wing coverts remaining buff-tipped (Farkas 1969). All birds are furtive during this period, when they are possibly more vulnerable than usual.

3.4.9. Unseasonal singing

From about early March to mid April there is a resumption of singing, albeit somewhat subdued. This singing is not useful in territorial mapping as it seems to come from more than just the territorial male. I hypothesise two possible reasons for these vocalisations. In the first place, the daylength during this period mirrors that of the beginning of spring or September/October when singing starts. The birds involved at this time of the year may be of both subspecies, meaning that there could be more than one singing bird per territory. Secondly, and perhaps less likely, the singing may be the adult males acting as 'singing-masters' (Farkas, 1969), with the immature males and females engaging in subsong and rehearsed song. The subsong is described by Lanyon (1960, cited in Farkas, 1969) as being characteristically random, warbling and of long duration, and the rehearsed song as primary song motifs (adult male territorial and courtship song) and specific call notes interspersed within the random warbling of subsong. Both song types have low outputs and female song development ends here (Farkas, 1969). This description does not fit the observations, although it matches exactly an observation of the author's of an immature Whitethroated Robin Cossypha humeralis at Weenen Game Reserve in northern Natal in January 1991.

3.4.10. Postbreeding dispersal

Clancey (1990) describes in detail the post-breeding dispersal of the eight subspecies of Natal Robin adults and juveniles (see 3.1.).

An influx of unringed birds to PVP during the end of March and early April probably represents migrating birds of the subspecies C. n. egregior arriving at their Natal/Mozambique wintering grounds. Two birds caught together, on 15 March 1992, had the adult plumage with the telltale buff-tipped wing coverts of first year birds. Both birds were subsequently ringed and one was seen throughout the winter.

In contrast to what is described by Clancey (1990), most of the C. n. natalensis adults remain on their breeding grounds during winter. Colour-ringed territory holding adults were observed on their territories, although these may be somewhat relaxed, throughout winter. Farkas (1969) also found that in the Houtbos Valley population of the same subspecies, it was the first-year birds which moved during winter, while the adults remained on their territories. If the first year birds disperse to wintering grounds without the adults, this must be an innate behaviour.

There is also the possibility that the apparent winter influx of birds is to some extent a result of a change to a more confiding nature in the C. n. natalensis adults and immatures, which have remained for the winter. Unringed birds of the two subspecies would probably be inseparable in the field, notwithstanding Clancey's (1990) detailed descriptions of both. On the other hand a bird ringed, as an adult in January 1989, was recovered dead in Princess Alice Avenue four months later, possibly as a result of being hit by a car. Although this is less than 200 m away, the month of April may be significant, being the month in which birds are expected to disperse to wintering grounds. Records of this nature are also significant as they demonstrate that PVP is not totally isolated with respect to its Natal Robin population.

Clancey (1990) separates the eight described subspecies mainly on tail length, but also on wing length and plumage saturation and coloration. Although there is some overlap and there are sex-difference complications, accurate mensural data and the comparison of birds in the hand to colour charts would assist in

the elucidation of some of the unanswered questions regarding these winter movements, especially with reference to the first-year birds.

Aggressive interactions between the territory holders and the alleged winter visitors are confined mainly to early April, after which they may be seen feeding side by side with no apparent hostility. Both subspecies are tame during the winter, with the visitors more remarkably so. At this stage it is possible to carefully approach a bird to within 2-3 m. Interestingly, the winter-visiting Spotted Thrush Zoothera guttata, which apparently also migrates to these parts from coastal Transkei (Maclean, 1985), is remarkably tame during its visit. However, it like the Natal Robin is very furtive during the breeding season.

During August both sets of birds start to sing, and some mild altercations are observed. By the first days of September the migrants have gone and the residents are starting to become less visible.

3.4.11. Imitation

This species is a fine imitator of other birds, mammals and humans. Farkas (1969) describes the courtship song as consisting only of imitations. Oatley (1959) hypothesises that the greater the repertoire, the greater the chances of securing a mate. He cites an example of a male with a poorly developed courtship song not being able to secure a female.

Birds at PVP imitate at least 11 species: Spurwinged Goose Plectropterus gambensis, African Fish Eagle Haliaeetus vocifer, Crowned Eagle, Diederik Cuckoo Chrysococcyx caprius, Klaas's Cuckoo Chrysococcyx klaas, Fierynecked Nightjar Caprimulgus pectoralis, Redfaced Mousebird Urocolius indicus, Blackheaded Oriole Oriolus larvatus, Cape Batis Batis capensis, Southern Boubou Laniarius ferrugineus and Olive Bush Shrike Telophorus olivaceus. Humans and car alarms are other favourites. The

European Bee-eater Merops apiaster does not seem to be imitated, although Farkas (1969) states that he has never known a male which does not imitate this species.

Of the 11 species listed above, the first five do not occur at PVP at all. This implies that in order to introduce these calls into the repertoire of the residents at PVP, there must be some movement of Natal Robins, at least into the valley.

3.4.12. Food

As described in Maclean (1985) and Oatley (1959), Natal Robins are largely ground-feeding insectivores which will take fruit in the canopy during winter. At PVP the fruits of the Pigeonwood Trema orientalis are much relished during the late summer and autumn months. Emerging termite alates are also a sought-after item, and a bird was observed once breaking open the tunnels that termites make on dead wood, in order to get at them.

3.4.13. Ringing results

A total of 287 individuals of 25 species were captured and ringed. In addition 88 birds were recaptured. There were four recoveries: A Natal Robin from Princess Alice Avenue (struck by a car), a Natal Robin from within the Reserve (unknown cause of death), a Terrestrial Bulbul from the bottom of Howard Avenue (unknown cause of death) and a Thickbilled Weaver Amblyospiza albifrons from Westville (10 km distant, struck by a car). Capture rates were low with a figure of 0,37 birds per 12-m net-hour.

Summarised ringing results are presented in Tables 3:3 and 3:4.

Table 3:3 Number of species and individuals ringed and recaptured at PVP, during the period January 1989 - April 1992.

	RINGED	RE-CAPTURED	TOTAL
Terrestrial Bulbul	51	41	92
Natal Robin	54	29	83
Cape White-eye	44	4	48
Bleating Warbler	33	6	39
Tambourine Dove	15	2	17
Paradise Flycatcher	10	4	14
Thickbilled Weaver	10	-	10
Grey Sunbird	9	1	10
Barthroated Apalis	9	-	9
Collared Sunbird	8	-	8
Boubou Shrike	8	-	8
Olive Sunbird	6	-	6
Spotted Thrush	5	-	5
Kurrichane Thrush	3	1	4
Green Twinspot	3	-	3
Goldenrumped Tinker Barbet	3	-	3
Spectacled Weaver	3	-	3
Sombre Bulbul	3	-	3
Pygmy Kingfisher	2	-	2
Forest Weaver	2	-	2
Blackeyed Bulbul	2	-	2
Forktailed Drongo	1	-	1
African Goshawk	1	-	1
Black Cuckoo Shrike	1	-	1
Squaretailed Drongo	1	-	1
TOTALS	287	88	375

Table 3:4 Summary of the ringing results at PVP, for the period January 1989 - April 1992.

*1 Length of ringing session.
*2 Length of nets erected for each ringing sess
*3 Number of birds captured.
*4 Number of birds captured per 12-m net per ho

	DATE	RINGING PERIOD (hrs) *1	NET LENGTH (m) *2	No. OF BIRDS CAUGHT *3	No. OF BIRDS/12-m NET-HOUR *4
1	8-1-89	3	42	2	0.19
2	14-1-89	3	54	3	0.22
3	21-1-89	5	48	13	0.65
4	22-1-89	4	48	7	0.44
5	11-2-89	4	54	8	0.44
6	12-2-89	4.5	48	9	0.50
7	26-2-89	3	72	9	0.50
8	4-3-89	4	72	11	0.46
9	11-3-89	3.5	72	9	0.43
10	4-6-89	3.5	48	1	0.07
11	31-7-89	3	48	10	0.83
12	1-8-89	3	60	3	0.20
13	19-8-89	4	79	3	0.11
14	26-8-89	3	48	12	1.00
15	2-9-89	4	75	13	0.52
16	9-9-89	4	57	4	0.21
17	27-1-90	6	60	6	0.20
18	28-1-90	4.5	60	2	0.09
19	17-2-90	4.5	72	10	0.37
20	25-2-90	4	72	2	0.08
21	20-3-90	2.5	72	8	0.53
22	24-3-90	3.5	72	2	0.10
23	28-3-90	1	72	1	0.17
24	29-3-90	1.5	72	2	0.22
25	30-3-90	4	72	1	0.04
26	7-4-90	3	72	2	0.11
27	21-4-90	3.5	72	4	0.19
28	19-7-90	3.5	72	5	0.24
29	20-7-90	6	72	12	0.33
30	21-7-90	6	72	8	0.22
31	4-8-90	4	18	7	1.17
32	4-8-90	4	18	8	1.33
33	19-8-90	3	72	6	0.33
34	27-10-90	4	50	11	0.66
35	28-10-90	4	50	20	1.20
36	29-10-90	4	50	12	0.72
37	9-11-90	2.5	45	4	0.43
38	13-11-90	3	45	2	0.18
39	14-11-90	2	45	3	0.40
40	21-11-90	3	45	3	0.27
41	28-11-90	1.5	45	1	0.18
42	1-12-90	6	45	29	1.29
43	17-12-90	3	45	3	0.27
44	27-12-90	3.5	45	9	0.69
45	30-12-90	2	45	1	0.13

	DATE	RINGING PERIOD (hrs) *1	NET LENGTH (m) *2	No. OF BIRDS CAUGHT *3	No. OF BIRDS/12-m NET-HOUR *4
46	9-3-91	4.5	21	1	0.13
47	9-6-91	3	24	2	0.33
48	14-7-91	3	51	4	0.31
49	17-8-91	3	51	3	0.24
50	31-8-91	5	51	8	0.38
51	6-9-91	3.5	51	4	0.27
52	9-11-91	4	51	7	0.41
53	29-9-91	3	51	1	0.08
54	5-10-91	3	51	1	0.08
55	7-12-91	2	39	6	0.92
56	22-12-91	3	39	8	0.82
57	18-1-92	5	39	6	0.37
58	25-1-92	3	39	5	0.51
59	1-2-92	3	39	3	0.31
60	22-2-92	4	39	1	0.08
61	15-3-92	4	39	4	0.31
62	28-3-92	4	39	2	0.15
63	23-4-92	5	39	8	0.49
	TOTALS	226.5	3325	375	
	MEAN	3.3	48	5	0.36

CHAPTER FOUR

STATUS OF SPECIES RECORDED AT PIGEON VALLEY PARK

4.1. Introduction

Simple species lists for conservation areas do not reveal anything more than presence or absence, although the latter cannot be conclusively proven. They are thus a useful starting point, but more detailed information on the breeding status of the recorded species will allow for comparison with other areas, as well as set a benchmark for further surveys in the same area. Such lists of breeding species would more closely approximate a measure of true species richness as used in species-area relationship studies.

In terms of the Theory, it is likely that with fragmentation, PVP will have experienced or may still be going through 'the process of relaxation from a state of supersaturation to a new equilibrium determined by the species-area relationship' (Blondel, 1991). Species' statuses may be tracked over time, and corrective action may be taken to halt any worrying declines. Information as to which species breed, allows managers to make strategic planning decisions to ensure that all species in a region are protected as breeding populations within a system of reserves.

4.2. Method

Numerous visits to the study area, and the completion of lists of species heard and seen on each visit, provide some insight into the status of each recorded species. In total 106 visits, standardised to a duration of two hours, were made between July 1986 and September 1992. In addition my own ad hoc observations as far back as 1982 were included. Historical records for the period 1981 to 1983 were provided by G.R. Nichols, who was

curator at the Park during this time. Lists were also obtained from other sources as were ad hoc notable records (Dr H.A. Campbell, R. Cowgill, J. Gourley, J. Marais and E. Reynolds; pers. comm.).

The frequency of occurrence of each species is calculated as the percentage of lists on which the species was recorded. It is recognised that differential detectability of the various species will bias results somewhat, but a crude measure of abundance is better than none. Loud, vocal, colourful, tame and diurnal species will obviously be recorded more often than their opposites.

Statuses are modified after Whitcomb et al. (1981) and Vernon (undated) and recorded as:

1) permanent residents: maintain year-round homeranges on the breeding grounds, with at most local 'drift' into nearby habitats.

2) short-distance migrants: breeding populations move a few hundred kilometres to a different wintering area. In Natal there are two sub-groups, i.e. those moving north/south and those moving east/west on an altitudinal gradient.

3) intra-African migrants: migrate within the continent, usually to the north of the equator. They are present for the austral summer.

4) Palaearctic migrants: most or all individuals of a given species migrate to the Palaearctic region for the austral winter.

5) Visitors/vagrants: species which are recorded rarely or uncommonly, and do not breed at PVP.

6) Historical: species which have been recorded at PVP in the past, but were not recorded in the past 5 years.

For migrants, the earliest date of arrival and latest date of departure were recorded where possible.

In order to get a rough measure of the extent of the edge effect, descriptions of sub-habitat preferences were made so as to define the true forest-inhabitants as separate from those which utilise the forest-edge. Bird species were placed, as best as possible, into one of three habitat categories; forest-interior, forest-edge and non-forest. As it is very difficult to assign species rigidly to one of the categories (see 2.4.), species were allocated using the suggested list of South African forest-birds presented by Oatley (1989), and my own considerable experience of the local avifauna. Where there was any doubt as into which category a species fits best, the 'historical' lists drawn-up by local birding authorities were consulted (see 6.2.). Their lists do not however differentiate between forest-edge and non-forest species, and I therefore had to make this distinction myself. I believe that the patterns which emerge mask any shortcomings which may have been introduced through subjectivity.

Species' breeding status was recorded on field sheets as per the current Southern African Bird Atlas Project status codes: 2 - suspected breeding (carrying nesting material or food for nestlings or fledglings), 3 - proven breeding (definite breeding, but it is not known whether the birds have eggs or chicks), 4 - eggs, 5 - chicks, 6 - eggs and chicks, 7 - dependent fledglings.

Breeding records are largely those of the current study, but augmented by others, in the main by G.R. Nichols (pers. comm.).

4.3. Results and discussion

4.3.1. Status of species occurring at Pigeon Valley Park

Detailed results are presented as an annotated checklist (Appendix 1), which also includes species recorded in the study area, but not at PVP. This list indicates species' status as per and Whitcomb et al. (1981).

One hundred and eighteen species were recorded at Pigeon Valley Park between 1981 and 1992. The status (see 4.2.) of these species is summarised in Table 4:1 and is recorded in brackets alongside the species name in Appendix 1. Birds were counted only if they have a direct association with the Reserve, i.e. they must land or feed low-over the Valley. This means that of the swifts, only the Palm Swift Cypsiurus parvus (by virtue of the fact that they breed in the Royal palms Roystonea regia lining King George V Avenue) and of the swallows, the Black Sawwing Swallow Psalidoprocne holomelas are included in the species total, as the remainder of these two groups do not have any direct association with PVP. Other species, which were rcorded from the Reserve, but only as incidental observations of individuals flying over, are listed in Appendix 1, but no status is indicated in brackets after the name, e.g. Lanner Falcon Falco biarmicus and Roseringed Parakeet Psittacula krameri.

Placing each species into only one category proved difficult, as some could be placed almost equally well into one of the other groups. Categorisation was therefore to some extent subjective, and was done on a 'best fit' basis. There is some overlap between short-distance migrants and intra-African migrants, as some individuals or species, such as the Pygmy Kingfisher Ispidina picta and Klaas's Cuckoo Chrysococcyx klaas, may migrate only as far north as Mozambique and Zimbabwe (Maclean, 1985).

Table 4:1 Species checklist for PVP, broken down by status (as per Whitcomb et al.,1981).

Status key:
Permanent residents - maintain year-round homeranges on the breeding grounds.
Short-distance migrants - breeding populations move a few hundred kilometres to a different wintering area.
Intra-African migrants - migrate within the continent, usually to the north of the equator.
Palaearctic migrants - migrate to the Palaearctic region for the boreal summer.
Visitors/vagrants - species recorded rarely at PVP, and do not breed.
Historical - species recorded at PVP in the past, but not in the past five years.

SPECIES STATUS	NUMBER OF SPECIES	PERCENTAGE OF TOTAL
PERMANENT RESIDENTS	43	37
SHORT-DISTANCE MIGRANTS	10	9
INTRA-AFRICAN MIGRANTS	3	3
PALAEARCTIC MIGRANTS	3	3
VISITORS/VAGRANTS	53	45
HISTORICAL	6	5
TOTAL	118	100

As can be seen from Table 4:1, 45% of the species may be described as visitors or vagrants. These are species which do not breed at the Reserve, yet are not migrant species, and therefore should not form part of species-area relationships.

Six species which were not recorded during the last five years, but which were recorded between 1981 and 1987, have been labelled historical (Table 4:1). Three, Whitebrowed Robin Erythropygia leucophrys, Olive Thrush and Fierynecked Nightjar, which may have bred during this period, can be considered as having undergone localised extinctions. The other three historical species, Greenspotted Dove Turtur chalcospilos, Black Widowfinch Vidua funerea and Crowned Hornbill Tockus alboterminatus, were only visitors.

4.3.2. Endemic species

Six southern African endemics have been recorded. Four of these breed, or are likely to breed at PVP: Cape Batis, Southern Boubou, Southern Tchagra Tchagra tchagra and Cape White-eye Zosterops pallidus. The other two are the vagrant Knysna Lourie Tauraco corythaix and the Chorister Robin, which is a regular but sparse winter visitor.

4.3.3. Red Data species

One Red Data species, the Spotted Thrush Zoothera guttatta, which is listed in the Red Data Book as Vulnerable (Brooke, 1984), is a regular winter migrant to Pigeon Valley. Four or five birds are present from March to September. Another, the Mangrove Kingfisher Halcyon senegaloides, listed with an Indeterminate status, utilises patches of forest as it moves between breeding and wintering grounds. This species has only been recorded twice at PVP.

4.3.4. Breeding species

Forty-one species, or 35%, have been confirmed as breeding at PVP in the last five years. A further 15 are considered to be likely breeders. If these 15 do in fact breed in PVP, then 47% of the total species list have bred, and the maximum species richness value, used in species-area relationships, would be 56 (assuming that all species bred during one breeding season).

4.3.5. Evidence for a dynamic equlibrium

The observed number of species recorded in an area, which has been isolated for some time and has a constant number of breeding species present, is at dynamic equilibrium with continual extinctions and colonisations balancing one another (MacArthur and Wilson; 1963, 1967).

At PVP, in the past twelve years, there has been a number of local extinctions of breeding species, while simultaneously other species have colonised the reserve (Table 4:2).

Table 4:2 Extinctions and colonisations of breeding species at PVP between 1981 and 1992.

EXTINCTIONS	COLONISATIONS
Hadeda Ibis	Hadeda Ibis (recolon.)
Whitebrowed Robin	Black Sparrowhawk
Little Bee-eater	Yellowbilled Kite
Yellowbilled Kite	White-eared Barbet?
African Goshawk	
Pygmy Kingfisher	
Hoopoe	
Olive Thrush	
Blackbellied Starling	
Redbilled Woodhoopoe	
Glossy Starling?	

Note: ? - means that breeding was suspected, but has not been proven.

Most of the observed extinctions may be explained in terms of forest succession, i.e. as functions of the characters of the island (Blondel, 1991). Since 1978, the former management policy of clearing the undergrowth has been relaxed, and the forest and its undergrowth have been allowed to regenerate. The Whitebrowed Robin, Little Bee-eater Merops pusillus, Pygmy Kingfisher, Hoopoe Upupa epops and Redbilled Woodhoopoe Phoeniculus purpureus have almost certainly disappeared, as breeding species, as a result

of reforestation and the loss of suitable edge habitat. The Glossy Starling Lamprotornis nitens possibly also falls into this category, as historical breeding was suspected, but not proven. Redbilled Woodhoopoes seem to be on the decline throughout the Berea (G.R. Nichols pers. comm.).

The Hadeda Ibis Bostrychia hagedash, African Goshawk Accipiter tachiro and Yellowbilled Kite Milvus parasitus have all been displaced by the Black Sparrowhawk Accipiter melanoleucus, which has bred since 1989. The Yellowbilled Kite and Hadeda Ibis have since attempted to recolonise, but are continually discouraged by the Black Sparrowhawk (a breeding attempt by the Hadeda Ibis, initiated in October 1992, may yet prove successful).

The reasons for the local extinctions of Olive Thrush and Blackbellied Starling Lamprotornis corruscus are less clear, although in the case of the thrush, the individuals seem to have been replaced by the similar Kurrichane Thrush Turdus libonyana, which is normally a species of more open woodland. This would represent a possible case of 'niche shift' (Cody, 1983), where, in the absence of the forest-dwelling Olive Thrush, the Kurrichane Thrush has been able to occupy the forest. Whether the Olive Thrush became extinct as a result of competition from the Kurrichane Thrush, or for some other reason, is a matter for further investigation.

It is possible that Blackbellied Starlings may be limited by nest-hole availability. With fragmentation of the forest, habitat for Blackcollared Barbets Lybius torquatus is improved, and under these conditions it may be that they are out-competing the starling for nest-holes. A small group of these starlings flies over the study area nightly on their way to roost, possibly at the Stainbank Nature Reserve. They also seem to be nomadic and able to cross inhospitable tracts, as would be expected of frugivores exploiting patchy resources. Reserve isolation, then, would not seem to be a factor in this example of a local extinction.

Actual turnover of breeding species may be much greater than that indicated above. Turnover rates of bird species in the eastern Deciduous Forest of North America is of the order of 10-25% (Lynch, 1987). Holmes (1990), in a patch of northern Hardwood Forest in North America, has shown that the dynamic equilibrium fluctuates around an average number of breeding species. Applying a conservative 10% turnover rate to the 56 suspected breeding species, gives an expected turnover of 5-6 species annually. This figure is far higher than what was actually observed. It is likely that at PVP, some species (with small populations) do not breed every year, and although they seem to be present from year to year, this may hide the fact that they alternately become locally extinct and then recolonise as breeding species. It is difficult in such cases to be absolutely sure that a species is not breeding, particularly as nests of forest bird species may be difficult to find, and thus true turnover rates may be underestimated.

A weakness of the Theory as pointed out by Blondel (1991), is that all species are considered as having equal probabilities of extinction. This is not the case, as at PVP forest succession will result in the extinction of a particular suite of species. Furthermore, it is possible to identify a set of coastal forest species which are intolerant of fragmentation (Chapter 6). Birdlists for open space areas in metropolitan Durban, as presented by Boon (1985), show that it is the same forest-bird species which occur in most of the forest preserves.

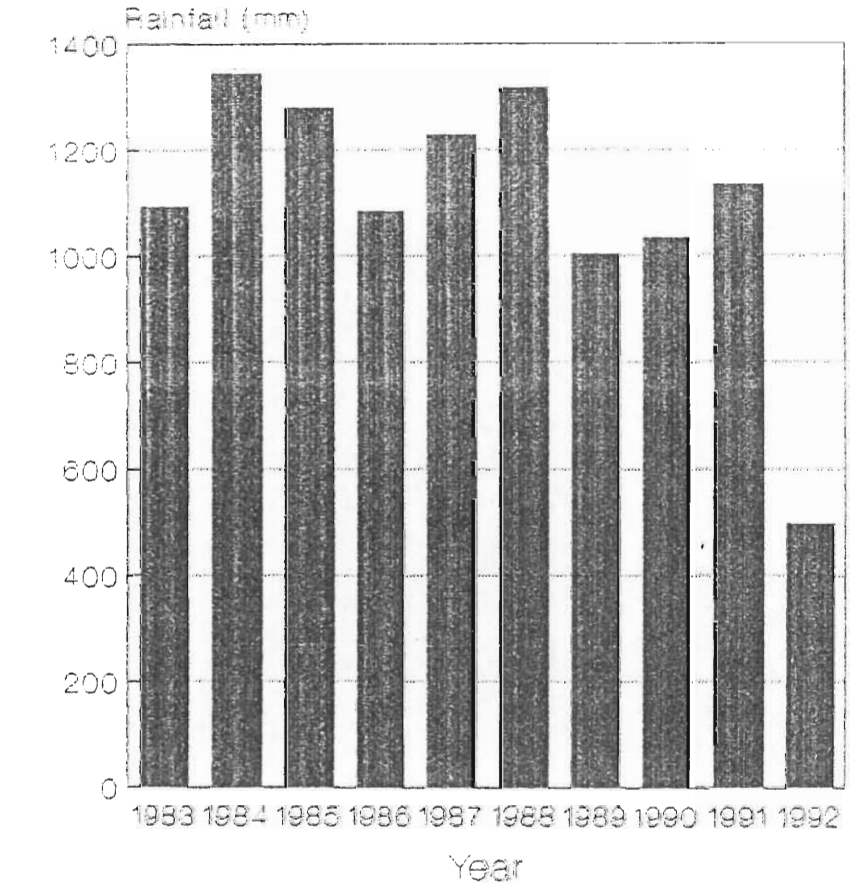
4.3.6. Environmental catastrophes

One of the causes of local extinctions are environmental catastrophes, such as severe storms, drought, disease and fire. Shugart (1990) describes a fire in Australia which virtually burnt up all the individuals in the entire Eucalyptus delagatensis species population. Shaffer (1987) demonstrated graphically, that it is environmental uncertainty and natural catastrophes which are most likely to cause stochastic

extinctions of species.

The exceptionally dry winter of 1992 caused drought conditions throughout southern Africa, the likes of which had not been seen for 70 years (Table 4:3). Durban received less than half of the mean annual rainfall recorded over the past ten years.

Figure 4:1 Annual rainfall (mm) recorded at Durban Botanic Gardens from 1983 to 1992.



Mean annual rainfall 1983-1992 = 1100 mm

Eight species were recorded at PVP for the first time during this dry period: Secretary Bird Sagittarius serpentarius, Little Sparrowhawk Accipiter minullus, Grey Cuckooshrike Coracina caesia, Yellowthroated Warbler Seicercus ruficapillus, Gorgeous Bush Shrike Telophorus quadricolor, Yellow Weaver Ploceus subaureus, Cape Canary Serinus canicollis and Goldenbreasted Bunting Emberiza flaviventris. It must be noted that it is possible that the Yellow Weaver, in winter eclipse plumage, may have been previously overlooked or misidentified as the Spottedbacked Weaver Ploceus cucullatus. It is not clear what the attraction of PVP was during this period, but perhaps the area was more habitable than others because of the presence of permanent water.

It seems that no species has become extinct during this period, but the 1992/93 breeding season may prove otherwise.

4.3.7. Species richness and the edge effect

The 118 species recorded at PVP may be divided, according to sub-habitat preference, into three groups (Appendix 2, list 1):

F - Those which favour forest-interior - 34 species.

M - Those which require a certain degree of cover, but are found mainly on the forest-edge or margin - 39 species.

N - Those species which are found more reliably in non-forest habitats, and are only found at PVP because of the edge effect - 45 species.

The allocation of species to the three groups is to some degree subjective (see 4.2.), but the pattern is probably correct.

A 10-ha sample (as opposed to an island) in a large contiguous forest tract would not support any species of category N. Because of patch dynamics most of the species of M would still be supported, although a few species might be lost. On the other hand, 14 of the regional pool of forest species which no longer breed or occur at PVP (see 6.3.1.), would most probably be found.

The new count of F and M birds would then total about 80 species, representing a net loss, relative to the current list, of 38 species. At first glance it would seem that insularity has increased the conservation standing of PVP. This is, however, obviously erroneous as the species gained are those in least need of conservation (N species) and the 14 lost (fragmentation sensitive F species) are those most in need of protection. Simberloff (1982) is incorrect in using the edge effect as supporting evidence that reserve fragmentation with concomitant increase in edge actually leads to greater species richness. In measuring the standing of conservation areas, species must be weighted, as it is necessary 'to avoid a simplistic numbers game when assessing the biological impact of habitat diruption' (Lynch and Whigham, 1984).

The above argument assumes that all species breed in the area, which they obviously do not. As such it is still useful to illustrate the pitfall of simply treating species as numbers. It also emphasises the magnitude of the edge effect. This is an example of scale, which Blondel (1990) refers to, where habitat gradients on Corsica and mainland France support similar species numbers as a whole, but at a habitat level the picture is quite different.

Nilsson (1986) showed that smaller patches of the same biotope, when compared to larger patches, support a higher proportion 'of abundant generalists that are often smaller species'. Internal fragmentation, such as paths and clearings (man-made) and tree-falls (natural), means that PVP is almost entirely made up of small parcels of edge. It is clear that an increase in patch size decreases the proportion of edge. In order to improve the conservation potential of this Reserve it is therefore strongly recommended that the edge effect be reduced substantially (see Chapter 7).

CHAPTER FIVE

DISPERSAL OF SPECIES THROUGHOUT THE STUDY AREA

5.1. Introduction

As described in Chapter 4, 118 species of birds have been recorded at Pigeon Valley Park in the past 12 years. Of these, 43 species may be considered permanent residents, while the list of species which breed, may breed or have bred stands at 56. The remainder of the species are migrants, visitors/vagrants or they have not been recorded in the past five years.

Bridgewater (1987) declares that 'a knowledge of the ability of organisms to move between different elements of the landscape....is necessary for conservation management'. Poynton and Roberts (1985) agree, stating that 'no estimates of extinction, emigration and immigration rates for any of the species are available at present'. In a call for more research and evidence, Newbey and Newbey (1987) claim that much has been written on the importance of corridors, of natural and hence 'friendly' vegetation, in increasing immigration to and emigration from core refugia and thus staving off local extinctions. However, at the time of writing nothing had been published to support this belief.

Stemming from Pigeon Valley's insular nature, a pertinent question relating to the conservation of the resident species is, to what extent are the populations of each species isolated from individuals of other, separate populations? Small, isolated populations may be susceptible to inbreeding effects, random fluctuations in breeding success, natural catastrophes, diseases, etc. (Shaffer, 1987). If the population is totally isolated there

is no chance of recolonisation from other sources, and any local extinctions would therefore be permanent. Wilcove and Robinson (1990), Whitcomb (1987) and Lynch and Whigham (1984) lend supporting evidence when they state that patch isolation influences the abundance of certain species. MacClintock et al. (1977) found that one small (14,16 ha) forest patch in their suburban Maryland study area had an avifaunal species composition similar to that of greater forest areas, something that they attributed to its connection to a larger '400 acre woodland by a disturbed corridor'. Bierregaard (1990) reported that certain bird species (i.e. obligate army-ant followers) were able to exist on small fragments as long as they were joined to larger tracts by favourable corridors. Numbers were continually replenished from the metapopulation. This replenishment is the 'rescue effect' described by Brown and Kodric-Brown (1977).

Isolated natural areas should therefore be avoided, and 'there exists a need to secure effective dispersal corridors between habitat islands, which implies a need for research (or at least better informed guesswork) regarding existing links and the way they are best managed' (Poynton and Roberts, 1985).

Corridors may take the form of narrow strips of hospitable terrain, or a series of stepping stones of habitat, which are suitable for the dispersal of certain species. Dendy (1987) asserts that corridors serve to increase effective population sizes, maximise heterozygosity and facilitate recolonisation. They may, on the other hand, allow the spread of catastrophic events between core areas (Simberloff and Abele, 1982).

This study attempts to discover whether all species are equally able to use two potential corridors in the study area, and if not to identify those species which may be most affected by habitat fragmentation. It further aims to outline management proposals to maximise the effectiveness of these corridors for the dispersal of forest birds.

PLATE 5:1 Section A of the PVP/Bulwer Park Corridor-showing the Jacarandas, the narrow planted island, adjacent gardens, the gap between the island and PVP in the background and the gap between the island and the Manning Road traffic islands, from which the photograph was taken.

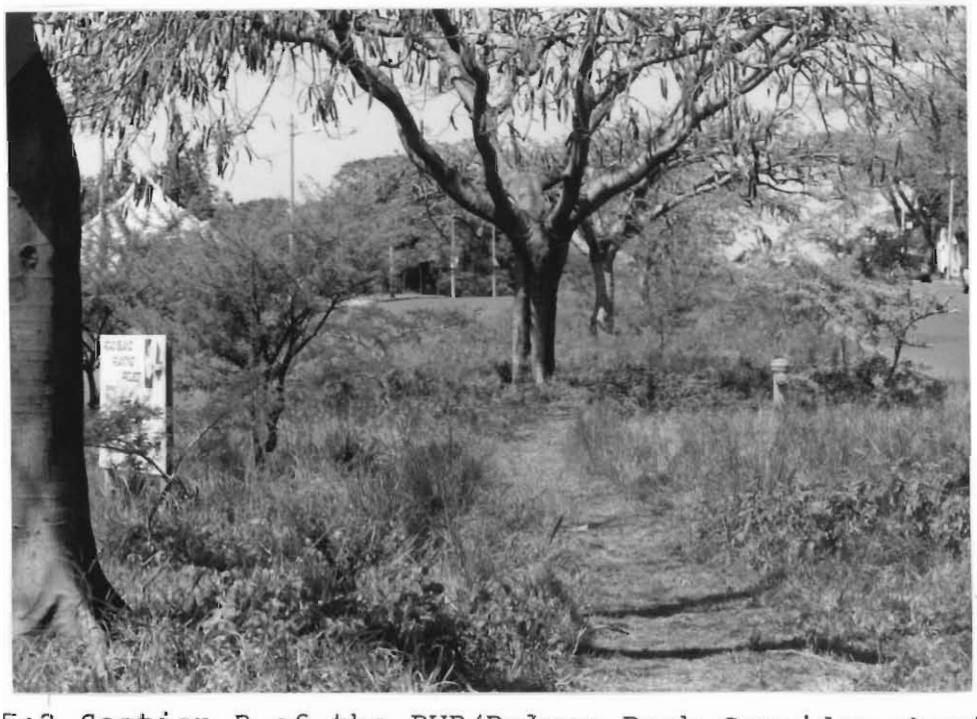


PLATE 5:2 Section B of the PVP/Bulwer Park Corridor-showing the central Flamboyant trees, the planted Acacia trees, the unmown grass sward and the information board.

PLATE 5:3 Traffic islands on Manning Road as they looked before planting by the Durban Parks Department and Durban Girls' High School.

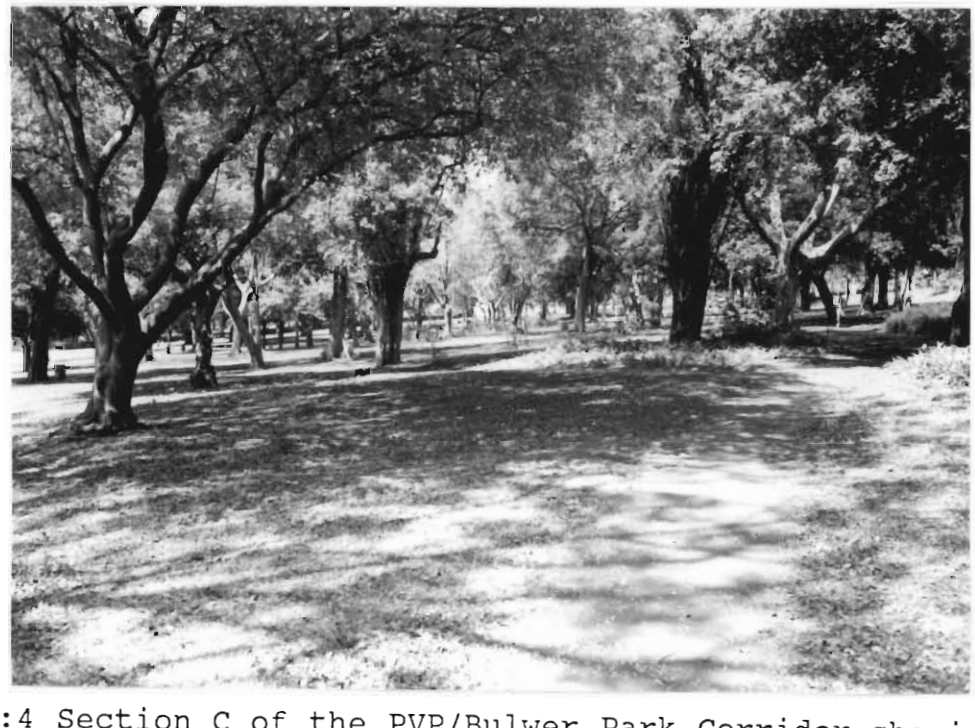


PLATE 5:4 Section C of the PVP/Bulwer Park Corridor-showing Bulwer Park with large specimen trees, mown lawns and the small area which has been underplanted.

FIGURE 5:1 1:6000 Cadastral map of a portion of the study area, showing sections A, B and C of the PVP/Bulwer Park Corridor and the PVP/Shepstone Nature Reserve Corridor.

KEY:

PVP/Bulwer Park Corridor		PVP/Shepstone Nature Reserve Corridor	
Section A		Section A	
Section B		Section B	
Section C		Section C	

5.2. Methods

5.2.1. Dispersal Corridors

Two potential dispersal corridors were identified for monitoring. Each was divided into three sections (A,B,C) with different characteristics.

Corridor 1) the Pigeon Valley/Bulwer Park Corridor (Fig. 5:1) runs from the Valley, down Rhodes Avenue into Manning Road and then along to Bulwer Park. The aim of this corridor is to allow the dispersal of wildlife further into the city, and to Bulwer Park in particular.

Section A) Rhodes Avenue is a relatively quiet suburban road with a very narrow traffic island of 2 m, on which stand large specimens of the exotic tree Jacaranda mimosifolia (Plate 5:1). Section B) Manning Road is far busier, as it is an arterial road along which many commuters travel daily. The traffic islands are ten metres wide with a row of stunted Flamboyant tree Delonix regia specimens down the centre. Both sets of islands have since 1990 been allowed 'naturalise', mowing confined to a narrow fringe and a walking path. Indigenous bulbs, perennials, shrubs and trees have been planted to speed and direct succession to an 'attractive climax'. Large houses, a créche and an old-age home line the road (Plate 5:2 and 5:3). Section C) Bulwer Park, at the end of the defined corridor, consists of many large mature trees, both indigenous and exotic, and grassed lawns. It has only recently been underplanted in one section with indigenous species. In parts the trees are growing close enough to create a continuous canopy (Plate 5:4).

Corridor 2) The Pigeon Valley/Shepstone Nature Reserve Corridor (Fig. 5:1) runs from King George V Avenue into Queen

PLATE 5:5 Section A of the PVP/Shepstone N. Reserve Corridor- showing the patch of coastal forest above PVP which has had the understorey and herbaceous layers removed.

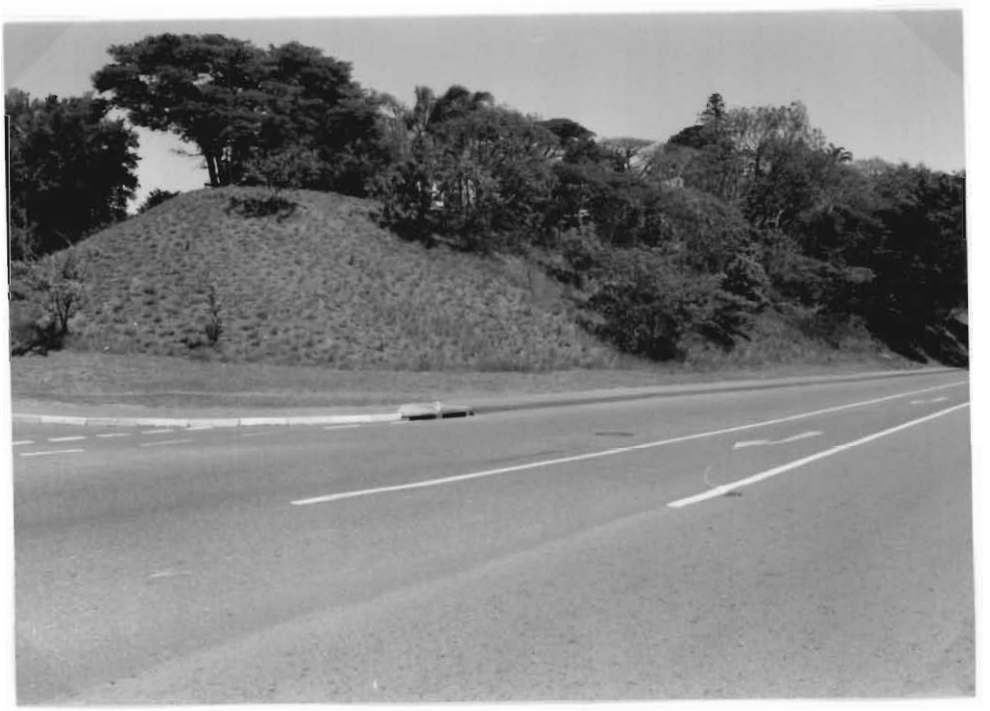


PLATE 5:6 Section B of the PVP/Shepstone N.Reserve Corridor- showing the bank of regenerating indigenous/exotic vegetation, shortly after a burn. The photograph is taken from PVP, and shows the gap between the Reserve and section B.

PLATE 5:7 Section B of the PVP/Shepstone N. Reserve Corridor- showing Mundy Park with its specimen trees, mown lawns and lack of undergrowth.

PLATE 5:8 Section C of the PVP/Shepstone N. Reserve Corridor- showing 75th Anniversary Ave. with its grassed banks, planted Fever trees and Strelitzia nicolai specimens.

Elizabeth Avenue and then into 75th Anniversary Avenue, after which it skirts the main student car park of the University and enters the Shepstone Nature Reserve. There are no traffic islands, but the road verges are potential dispersal corridors.

Section A) the corridor starts with an approximately 1-ha patch of forest, which has had the understorey removed (Plate 5:5). Section B) on the west side of King George V Avenue consists of a bank of regenerating indigenous/exotic vegetation, which provides fairly dense cover, Queen Elizabeth Avenue, which is flanked on the northwest by a formal park (Mundy Park) with big, mostly indigenous trees and a mown lawn and on the southeast by a patch of regenerating coastal forest, which has a poorly developed sub-canopy and herbaceous layer as a result of infrequent clearing (Plates 5:6 and 5:7). Section C) 75th Anniversary Avenue has been partially cleared of invasive alien plants and replanted with indigenous, but non-endemic species, such as Fever trees Acacia xanthophloea and Dune aloes Aloe thraskii (Plate 5:8).

In order to determine which bird species use the two corridors, each was slowly walked from the Valley outwards and back. The PVP/Bulwer Park Corridor was covered 17 times and the PVP/Shepstone Nature Reserve Corridor 21 times, each visit timed to take between 50 and 60 minutes. Walks were planned so as to avoid periods of high traffic activity. All species heard or seen were recorded on enlarged 1: 6000 cadastral maps, which showed the corridors and their three sections. Special emphasis was placed on noting species observed actually leaving or entering the Valley. Notes were also made of species seen crossing roads, which were perceived, at least anthropocentrically, as physical barriers to bird dispersal. Species seen flying over the area were recorded as such. The number of times a species was recorded as a fraction of the total number of visits (relative frequency), is then a rough index of the extent, ignoring variation in detectability, to which a particular species is able to use the

particular corridor. Whitcomb et al. (1981), who correct for detectablity, called this index of isolation 'bridge utilisation'.

Using the results of these walked surveys, as well as a detailed knowledge of the species in the area, it was possible to categorise each species' usage of the corridors according to Newbey and Newbey's (1987) classification, which is modified slightly below:

A - the major part of their range.
B - an important part of their range.
C - corridor; more reliably present in other localities, e.g. at PVP.
D - minor part of their range.

The list of species encountered in the two corridors, was then compared to the PVP's total list, in order to identify those species which appear to be largely confined to the Valley, with little immigration or emigration of individuals.

5.2.2. Gardens

Apart from using the two identified corridors, it is likely that some species make extensive use of gardens for dispersal, particularly where they are well vegetated. Indeed, the shortest path between PVP and Bulwer Park is via private gardens. An appeal was made in the Albatross, the Natal Bird Club's newsletter (Fig 5:2), for annotated, local garden lists. Response was very poor, with only one return. Three further lists were procured by direct appeals. These four lists were added to two of mine, one of which had been kept for ten years. The lists were then checked against the total PVP list to highlight those species which appear to be able to use gardens as permanent residents, those which use gardens as 'stepping stones' on their way to more suitable habitat and those which do not appear to use gardens at all.

FIG 5:2 Copy of the article which appeared in Albatross, appealing for garden birdlists.

APPEAL FOR GARDEN BIRDLISTS

If you live within the area bounded by Francois - Frere - Berea - Bidston - Cato Manor Roads, i.e. Glenwood/Manor Gardens, I need your help!

Lists of garden birds are needed for a university research project, which has as one of its objectives, the identification of a list of species susceptible to habitat alteration in a man-dominated landscape.

These lists should indicate:
1) Name and telephone no. (for acknowledgements) of the observer.
2) Address of the garden.
3) Approximate size of the garden.
4) Brief vegetation description, e.g. small shrubs with mown lawn.
5) List of species. In addition mark list with B - if breeds,
   R - if resident and spends a lot of time in the garden,
   V - fairly frequent visitor, S - sporadic with fewer than five records, the exact number may be given.
   O - overfly, where species are seen flying by but do not use the garden itself eg. swifts, herons.
6) Interesting notes.

Any contribution will be appreciated, and an atlas card may make the job easier. Please respond by sending lists to -
11 Mooredene, 25 Glengariff Place, Glenwood, 4001

RICHARD BOON

5.2.3. Shepstone Nature Reserve

This small nature reserve on the western campus of the University of Natal Durban supports populations of various forest species, and probably acts as an important stepping stone in the dispersal of birds to and from PVP. A short survey was conducted to determine exactly what species occur in this area.

The proclaimed land supports two main habitat types. The forest (approximately 5 ha) is fairly heavily infested with alien plants and much of the undergrowth has been cleared. Many of the indigenous trees are old and showing signs of damage (Plate 5:9). The grassland spur (approx. 1,5 ha) is in better condition as fairly frequent mowings and fires serve to halt alien infestations (Plate 5:10).

PLATE 5:9 View of the Shepstone Nature Reserve, to show the effects of the felling of alien trees, the damaged and dying ecotonal indigenous trees, as well as the poorly developed undergrowth.

PLATE 5:10 View of the grassland spur at the Shepstone N. Reserve. Cato Manor is in the background.

5.3. Results and Discussion

5.3.1. Dispersal Corridors

5.3.1.1. Pigeon Valley/Bulwer Park Corridor

Excluding species observed flying over the corridor (at heights such that they were merely incidental and therefore not utilising the area), 40 were recorded in all (Appendix 3, species status as per 5.2.1. is recorded alongside the species' name). Few of those observed were true forest species, while the ubiquitous forest-edge species and birds typical of more open habitats predominated (refer to Appendix 2, list 1 for forest versus forest-edge or non-forest species). It seems, thus, that the degree to which birds can or cannot utilise a particular corridor is species-specific. It is obvious that, with varying probabilities of detection, some bird species could have utilised the corridor undetected, and the conclusion that certain species are not able to make use of existing corridors cannot be hard and fast. It takes only two individuals of different sexes to found a new population, which means that a few individuals escaping discovery is significant. On the other hand, the hundreds of hours I (and other observers) spent in the field lead me to believe that the results presented here are meaningful.

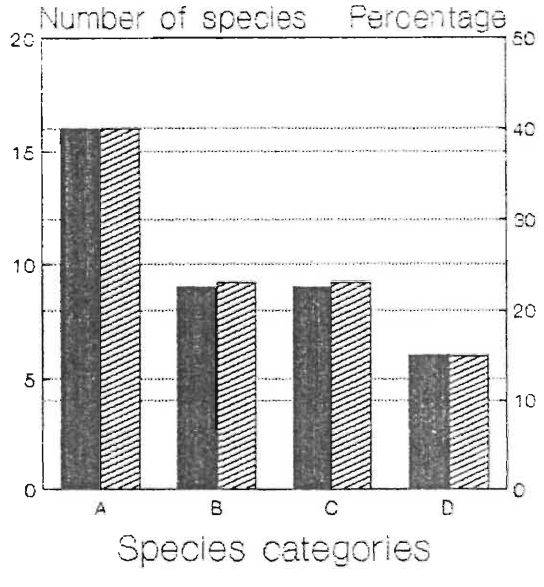
Oatley (1989) criticises the assumption in biogeographic debate that 'forest birds are reluctant to cross gaps between forests', stating that 'many forest birds.....are able to cross gaps between forests'. This is especially so for altitudinal migrants. While the current work does not disprove his statement, it does seem to disagree, as a number of species do not seem to use or are very rarely found using corridors or gardens in the study area. As examples, the winter visiting Barratt's Warbler and Chorister Robin were never found on the corridors, in gardens or away from cover at PVP, yet these two species are known to be altitudinal migrants (Cyrus and Robson, 1980; Maclean, 1985), and should thus be most able to cross gaps between patches of

favourable habitat. Bierregaard (1990) provides further compelling evidence for the effects of isolation in his before and after studies of central Amazonian isolates. Isolation by 70 m of non-forest habitat led to a virtual halt in movements between forest patches.

I suggest that on migration the behaviour of altitudinal migrant forest species (which must cross non-forested habitat) is very different to their behaviour on their breeding or wintering grounds, where they are largely confined to the forest. Perhaps the biannual drive to migrate overcomes the natural tendency of forest-interior birds to remain within the forest.

Figure 5:3 Summary of species statuses on the PVP/Bulwer Park Corridor, categorised as per 5.2.1.

Key: A - the major part of their range.
B - an important part of their range.
C - corridor species; more reliably present in other localities.
D - minor part of their range.



Total species = 40

Species classified as A (see 5.2.1., Appendix 3 and Fig.5.3.), e.g. Speckled Mousebird Colius striatus and Bronze Mannikin Spermestes cucullatus, are more common outside PVP than within. Such species are in no danger of local extinction, as suburbia adequately supplies their resources.

An exception in this category would be the Brownhooded Kingfisher Halcyon albiventris, which is more common outside PVP than within, but is only sparsely distributed throughout the study area.

Categories B,D and C, in that order, contain species which tend to rely on PVP for their conservation to an increasing degree. Paradise Flycatchers Terpsiphone viridis and Kurrichane Thrush, both categorised as B, while centred in the Valley are also fairly common outside, with the suburbia supporting a number of individuals, this effectively increasing the local population size. Species, e.g. Barthroated Apalis Apalis thoracica and Grey Sunbird, placed in D are only sparsely encountered outside of the Reserve, and therefore the corridor is probably functioning for them (in the sense that they can use it for dispersal) without increasing the local population substantially. C Species, such as Sombre Bulbuls Andropadus importunus and Collared Sunbird Anthreptes collaris, are in the study area primarily birds of PVP, and are only occasionally encountered on the corridor, and then very much as birds of passage. The corridor is in these cases serving to allow genetic interchange, and provides the possibility of recolonisation after local extinction. Forest species which do disperse along the corridor, but were not observed doing so would also be classified in the D category. Local population sizes are not much affected by these passage birds. Some species labelled C were more reliably found in habitats other than forest, e.g. Red Bishop Euplectes orix-in wetlands.

This corridor falls far short of the minimum corridor width of 152 m, empirically derived by Roberts (1990) for her community 5; Protorhus longifolia (sapling)-Psychotria capensis Short Thicket. PVP is an example of this vegetation community type, and Bulwer Park would also have been so. Most gardens along the route are 'well kept' with a minimum of vegetation cover, and as such do not contribute to the effective corridor width.

The corridor itself centres on the traffic islands on Manning Road, which were planted up by the Durban Parks Department and pupils of Durban Girls' High in 1990. Indian Mynas Acridotheres tristis used to be the commonest species on the short grassed islands, but are less common nowadays. They have been replaced to some extent by species such as, Spectacled Ploceus ocularis and Spottedbacked Weavers and Yelloweyed Canaries Serinus mozambicus.

The choice of Acacia species and Albizia adianthifolia as the tree species which were introduced, means that the island will on maturity have a savannah nature with a non-continuous canopy. I predict that the ultimate physiognomy of these islands will be better suited to attracting bird species of open woodlands than forest birds. The corridor would therefore not be effectively fulfilling its aim of providing a dispersal route between PVP and Bulwer Park.

Bulwer Park, with its large indigenous trees periodically supports some of the bird species found in the forest at Pigeon Valley, e.g. Puffback Dryoscopus cubla, Grey Sunbird and African Goshawk. These tend to be arboreal species, while most of the ground-foraging guild of forest-birds is noticeably lacking.

A number of species with their local core populations at PVP have not been recorded in the corridor or at Bulwer Park (Table 5:1). This list covers only those species found on a number of occasions at PVP, and does not include those which are only recorded rarely. For the listed species, PVP seems to be at the end of a peninsula of suitable habitat which runs from the distal less-developed parts of the city towards its centre. Should there be a local extinction of a particular species in the Valley, there is a good chance that recolonisation would not occur. This peninsula effect was discussed by Diamond (1975) as part of his reserve-design principles.

TABLE 5:1 Species which were recorded on a number of occasions at Pigeon Valley Park, but not on the Pigeon Valley/Bulwer Park Corridor, or elsewhere in the study area east of PVP.

Buffspotted Flufftail	Spotted Thrush
Tambourine Dove	European Marsh Warbler $
Green Coucal #	Yellowbreasted Apalis
Spotted Eagle Owl #	Bleating Warbler
Narina Trogon #	Bluegrey Flycatcher
White-eared Barbet #	Cape Batis
Redfronted Tinker Barbet	Chinspot Batis
G/rumped Tinker Barbet *	Southern Boubou
Sharpbilled Honeyguide #	Southern Tchagra
Black Cuckooshrike #	Blackbellied Starling
Squaretailed Drongo	Olive Sunbird
Terrestrial Bulbul	Forest Weaver

* Recorded once at 11 Mooredene (Table 5:3).
# Recorded on fewer than 10% of the 106 visits (see 4.2.), but not considered rare as they were observed on a number of additional ad hoc visits.
$ Summer visitor.

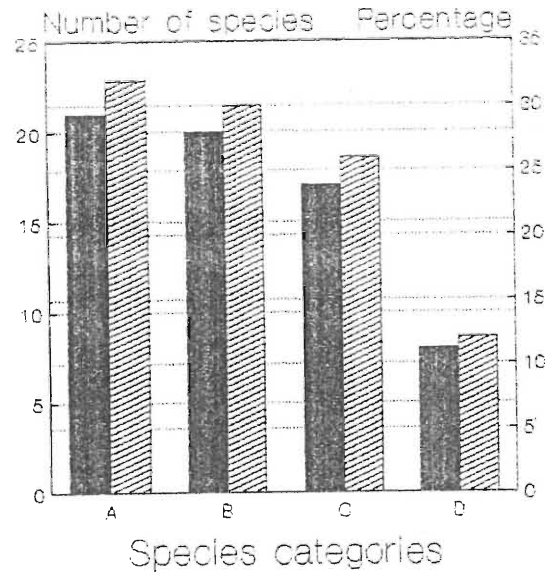
5.3.1.2. Pigeon Valley Park/Shepstone Nature Reserve Corridor

A total of 66 species has been recorded on this corridor (Appendix 4, the species status as per 5.2.1. is recorded alongside the species' name). This total excludes birds recorded at the Shepstone Nature Reserve. As with the Bulwer Park Corridor, many of the species recorded are those which are most able to tolerate disturbance to some degree, and are therefore

in least need of any protection. Two exceptions would be the Brownhooded Kingfisher and the Bluegrey Flycatcher Muscicapa caerulescens, which are more common outside of PVP than within, but are thinly dispersed throughout the study area.

Figure 5:4 Summary of species statuses on the Pigeon Valley Park/Shepstone Nature Reserve Corridor, categorised as per 5.2.1. above.

Key: A - the major part of their range.
B - an important part of their range.
C - corridor species; more reliably present in other localities.
D - minor part of their range.



Total species = 66

PLATE 5:11 48 Clair Ave., showing the dense undergrowth. PVP may be seen in the background.

PLATE 5:12 Garden at Glenridge Gardens, showing the well kept lawns and herbaceous border with scattered trees.

PLATE 5:13 The gardens at Barrington, showing much the same structure as Glenridge Gardens.

PLATE 5:14 The neighbourhood at the flat Mooredene, which has very little garden.

From Figure 5:4 (and Appendix 4), it can be seen that the aggregate percentage of B, C and D species has increased relative to the PVP/Bulwer Park Corridor. This is the group which relies, within the greater study area, to a greater or lesser extent on PVP (some C species are on passage to habitats other than forest). As expected, by comparing the results from the two corridors, it can be seen that the number of 'significant' species (true forest species) declines towards the city (i.e. on the PVP/Bulwer Park Corridor). A number of species was actually observed entering and leaving the Valley. For these, King George V and Princess Alice Avenues do not represent absolute barriers. As with the PVP/Bulwer Park Corridor, certain species recorded regularly at PVP were never observed anywhere on the corridor. These are listed in Table 5:2, and of these those which cause the most immediate concern are the Squaretailed Drongo and the Forest Weaver Ploceus bicolor. Both have very small sedentary populations, and with the exception of the Forest Weaver having been recorded on section A of the corridor on the opposite side of Princess Alice Avenue, neither appears to move from the Reserve at all. Both populations must therefore be vulnerable to local extinction, recruitment relying very much on internal productivity. Other species, such as the Cape Batis and Tambourine Dove Turtur tympanistria, are hardly any better off, being recorded only once each on the corridor. The Tambourine Dove seems to have a healthy population at PVP, while there are probably not more than six Cape Batises resident. The remainder of the species in Table 5:2 are less cause for concern, as they are nomadic, migrant or non-resident, this indicating their ability to find scattered refugia.

The same arguments of species escaping detection, presented with reference to the Pigeon Valley Park/Bulwer Park Corridor, apply here.

TABLE 5:2 Species recorded on a number of occasions at PVP, but not in the Pigeon Valley Park/Shepstone Reserve Corridor.

Buffspotted Flufftail	Squaretailed Drongo
Klaas's Cuckoo	Spotted Thrush
Green Coucal	European Marsh Warbler
Spotted Eagle Owl	Forest Weaver
Narina Trogon	

Merriam (1984, cited in Bridgewater, 1987) claims that it is the physiognomy of the vegetation rather than the species composition which determines the effectiveness of a dispersal corridor. While this may be so, I contend that structural features being equal, an indigenous corridor would be more favourable, and a safer conservation strategy than an exotic one. Firstly, obligate symbiotic relationships in the food web would be less likely to be catered for in the latter. In addition, bird species have co-evolved with the local flora, which if intact must therefore be at least adequate for the local bird community. The suitability of exotic vegetation across the spectrum of fauna, which the corridor should support, is untested. I have no doubt that the effectiveness of this corridor would be increased substantially by converting as much as possible to indigenous forest and by removing remaining aliens and exotics. Although I know of no direct reference which clearly shows that indigenous species are preferable to alien species, I think this may be inferred from the literature. Alien plant species are abundant 'generalists' which exploit areas of disturbance. They then provide edge habitat for generalist bird species, or those most able to tolerate disturbance (Whticomb et al., 1981). Lynch and Whigham (1984) state that these species 'are not of urgent concern to conservationists' and that they have a low

PLATE 5:15 223 Brand Rd., showing the front garden, which has been planted with indigenous species, and is subjected to a low-key maintenance regime.

PLATE 5:16 426 Frere Rd., showing the small garden and the front lawn, which is only mown infrequently.

conservation importance. These are the 'backyard' suburban garden birds which we are all so familiar with, e.g. Blackeyed Bulbul Pycnonotus barbatus.

The planting of 75th Anniversary Avenue has thus far not been very effective in assisting bird dispersal. It is an observation that the forest-dependent bird species, which were recorded, tended to keep to patches of uncleared indigenous vegetation. Mundy Park has the potential to be 'improved' as habitat for forest bird species by increasing the area planted to trees and allowing for patches of undergrowth.

5.4. Gardens

Fonaroff (1974, cited in Whitcomb et al., 1981) states that garden birds on Trinidad tend to be savannah as opposed to forest species. This pattern seems to be mirrored in the study area, most garden species tending to be those characteristic of more open areas. Forest species occur as transients or as residents only in the biggest gardens with suitable vegetation cover.

Although the garden lists are not directly comparable for many reasons, e.g. observer and study period differences, garden sizes and vegetation characteristics, some observations may be made:

A total of 78 species was recorded as directly utilising at least one of the six gardens (Table 5:3). A further 13 (mostly swifts and swallows) were recorded as resident in the area, but they were not found to be associated with the gardens per se.

TABLE 5:3 Species recorded from six gardens, in and around the study area.

1 = 223 Brand Rd., Glenwood. - R. Boon, (garden)
2 = 11 Mooredene, 25 Glengariff Place, Glenwood. - R. Boon, (garden)
3 = 426 Frere Rd., Glenwood. - J. Marais (garden)
4 = 48 Clair Ave., Glenwood. - J. Gourley (garden)
5 = 57 Barrington, 60 South Ridge Road. - E. Reynolds (flatgrounds)
6 = 1302 Glenridge Gardens, 61 South Ridge Rd. - R. Cowgill (flatgrounds)
* - denotes species utilising gardens.
o - denotes species seen flying over gardens.

GARDEN NUMBER (see key)	1	2	3	4	5	6
Hadeda Ibis	*		*	*		*
Yellowbilled Kite	o		o	o	o	o
Booted Eagle	o		o			
Little Sparrowhawk	*					
Black Sparrowhawk	*		o	*		
African Goshawk	o	o	o	*	*	*
Gymnogene				*		*
Lanner	o		o	o	o	*
Feral Pigeon	*	*	*			*
Redeyed Dove	*	*	*	*	*	*
Laughing Dove	*	*	*	*	*	*
Cinammon Dove				*		
Purplecrested Lourie	*	*		*	*	*
Klaas's Cuckoo	*			*		
Diederik Cuckoo	*		o	*	*	
Burchell's Coucal	*			*		
Barn Owl	*					
Spotted Eagle Owl				*		
Fierynecked Nightjar				o		
Black Swift	o		o			o
Whiterumped Swift	o	o	o	o	o	o
Little Swift	o		o		o	o
Alpine Swift			o			
Palm Swift	o		o	o	o	o
Speckled Mousebird	*	*	*	*	*	*
Pygmy Kingfisher	*			*		*
Mangrove Kingfisher	*			*		
Brownhooded Kingfisher	*			*	*	*
Hoopoe			*	*		*
Redbilled Hoopoe	*		*	*	*	*
Blackcollared Barbet	*	*	*	*	*	*
White-eared Barbet				*		
Redfronted Tinker Barbet				*		
Goldenrumped Tinker Barbet		*		*		
Greater Honeyguide				*		
Goldentailed Woodpecker	*	*	*	*	*	*
Cardinal Woodpecker	*		*	*	*	*
European Swallow	o		o			o
Lesser Striped Swallow	o		o	o		o
Rock Martin	o		o			o
Brownthroated Martin	o		o			
Black Cuckooshrike				*		
Forktailed Drongo	*		*	*	*	*
Blackheaded Oriole				*		*
Pied Crow	o	o	o	o	o	o
Southern Black Tit	*		*	*	*	*

GARDEN NUMBER (see key)	1	2	3	4	5	6
Blackeyed Bulbul	*	*	*	*	*	*
Terrestrial Bulbul				*		
Sombre Bulbul	*	*		*		*
Kurrichane Thrush				*	*	*
Familiar Chat		*				
Natal Robin	*			*	*	*
Willow Warbler	*					*
Barthroated Apalis				*		
Bleating Warbler				*		
Tawnyflanked Prinia	*			*	*	*
Dusky Flycatcher	*		*	*		*
Black Flycatcher				*	*	*
Cape Batis				*		
Chinspot Batis				*		
Paradise Flycatcher	*	*		*	*	*
Cape Wagtail	*	*		*		*
Fiscal Shrike	*		*	*	*	*
Southern Boubou				*		
Puffback				*	*	
Indian Myna	*	*	*	*	*	*
Wattled Starling	*					
Glossy Starling						*
Blackbellied Starling				*		
Redwinged Starling	o	o	o	o	*	*
Whitebellied Sunbird	*	*	*	*		*
Grey Sunbird	*			*		
Olive Sunbird				*		*
Black Sunbird	*		*	*		*
Collared Sunbird	*			*		
Cape White-eye	*	*	*	*	*	*
House Sparrow	*	*	*	*	*	*
Thickbilled Weaver	*		*	*		
Forest Weaver				*		
Spectacled Weaver	*	*	*	*		*
Spottedbacked Weaver	*		*			*
Cape Weaver	*		*			
Green Twinspot				*		
Bluebilled Firefinch	*					
Common Waxbill				*		
Grey Waxbill				*		
Bronze Mannikin	*	*	*	*	*	*
Pintailed Whydah	*			*		
Yelloweye Canary	*	*	*	*	*	*
Bully Canary	*	*	*	*		*
Streakyheaded Canary	*		*	*	*	*

The garden in Clair Avenue is no more than 100 m from PVP, and is densely vegetated, albeit with exotic plant species. This garden was the only one in which forest species such as, Grey Waxbill Estrilda perreini, Forest Weaver and Green Twinspot Mandingoa nitidula were observed. These species were not recorded on either of the two corridors. This then, demonstrates the important role which suitably vegetated gardens may play in the dispersal of forest bird species in the study area.

The gardens in Frere Road and Glengariff Place were least vegetated and most distant from forested natural areas. This is reflected in their species lists which lack significant forest 'specialists', and are dominated by 'generalist' species.

The garden in Brand Road has been well studied for ten years, during which time it has been transformed from a typical, sparsely vegetated suburban garden into a densely vegetated indigenous 'bushclump'. Species requiring significant shelter, e.g. Grey Sunbird and Collared Sunbird, have been recorded more commonly with increasing 'succession'.

Roberts (1990) points out that 'private gardens constitute the largest category of available open space within the city'. This, coupled with the above observations, and the fact that the vast majority of gardens in the study area consist of lawns, a few exotic shrubs and scattered trees, suggests that there is great potential for increasing current dispersal rates through gardens.

5.5. Shepstone Nature Reserve

Fifty-six species were recorded at the reserve during six visits (between June and October 1992), while seven additional species were recorded as incidentals, which flew over, but did not directly use the reserve (Table 5:4). The visits were

TABLE 5:4 Species recorded on six visits to the Shepstone Nature Reserve between June and October 1992.

* - within the Reserve proper.
o - species recorded flying over the reserve,
or species recorded outside, but from the reserve.

VISIT NUMBER	1	2	3	4	5	6
Blackheaded Heron			*			
Hadeda Ibis	o	*	*	*	o	o
African Goshawk			*			
Natal Francolin				*		
Redeyed Dove	*	*	*	*	*	*
Laughing Dove					*	
Tambourine Dove				*		
Spotted Eagle Owl		*				
Whiterumped Swift						o
Palm Swift	o			o		
Speckled Mousebird	*		*		*	*
Brownhooded Kingfisher			*			
Little Bee-eater		*	*	*	*	*
Blackcollared Barbet	*	*	*		*	
Goldenrumped Tinker Barbet		*			*	
Lesser Honeyguide	*					
Goldentailed Woodpecker	*		*			
Cardinal Woodpecker			*		*	
Lesser Striped Swallow			o	o	o	o
Black Cuckooshrike	*					
Forktailed Drongo	*	*	*	*	*	*
Squaretailed Drongo					*	
Blackheaded Oriole	*					
Pied Crow	o		o			
Southern Black Tit	*	*	*	*	*	
Blackeyed Bulbul	*	*	*	*	*	*
Terrestrial Bulbul	*	*	*	*		
Sombre Bulbul	*	*	*	*		*
Yellowbellied Bulbul	*	*	*	*		
Kurrichane Thrush	*	*	*	*	*	*
Spotted Thrush	*	*				
Natal Robin	*	*	*	*	*	*
Starred Robin			*			
Whitebrowed Robin			*	*		*
Barthroated Apalis	*	*	*	*		*
Bleating Warbler	*	*	*	*	*	*
Tawnyflanked Prinia	*	*	*	*	*	*
Dusky Flycatcher	*	*	*	*		
Black Flycatcher	*	*	*		*	*
Fiscal Flycatcher		*	*			
Chinspot Batis	*		*	*	*	
Bluemantled Flycatcher		*				
Paradise Flycatcher	*		*	*	*	*
Cape Wagtail	*					
Southern Boubou	*	*	*	*	*	o
Puffback			*			
Southern Tchagra			*			
Blackbellied Starling	o	o	o			o
Redwinged Starling	o		o	o		o
Whitebellied Sunbird	*	*	*	*	*	*
Grey Sunbird	*	*	*	*	*	
Olive Sunbird			*	*	*	*
Black Sunbird	*	*	*	*	*	*
Collared Sunbird	*				*	
Cape White-eye	*	*	*	*	*	*
Thickbilled Weaver	o	o	o		o	o
Forest Weaver			*		*	
Spectacled Weaver	*	*	*	*	*	*
Spottedbacked Weaver			*		*	
Yellow Weaver	*					
Bronze Mannikin	*	*	*	*	*	*
Yelloweyed Canary	*	*	*	*	*	*
Bully Canary	*	*	*	*	*	*
Streakyheaded Canary	*					

standardised to last approximately one hour each. Three forest species which were recorded, Starred Robin Pogonocichla stellata, Bluemantled Flycatcher Trochocercus cyanomelas and Yellowbellied Bulbul Chlorocichla flaviventris, were of particular interest. The robin has never been recorded at PVP, the flycatcher only once and the bulbul only rarely. The last two possibly find the 75th Anniversary Avenue Corridor, or in particular its constriction at the University parking lot, something of a barrier to dispersal to PVP. As Starred Robins are altitudinal migrants (Maclean, 1985), it is difficult to imagine that they find the Corridor an insurmountable obstacle. Perhaps on their coastwards migration, if they choose their route carefully, they do not encounter much in the way of a barrier until this point. The alternative hypothesis is that PVP does not provide the resources required by these species, which is why they are not found there. Squaretailed Drongos and Forest Weavers, which are probably vulnerable at PVP, occur at the Shepstone Nature Reserve, but only in small numbers.

It is clear that it is important that potential immigrants are able to find a suitable route to PVP, in order to 'rescue besieged populations', but it is doubtful if the present corridor fulfils this role.

The usefulness of this conservation area could be enhanced many times with good management. Alien plants need to be eradicated in a planned, efficient manner. The forest needs protection and nurturing in order to increase its size as far as possible. A planting programme would help to increase the rate of succession under a protected regime. The grassland needs to be managed in order to increase its productivity. Central, focal parts of the reserve should be ruled out of bounds to dogs, to reduce disturbance. People walking their pets could still be accommodated with some sensitive planning. The large tarred surface of the Shepstone car park is something of an environmental disaster area, and as such its possible effect as a barrier to bird dispersal could be lessened by the planting of a number of indigenous specimen trees.

CHAPTER SIX

FOREST BIRD SPECIES SENSITIVE TO FRAGMENTATION

6.1. Introduction

In accordance with the Theory of Island Biogeography (MacArthur and Wilson; 1963, 1967), it can be predicted that with the reduction of the once continuous forests of the Berea Ridge to small pockets of natural vegetation, such as Pigeon Valley Park, local extinctions are likely to have occurred.

Such extinctions are the result of loss of microhabitats, new areas being too small to support minimum viable populations or even single territories, increased brood parasitism, increased predation from edge species and reduced immigration rates (Wilcove and Robinson, 1990).

According to the Theory, reduced areas would have for a time been supersaturated with bird species, and those species less tolerant, for whatever reason, to fragmentation would have become locally extinct through 'relaxation' to a new equilibrium. Lovejoy and Oren (1981) suggest that such a loss of species should be monitored to determine if it is random or predictable, in that extinction results in a similar set of species for similar sized ecosystem fragments. If the latter is the case, the identification of this group of species would help in defining a set of coastal forest birds, which could be used as an indicator of environmental health. Warning bells should ring and investigations follow if any are missing, as breeding species, from substantial tracts of forest. Further development of forested natural areas would have to be sensitive to the conservation of these species.

The question of whether a single large or several small reserves of equal aggregate area (represented by the acronym- SLOSS) best serve the aim of preserving a diverse and sustainable example of the fauna and flora of a given region, has been hotly debated. Diamond (1975) and Whitcomb et al. (1981) amongst others argue strongly for large reserves, while Simberloff and Abele (1981) propose the opposite. The current study has some bearing on the SLOSS contŕoversy.

6.2. Methods

Lists (see Appendix 2), differentiating between forest (F) and margin (M) species, suggesting what may have occurred historically on Durban's Berea Ridge circa 1850, i.e. while the forests were still intact, were solicited from the following local birding authorities:

G.R. Nichols - curator at PVP between 1981 and 1984.
Dr P.A. Clancey - ornithologist at the Durban Natural History Museum from 1952 to present.
Dr A. Berruti - ornithologist at the Durban Natural History Museum from 1988 to present.
K. Cooper - Conservation Director of the Wildlife Society of S.A.. Local natural historian for 30 years.
R. Cowgill - local birder for many years.

A further two lists were added, this giving a total of seven. These were that of mine and an extraction of the forest species from Lawson's Checklist of the Birds of Durban (1966), which he commenced circa 1956.

These seven lists were then compared with the current species checklist (see Appendix 2, List 1) for PVP in an attempt to identify birds susceptible to forest fragmentation and disturbance. Those identified would then be defined as an 'indicator group' and would be useful in both the planning and management of coastal forest reserves.

Species were selected for 'indicator status' if at least four of the seven lists which were used for comparison suggested that the species should be present. Furthermore, the species should be considered a forest or forest-edge species and it should no longer occur or be present only in small numbers on the study area, or at PVP. If the species is classified as a Red Data species (Brooke, 1984) and was expected to have previously occurred locally, it was automatically included. The final group of 'indicator species' therefore includes those species which have small breeding populations at PVP, species not expected to breed (non-breeding migrants) and those which may be expected to breed but no longer do so. This last class represents those species which are effectively extinct at PVP.

Using the technique described above, means that the selection process is somewhat subjective, and there were therefore species for which I had to use my own judgement. I believe that ten years of intensive experience at PVP and other coastal forests in Durban makes this judgement reasonable. There was a further group of species, which were possible candidates for inclusion in the indicator group, but these were omitted because I was not fully convinced that they would have occurred historically, as breeding species, historically, on the Berea Ridge. These were called 'imponderables'.

Bierregaard (1990) warns that without accurate, historical, avifaunal survey data it is wrong to claim for any given habitat island that a species has gone extinct at a local level. Therefore, it is impossible to say that all or any of the identified indicator species bred historically at PVP (or the sample of the forest on the Berea Ridge which was to become PVP). However, at the coarser scale of the entire forest tract, which ran from the Umbilo River to the Umgeni River, I am confident that most of these species were present as breeding species or seasonal visitors.

Some compelling evidence of species and subspecies loss from historical ranges in Durban, is to be found in the SAOS Checklist of Southern African Birds (Clancey ed.; 1980, 1987), which gives the locality at which type specimens were originally collected. Table 6:3 lists all forest bird species and subspecies first described from Durban and its environs, the type locality, date of description and current status of the species/subspecies.

6.3. Results and discussion

6.3.1. Indicator species

A total of 55 species (see Appendix 2; those species which have status descriptions alongside the species name, and the summary presented as Table 6:1), including 'imponderables' (species less likely to have occurred historically on Durban's Berea), are proposed as a first attempt at defining a set of indicator species. I propose that this group may be used to measure how complete a particular coastal forest avifauna is at the latitude of Durban. The list also has predictive value north and south of the metropolitan boundaries, but with diminishing significance with increasing distance. As there certainly is subjectivity in compiling such a list, there may be questions over the inclusion of ten of the species. For example, although the Cape Parrot Poicephalus robustus, Black Cuckoo Cuculus clamosus, Emerald Cuckoo Chrysococcyx cupreus and Olive Woodpecker Mesopicos griseocephalus could be included using the criteria mentioned above (see 6.2.), I believe that all four are more likely to be found in forests situated 20 km or more inland at this latitude. For the remaining 45 species inclusion seems non-controversial. The definition of this group is important as 'the challenge for conservationists is to predict the nature of the changes in community composition and structure and the likely processes of extinction as a consequence of decreases in habitat size and fragmentation' (Blondel, 1991).

TABLE 6:1 Proposed set of 'indicator species' for measuring the 'completeness' of isolated coastal forest bird communities.

Key: # - 'imponderables', or species whose inclusion may be doubtful.
NR - species not recorded at PVP in the past five years.
Br - breeding species at PVP.
NBr - nonbreeding species at PVP (not expected to breed).
E - 'extinct' as a breeding species at PVP.

Cuckoo Hawk Aviceda cuculoides NR E
Bat Hawk Macheiramphus alcinus #
Longcrested Eagle Lophaetus occipitalis NR E
Crowned Eagle Stephanoaetus coronatus E
Southern Banded Snake Eagle Circaetus fasciolatus NR E
Little Sparrowhawk Accipiter minullus E
Little Banded Goshawk Accipiter badius #
Gabar Goshawk Micronisus gabar #
Gymnogene Polyboroides typus E
Natal Francolin Francolinus natalensis E
Buffspotted Flufftail Sarothrura elegans Br
Rameron Pigeon Columba arquatrix NBr
Delegorgue's Pigeon Columba delegorguei NR E
Tambourine Dove Turtur tympanistria Br
Cinammon Dove Aplopelia larvata NR E
Green Pigeon Treron calva NR E
Cape Parrot Poicephalus robustus #
Black Cuckoo Cuculus clamosus #
Emerald Cuckoo Chrysococcyx cupreus #
Klaas's Cuckoo Chrysococcyx klaas Br
Green Coucal Ceuthmochares aereus E
Wood Owl Strix woodfordii NR E
Narina Trogon Apaloderma narina E
Pygmy Kingfisher Ispidina picta E
Mangrove Kingfisher Halcyon senegaloides NBr
Trumpeter Hornbill Bycanistes bucinator NR E
Crowned Hornbill Tockus alboterminatus NR E
Greater Honeyguide Indicator indicator E
Scalythroated Honeyguide Indicator variegatus E
Lesser Honeyguide Indicator minor E
Sharpbilled Honeyguide Prodotiscus regulus Br
Olive Woodpecker Mesopicos griseocephalus #
African Broadbill Smithornis capensis NR E
Black Sawwing Swallow Psalidoprocne holomelas E
Black Cuckooshrike Campephaga flava E
Grey Cuckooshrike Coracina caesia E
Squaretailed Drongo Dicrurus ludwigii Br
Yellowbellied Bulbul Chlorocichla flaviventris E
Olive Thrush Turdus olivaceus NR E
Spotted Thrush Zoothera guttata NBr
Brown Robin Erythropygia signata NR E
European Marsh Warbler Acrocephalus palustris NBr
Yellowthroated Warbler Seicercus ruficapillus E
Bluegrey Flycatcher Muscicapa caerulescens Br
Cape Batis Batis capensis Br
Bluemantled Flycatcher Trochocercus cyanomelas NR E
Southern Tchagra Tchagra tchagra Br
Gorgeous Bush Shrike Telophorus quadricolor E
Greyheaded Bush Shrike Malaconotus blanchoti NR E
Blackbellied Starling Lamprotornis corruscus E
Forest Weaver Ploceus bicolor Br
Green Twinspot Mandingoa nitidula E
Grey Waxbill Estrilda perreini E
Swee Waxbill Estrilda melanotis #
Pied Mannikin Spermestes fringilloides #

The fact that a group of forest-bird species can be identified as susceptible to fragmentation, lends strong support to the 'single large' camp in the SLOSS debate, when habitat heterogeneity is kept constant. Further backing comes from the lists presented by Boon (1985), which show that Durban's smaller forest reserves tend to lack the same bird species. This is compounded by increasing isolation from potential sources of colonists, as on a gradient from the less developed metropolitan boundary to the city centre. It is therefore not simply numbers which are important when planning reserve systems, but rather the composition of the community. Whitcomb et al. (1981) state that in the eastern Deciduous Forest of the United States parulids occur at high densities in large tracts and almost never in small fragments. They further suggest that the maintenance of the regional species pool would require forest reserves of the order of hundreds or thousands of hectares. It is these susceptible species which need to be weighted for in conservation terms in order to put a strong case for some large reserves in any regional system. As an illustration, in my experience, African Broadbills Smithornis capensis, Crowned Eagles, Cuckoo Hawks Aviceda cuculoides and Green Coucals Ceuthmochares aereus only occur in large forested tracts with a low disturbance regime, and then only at low densities.

Of the 45 species labelled as 'definites', 14 have not been recorded (NR) at PVP in the last five years (Appendix 2 and Table 6:1). Of the remaining 31, only nine have been proven breeding (Br), in the same period, while four would not be expected to breed (NBr), as they are seasonal, nonbreeding visitors to the study area. This means that as many as 32 forest bird species (45 - 9 - 4 = 32) are extinct (E) as breeding residents at PVP and on Durban's Berea (the assumption that they all occurred and bred is made here). Nineteen of these 32 species have been recorded as visitors or vagrants at PVP in the past five years.

6.3.2. 'Keystone' species

As species form part of food webs, each extinction can also be expected to have a ripple effect which would further disrupt the natural functioning of the ecosystem. As an example, there are probably no more than between four and eight Squaretailed Drongos at PVP, and this population appears to be somewhat isolated (see 5.3.1.2.). The drongo is an example of a 'sentinel' in mixed species feeding flocks, catching insects flushed by 'beaters' (Robinson et al., 1990). As a 'sentinel' the drongo warns of impending danger and may thus act to reduce predation pressures on species which join the flocks. Local extinction of this bird could add pressure to already beleaguered populations of indicator and vulnerable species, such as the Cape Batis and Forest Weaver, which join feeding flocks. Other examples would be the Nectariniidae and their relationship with the mistletoes as pollinators, and various frugivorous birds and their role in the dispersal of the resulting fruit. Identification and protection of such 'keystone' species is vital as they have ecological significance to the functioning of the ecosystem (Saunders et al., 1987).

6.3.3. Red Data species

Of the 55 species which are identified as likely to be vulnerable to habitat alteration, nine are Red Data species (see Appendix 2 and Table 6:2). Of these, three are 'imponderables' (see 6.3.1.) and six are likely to have been present historically in Durban's coastal forests. The six species are therefore included in the indicator group. Red Data species are species which adequate conservation of natural habitats should aim to address.

Table 6:2 Red Data species included in the proposed set of 55 indicator species (status as per Brooke, 1984).

Note: # - indicates 'imponderables'.

SPECIES	RED DATA STATUS
Cuckoo Hawk	Indeterminate
Bat Hawk #	Rare
Southern Banded S. Eagle	Rare
Delegorgue's Pigeon	Indeterminate
Cape Parrot #	Vulnerable
Mangrove Kingfisher	Indeterminate
African Broadbill	Vulnerable
Spotted Thrush	Vulnerable
Pied Mannikin #	Indeterminate

6.3.4. SLOSS debate

Diamond (1975) points out that a reduction in area, as would have occurred when PVP was isolated, would lead to immediate extinctions due to the loss of habitat, e.g. the exclusion of a forested stream frequented by Longtailed Wagtails Motacilla clara, and to the new area being smaller than the territory size of one pair, as in thinly dispersed species such as raptors. Later extinctions would follow because some resulting species' populations would be smaller than specific minimum viable population thresholds. This would lead to extinctions through stochastic fluctuations in reproductive output, natural catastrophic events, edge intolerance, inbreeding depression, loss of heterozygosity through genetic drift, etc. (Shaffer, 1987; Whitcomb et al., 1981). A loss in habitat heterogeneity caused by a disruption of the disturbance regime may also lead to the disappearance of those species adapted to using such patches in an otherwise uniform ecosystem (Blondel, 1991).

There is no doubt that larger islands or isolates support more breeding species than smaller reserves, as expressed mathematically by the species-area relationship (MacArthur and

Wilson; 1963, 1967). This is as a result of an area effect per se, as well as an increase in habitat diversity which is positively correlated with increasing area. With an increase in area, refugia become big enough to support the large territories of thinly dispersed species (e.g. raptors), while at the same time increasing the area may allow a population to establish itself in sufficient numbers so as to constitute a minimum viable population. Area increase usually has the effect of increasing habitat diversity, so that species with specific requirements or patchy distributions may also be included. This then raises the question of whether the judicious choice of small reserves with total area equal to one large reserve, so as to maximise habitat diversity, would best serve the aim of maximising bird species diversity and richness. The answers to this question are not clear-cut and are probably taxon-specific.

Simberloff and Abele (1982) propose that even if two reserves are randomly selected they will be likely to support more species than one large one, because they have a greater habitat diversity. In an extreme case, for example, if the large reserve comprises uniform coastal forest and the two small reserves support a forest and a wetland, it is certainly likely that the addition of the two species lists would produce a species total greater than that of the large reserve. Simberloff (1982) says that there are no examples to be found in the literature where one large site is better. However, where the two smaller reserves are selected to represent the same habitat type as the large reserve, the results may be quite different. Although the smaller reserves with more 'edge' may support more species, these are 'generalists' and not as significant to bird conservation as forest-interior 'specialists' (Lynch and Whigham, 1984). Such species would be likely to thrive with or without reserves, e.g. Blackeyed Bulbul and Spectacled Weaver. Other species such as Crowned Eagle, Wood Owl Strix woodfordii, Green Coucal and African Broadbill do not occur as breeding species on small reserves in Durban. For example, the Crowned Eagle only breeds locally in the Hawaan Forest and at the Krantzkloof Nature

Reserve (>500 ha), both substantial tracts of forest. Autecological studies need to be conducted on some of the identified indicator species to determine at what size a reserve or habitat type becomes large enough to support populations of these species. Reserves for thinly dispersed species would have to be massive to protect populations of even 50 individuals. This number is quoted as being sufficient to retard the effects of inbreeding depression on populations of domestic animals (Frankel and Soulé, 1981 cited in Shaffer, 1987), and is obviously an inadequate hedge against extinction.

Population considerations are important and often neglected in the literature. McCoy (1983) describes a technique for determining the minimum area of tracts which would conserve a pool of species. He however neglected to consider populations and arrived at relatively small sizes, which may in reality harbour but one pair of a given species. In an experiment which aimed to show that the splitting of single mangrove keys into two, results in an increase in overall species richness, Simberloff and Abele (1982) attributed the failure of the experiment with their smallest key, to populations on the two isolates falling below a minimum critical threshold. Simberloff (1982) also states that 'if diversity is the goal, a network of small reserves might be a better conservation strategy than one large one, at least as long as the small ones are large enough to support a minimum viable population for most target species'.

Small reserves and minimum viable populations of 'indicator' species are often a contradiction in terms. Most of the proposed indicator species, raptors or otherwise, would require large areas.

On the other hand, where a system of smaller reserves with an equal area to one large one, act as one big metareserve (i.e. dispersal is possible for even the most sedentary species), results may be quite different. Species, in such a context, would be able to move freely between refugia, thus reversing local

extinctions of small populations as described by the 'rescue effect' of Brown and Kodric-Brown (1977). However, results presented here (Chapter 5) makes me doubt whether metareserves in an urban context are a reality for any but those species most able to disperse over areas of 'unfriendly' habitat. Simberloff (1982) concedes that a 'several small' strategy would rely on individuals moving between areas to reduce inbreeding effects and to maintain levels of heterozygosity. It is likely that many of the sedentary 'indicator species' identified above would have difficulty surviving in such a system of reserves. If all the reserves in a system are too small to support viable populations of 'indicator species', the 'rescue effect' would not operate, as there would be no source areas to drive the recolonisation process. A fair conclusion from the above is; where small reserves are not a choice but rather dictated by various constraints the effectiveness of dispersal corridors need to be maximised.

A compelling argument for several small reserves is that all populations of a particular species are unlikely to be simultaneously subjected to the same natural catastrophe, e.g. introduced predators, diseases or fires (Simberloff and Abele, 1982). They relate the stories of feral cats on the Seychelles archipelago, and that of the extinction of the Heath Hen Tympanuchus cupido which was eventually restricted to a single locality, as supporting evidence. However, in the case of the Seychelle Islands only absolute isolation from the cats has allowed most of the endemic species to survive. This case history therefore does not carry too much support for their suggested strategy of systems of small reserves, which they admit relies on inter-reserve dispersal. In addition, Gilpin (1987) points out that populations that become locally extinct and then recolonise, go through a genetic bottleneck which will intensify inbreeding effects through what is known as the 'founder effect'. He also suggests that maintaining more than one population may promote the preservation of genetic variance as random fixation and selective pressures are likely to differ for the different

populations. Soulé (1987b), in summarising minimum viable population analyses, suggests that a few thousand individuals (obviously variable by taxon and situation) will be necessary to ensure a 95% probability of persistence of a population for a few centuries. In the case of raptors and other large species, minimum critical areas would then be prohibitive and unattainable in urban situations. In such a context he contends that the viable population literature indicates that the best strategy would be a system of reserves with 'uncorrelated environments, so that major environmental perturbations do not occur simultaneously, or with the same severity at each site'. Shaffer (1987) states that an attempt to increase the expected probability of persistence of a population would be better served by adding a second equal population than by doubling the original population, even in the absence of migration. This makes some sense, but refugia need to be at least large enough to support a sustainable population of those species with the greatest area requirements.

Summarising the above discussion, it seems that both strategies have their strengths, but it would be best where feasible to establish a system of large reserves with effective dispersal corridors connecting them. Intensive management may be necessary to prevent the spread of fires, diseases, etc. along the corridor. To ensure the protection of areas or species in the face of possible spread of a catastrophe it might be necessary, where possible, to sever the corridor temporarily.

6.3.5. Sub-regional extinctions

Loyn (1987) contends that even with a 70% reduction in the forested extent of the Latrobe Valley in southeastern Victoria, no forest species have been lost. Lynch (1987) asserts that within the eastern Deciduous Forest region of the United States only two species have definitely gone extinct and a further two have probably been extirpated. This contrasts with the Durban metropolitan region (admittedly a smaller scale) where at least

four species seem to have become locally extinct, as breeding residents - Cuckoo Hawk, Green Pigeon Treron calva, Delegorgue's Pigeon Columba delegorguei and African Broadbill. Table 6:3 lists 24 species and subspecies which were originally described from specimens collected in the forests of Durban. It is alarming to note how many have lost this part of their former range and the rarity of many of the remainder. Although spatial scale is important when looking at extinctions, the fact that there have been losses, in this area, means that as other areas are more affected by insularisation these extinctions may ultimately become real at regional, southern African and global scales.

Table 6:3 The current status of forest and forest-edge bird species and subspecies which were first described from specimens collected in the greater Durban area.

Note: Subspecies are included to demonstrate unequivocally that a species once occurred in the area. Statuses are subjective, and given for the area bounded by the Kloof escarpment, the Umhlanga River, the Amanzimtoti River and the Indian Ocean. Taxonomy, type localities and dates are as per the SAOS Checklist of Southern African Birds (Clancey ed.; 1980, 1987).

Cuckoo Hawk-Aviceda cuculoides verreauxii (Durban, 1846). Most likely extinct in Durban. Does not breed.

Bat Hawk-Macheiramphus alcinus andersonii Not described from Durban, but mentioned as occurring there. Occurrence in Durban is extremely rare, and does not breed.

Southern Banded Snake Eagle-Circaetus fasciolatus (Durban, 1850). Occurrence in Durban is extremely rare, and does not breed.

Natal Francolin-Francolinus natalensis (vicinity of Port Natal = Durban, 1834). Still fairly common where there is suitable habitat.

Buffspotted Flufftail-Sarothrura elegans ('in the direction of Port Natal' = Durban, 1839). Still fairly common where there is suitable habitat.

Delegorgue's Pigeon-Columba delegorguei (Port Natal, i.e., Durban, 1847). Locally extinct.

Green Pigeon-Treron calva delalandii (South Africa = Durban, 1854). Very rare visitor to Durban, probably does not breed.

Green Coucal-Ceuthmochares aereus (Natal, 1873; restricted to Durban, Natal Coast, by Clancey). Uncommon, but still found in suitable larger forest tracts.

Mangrove Kingfisher-Halcyon senegaloides ('Country about Port Natal' = Durban, 1834). Rare winter visitor to mangrove habitats. May have formerly bred on wooded streams.

Goldentailed Woodpecker-Campethera abingoni constricta (Gillits, near Kloof, 1965). Common in Durban.

Black Sawwing Swallow-Psalidoprocne holomelas ('Port Natal', i.e. Durban, 1850). Fairly common on the outskirts of the city, but uncommon on the Berea.

Squaretailed Drongo-Dicrurus ludwigii ('Port Natal', i.e., Durban, 1834). Common, but thinly dstributed in forested areas.

Yellowbellied Bulbul-Chlorocichla flaviventris ('near Port Natal', i.e. Durban, 1834). Uncommon on the Berea, but fairly common in larger nature reserves such as Stainbank.

Spotted Thrush-Zoothera guttata (Algoa Bay, eastern Cape = Durban, Natal, apud Smith, 1836). Sparsely distributed winter visitor to forests. May have formerly bred.

Brown Robin-Erythropygia signata (Umhlanga Rocks, near Durban, 1850). Nowadays, only found to the north and south of the city at Umhlanga and Amanzimtoti. May have previously occurred more widely.

Yellowthroated Warbler-Seicercus ruficapillus (Durban, 1850). Nowadays a rare winter visitor to the coast. Previous status uncertain.

Dusky Flycatcher-Muscicapa adusta fuscula (Durban, 1850). Mainly a common winter visitor to the Berea. Breeds at slightly higher altitudes, as at Westville, Durban.

Bluegrey Flycatcher-Muscicapa caerulescens (Durban, 1865). Fairly common in Durban, but sparse on the Berea.

Southern Tchagra-Tchagra tchagra natalensis (Umgeni R., Durban, 1903). Sparse throughout Durban. An endemic species.

Gorgeous Bush Srike-Telophorus quadricolor (Port Natal, i.e., Durban, 1851). Very scarce throughout Durban. Only recorded in the study area during the winter of 1992.

Greyheaded Bush Shrike-Malaconotus blanchoti hypopyrrhus (Durban, 1844). Rare throughout Durban, may be extinct as a breeding species. Not recorded in the study area during the study period.

Olive Sunbird-Nectarinia olivacea ('towards Port Natal', i.e., Durban, 1840). Common throughout Durban, in forested habitats.

Green Twinspot-Mandingoa nitidula (the Type probably from Pinetown, 1865). Uncommon throughout Durban, where it is found at the forest-edge.

Grey Waxbill-Estrilda perreini incana (Port Natal = Durban, 1850). Uncommon throughout Durban where it is found at forest edges.

CHAPTER SEVEN

RECOMMENDATIONS

At the crux of analysing the success or failure of Pigeon Valley Park as an urban nature reserve, is the question of its raison d'etre.

An impressive list of 118 bird species for a 10-ha patch of forest, hides the fact that only 35% have been confirmed as breeding in the last five years. Furthermore, many of these are not true forest species (see Appendices 1 and 2), but, as described by Whitcomb et al. (1981), they are a 'generalist' subset of the regional species pool, or those in least need of protection. Wilcove and Robinson (1990), in summarising work done on the avifauna of the eastern Deciduous Forests of North America, emphasise that fragmentation results in a predictable subset of species on forest isolates. Indeed, it has been shown that it is possible to identify a number of 'indicator' bird species for coastal forest at the latitude of Durban (Chapter 6). These are susceptible to insularisation, some to the extent that they are probably regionally extinct as breeding species. Many of these species have undergone dramatic population declines and are no longer found over large parts of their former range (a number of species originally collected in Durban are now rare or absent-Chapter 6), this being 'a good indication that some of the interactions within the ecosystem have changed' (Main, 1987).

If, as Roberts (1990) puts it, the principal strategic aim of D'Moss is 'to preserve a diverse and self-perpetuating example of the original fauna and flora', then, at least for the avifauna of PVP, it falls short. As it is not realistic that PVP conserve the full array of regional bird species, it is proposed here that the operational aim of PVP should be specifically to preserve, as far as possible, a representative sample of a coastal forest ecosystem with 'maximum sustainable biotic diversity' (Roberts,

1990). Such aims provide a focus for management, 'because they are regarded as achievable' (Hopkins and Saunders, 1987). Scarce resources should not be squandered on lost causes, and those forest species incapable of establishing or maintaining populations on an island of this size should be provided for in larger tracts. PVP, in such cases, while not supporting resident populations, may assume the role of an effective stepping stone for the dispersal of fragmentation sensitive species. Implementation of the above aim will mean sacrificing species richness and diversity per se, as species characteristic of more open areas and edges will be selected against (see 4.3.3.). Other reserves in the regional D'Moss system should have the aim of preserving these species, and thus the regional responsibility of conserving representative samples of the historical ecosystems will be vested in a spectrum of conservation areas and agencies. On a regional basis, large reserves will have to be provided to cater for those species which have large area requirements, and autecological studies need to be conducted on species which have specific habitat requirements, to determine what these are (Whitcomb, 1987).

A further operational aim would be to maximise the provision of wintering habitat for the Spotted Thrush, which by virtue of its vulnerability is considered an important 'indicator species'. Such an aim would not conflict with PVP's primary aim, outlined above.

7.1. Management proposals

1) The forested area of PVP should be maximised by:

a) encouraging and allowing the forest to expand right up to the reserve boundaries, by planting up the edges and not mowing or clearing them. Key plant species, such as Chaetacme aristata (in the case of Natal Robins) and figs (for frugivores and insectivores), should be chosen to maximise productivity in bird terms. Holmes (1990) has shown that floristics may influence bird

distribution in northern Hardwood Forests, while somewhat conflicting evidence comes from Whitcomb et al. (1981), who found that many forest-interior specialists were able to use a wide range of forest types in relation to successional stage, vegetational composition and microhabitats. Blondel (1990) describes what can be achieved with the success of a reforestation project on the previously logged Mont-Ventoux, in France, where bird communities of native and reforested stands were very similar.

b) allowing the forest to encroach on the walkway/stormwater course up the middle of the Park. Whitcomb (1987) maintains that 'management of such preserves should be aimed at minimising disturbance of the forest interior'.

c) allowing the understorey and herbaceous layer to regenerate in the area isolated from the rest of the valley by Princess Alice Avenue (section A on the PVP/Shepstone Nature Reserve Corridor). This area at present supports none of the leaf litter-foraging guild, e.g. Terrestrial Bulbul and Natal Robin, other than as transients.

Both points b) and c) were suggested by Roberts (1990) and are strongly supported here.

With the increase in size of the forested area at PVP, I predict that population sizes of forest birds will increase, thus rendering each species less vulnerable to local extinction. By reducing the edge and increasing the forested area as described, as many as ten new Natal Robin territories could be accommodated. This would have the effect of increasing the population by about 50%. If the extent of the forested area is a limiting factor for any other species, it might be expected that they too would show population increases of a similar magnitude. Species which have been precluded from PVP, because they require a territory size which is greater than the current forested area, may in time re-establish themselves. An increase in forested area

allow certain species, which do occur on occasion, to establish themselves with viable populations. Yellowbellied Bulbuls and Blackbellied Starlings are possible examples of such species. Reduction of the edge effect will make the area more suitable for those species which are intolerant of disturbance and have a 'psychological need for a forested buffer zone' (Whitcomb et al., 1981). I predict that the Reserve's value as a stepping stone for some of the less common forest species may also be enhanced.

A larger area may have the effect of attracting more Spotted Thrushes to safe wintering grounds. Management for rare species is often compatible with maintaining species diversity, even though specific habitat requirements may differ (Smith, 1987).

This study suggests (see Chapter 6.3.4.) that the adequate conservation of all coastal-forest birds in Durban is not likely to be achieved by a system of several, isolated, small reserves. Keeping habitat constant, the larger the reserve the greater the species number (MacArthur and Wilson; 1963, 1967). Certain area-dependent species are not found in small reserves, and there are even those which no longer occur in Durban, probably because sufficient hospitable tracts no longer exist (see 6.3.5.). Lynch (1987) correctly points out that patch area can be a useful index for measuring impacts of insularisation as it encompasses 'a plethora of more immediate ecological factors'. It, therefore, cannot be emphasised more strongly that if the management aim of a particular natural area is to conserve all coastal-forest birds, then, if at all possible, the forested area should be maximised. As pointed out above, the conservation of some area-dependent species in metropolitan Durban may already be a lost cause, with

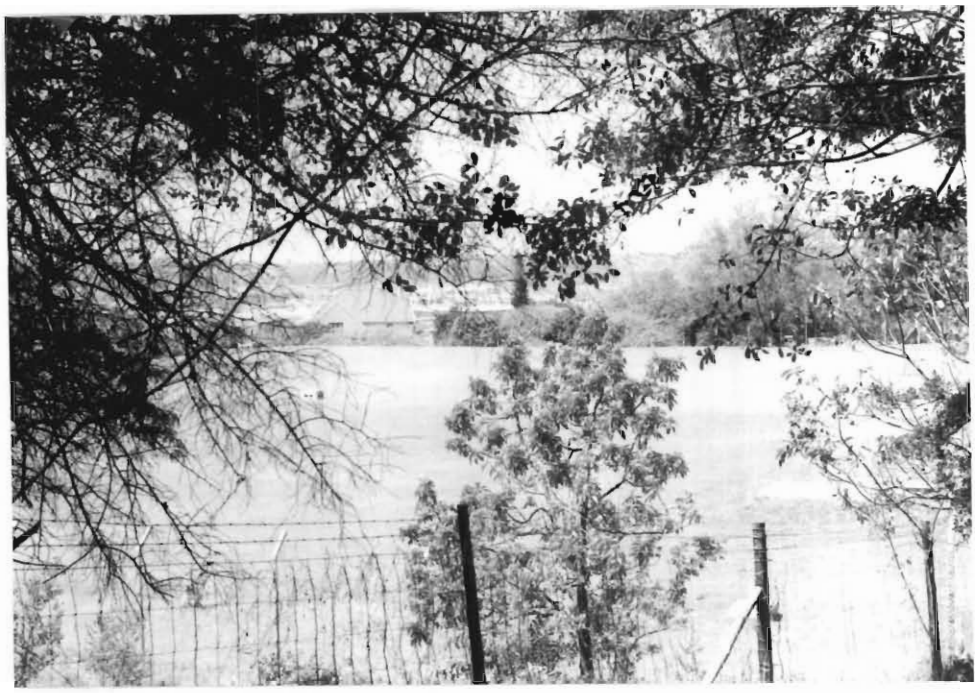


PLATE 7:1 The large reservoir at PVP, showing the mown grass cover with fringing vegetation.

remaining natural tracts being too small to support MVPs. These species need to be identified (many of the 'indicator' species of Chapter 6), and their conservation needs must be provided on the fringe of the city (where land may be available for larger reserves), as well as further afield. However, Lynch and Whigham (1984), bearing in mind MVPs, suggest that goals must be realistic and claim that a 'network of medium-sized (10-100 ha) avifaunal reserves.....can play a useful role in conserving certain regionally endangered bird species'. They continue by stating that such systems rely heavily on inter-patch dispersal, without which 'much larger avifaunal reserves would be required to maintain bird populations'. In the absence of large areas (the present situation with D'MOSS), dispersal (which is probably currently insufficient) must be maximised (see proposals 6-12).

2) The large reservoir at PVP should no longer be mown, and it should be planted up with indigenous shrubs and smaller flowering annuals and perennials. The overall physiognomy of this area would be scrubby and should be designed and managed to attract non-forest, but fragmentation sensitive species, such as Southern Tchagra Tchagra tchagra and Whitebrowed Robin. Other fauna, e.g. butterflies, would also be likely to benefit from such an area. A cutting should be made into the bank on the southern side of the reservoir in an attempt to encourage the breeding of Black Sawwing Swallows, Little Bee-eaters and Brownhooded and Pygmy Kingfishers. Most of the Reserve and surrounds would therefore be managed to favour the development of coastal forest, but where the underlying reservoir would not support such habitat, there is the opportunity of managing for more diversity, which would also appeal to visitors.

3) The grassed area alongside the large reservoir should be managed to succeed to forest. This is in line with the main aim of increasing the forested area.

4) I propose that intensive visitor use should be accommodated on the small reservoir near the gate, with the provision of

picnic facilities. A further bank cutting should be made to encourage the breeding of species described in 2) above.

5) Experiments should be conducted in the provision of nesting logs, both real and artificial, to see whether hole-nesters, such as the Blackbellied Starling, are excluded at PVP by the non-availability of nest sites.

6) Most of Bulwer Park, barring the entrances and playground areas, should be underplanted with endemic indigenous understorey species and saplings. The current area which has been planted up is too small, and the choice of plant species could have been more perceptive. Herbaceous undergrowth should be encouraged. It will probably be necessary to retain formal park entrances and playgrounds with their trappings, so as not to offend local residents who have fixed perceptions of what a park should be. Much public-relations work would have to be done to allay the fears of local residents that such an area would attract vagrants and criminals. PVP could be cited as contradictory evidence, as it is nowadays safe and vagrant free, because of fencing, regular patrolling by park staff and the presence of numerous genuinely interested visitors. Fencing and patrolling of Bulwer Park would also work, with playgrounds and dogs fenced out, and forest birds and other wildlife fenced in. The expected costs could possibly be recouped through a reduction in maintenance costs. Visitors, walking dogs, should be catered for with a trail skirting the fence.

7) The Pigeon Valley/Bulwer Park Corridor should be planted with endemic trees to create a continuous canopy with adequate cover to encourage dispersal. It is unlikely that the existing Flamboyants, and the planted acacias and Flatcrowns Albizia adianthifolia, will be successful in ensuring the dispersal of forest bird species to and from Bulwer Park. The physiognomy and floristics of this created habitat and its likely climax will, I predict, with its savannah nature attract species of open woodlands. PVP and Bulwer Park are coastal forest remnants.

Corridor features should therefore be designed for the dispersal of coastal forest fauna and flora. Security need not be sacrificed, and with careful management a trade-off between undergrowth height and safety may be made. Trees should be selected only if they occur in either Park, they should have an upright growth habit and be pruned and clean-cut around the stems to minimise their attractiveness to vagrants or criminal elements (Bodenstein, 1991). In time, the shrubbery in the form of Chrysanthemoides monilifera may provide cover for dispersing terrestrial forest species (e.g. Southern Boubou), while the continuous tree canopy may facilitate the movement of arboreal forest species (e.g. Cape Batis).

8) The Pigeon Valley/Shepstone Nature Reserve Corridor should also be planted with endemic forest species, and succession should be encouraged to create a ribbon of forest, albeit mainly edge, between the two refugia. Alien plant species need to be removed and their recolonisation prevented. Poynton and Roberts (1985) argue strongly against disregarding potential conservation areas because of heavy infestations of alien plants. These areas almost certainly do harbour resident populations of many indigenous bird species, as well as provide suitable dispersal corridors. They can also, with eradication of the alien plants, be managed back to their former indigenous status (PVP is an example of such an area). Notwithstanding the above argument, I believe that it can be claimed that endemic species are more valuable in providing suitable habitat and dispersal corridors (see 5.3.1.2.). Sections of Mundy Park should be underplanted in order to create a forest-like habitat. The current pro-indigenous sentiment of some of the residents who live adjacent to this park (G.R. Nichols pers. comm.) should be capitalised on. In order to achieve this, a public meeting should be held in the park to outline the role of the park as part of an important dispersal corridor reaching into the city. Homeowners should be encouraged to get involved in this Park, by assisting the Durban Parks Department with planting, watering or at least by keeping an eye on young trees until they are big enough to withstand vandalism.

They should also be given advice on the selection and acquisition of plants for their gardens.

9) The Shepstone Nature Reserve is in need of good management. There has been a perceptible, steady deterioration in the forest, many of the trees appearing damaged or diseased. An effective strategy plan should be drawn up for the eradication of alien plants. Most of the area should be fenced to exclude dogs, with a stile as access to humans. Plenty of space exists for walking dogs nearer the sports grounds, in what would be an intensive-use zone.

10) The Shepstone car park should be planted with indigenous trees to help to break the dispersal barrier between the 75th Anniversary Avenue and the Shepstone Nature Reserve. A list of potential species, which was vetted by G.R. Nichols (pers. comm.), is presented as Table 7:1. Trees were selected so as not to cause root damage to the car park's tarred surface, falling fruit should not damage cars, trees should supply shade, they should be relatively fast growing, they should be endemic to either the Shepstone Nature Reserve or PVP and additionally be resistant to wind and hot conditions. Plant holes need to be made as big as possible and reinforced at the edges so as to reduce the risk of damaging tarred areas. Each tree should be protected by a wire basket or 'tree guard' to minimise the risk of vandalism.

Table 7:1 Suggested trees for planting at the Shepstone car park.

(Species were chosen so as not to damage the surface or cars. Furthermore, they had to be endemic to the area, shade providing, fast growing and resistant to wind and heat.)

Acacia robusta	Albizia adianthifolia
Apodytes dimidiata	Bridelia micrantha
Celtis africana	Celtis mildbraedii
Clerodendrum glabrum	Commiphora woodii
Cordia caffra	Croton sylvaticus
Ekebergia capensis	Erythrina lysistemon
Euclea natalensis	Margaritaria discoidea
Maytenus peduncularis	Olea woodiana
Protorhus longifolia	Scolopia zeyheri
Trichilia dregeana	Turraea floribunda
Vepris lanceolata	

11) The central area of Jubilee Park, which is little more than a mown lawn, should be planted to endemic species, and the regeneration of coastal forest should be encouraged. Minimal lawn should remain for students to use during their lecture breaks.

12) All possible sites in the study area should be used for the planting of indigenous trees by the Durban Parks Department and the University horticultural staff. Obvious areas include the traffic island in MacDonald Road, which runs upwards from Manning Road, the park next to the bus terminal further up this road and the triangular traffic islands on the corners of King George V and South Ridge, King George V and Princess Alice and King George V and Cato Roads.

I am concerned that for a number of forest species which have resident populations at PVP, the existing corridors seem to be ineffective as dispersal routes. Should recommendations 6) to 12) be adopted, I believe that the dispersal of at least some forest bird species will be enhanced. PVP would suffer less isolation than it currently does, it would enjoy greater genetic turnover of its biota and an improved 'rescue effect', as described by

Brown and Kodric-Brown (1977). In addition, for those forest species with a fair tolerance of fragmentation, local metapopulation sizes would increase as areas within the study area become more forest-like in nature. For such species the open spaces of the study area would represent an integrated network, and as such, function as a metareserve.

13) Residents within the entire study area should be kept informed of and involved in, where possible, the implementation of the proposed management actions. This could be done through mailshots, displays on information boards at shopping centres, newspaper articles, guided trails from PVP to Bulwer Park and to the Shepstone Reserve and presentations to various groups, e.g. the local Neighbourhood Watch, schools and the local branch of the Wildlife Society. The potential impact of homeowners is tremendous as 'private gardens constitute the largest category of available open space within the city' (Roberts, 1990). The planting of indigenous species and the managing of gardens, to shelter migrating flora and fauna, should be encouraged through an ongoing public-relations and information programme.

It is the attitude of the local residents which will determine the success of the proposals submitted here. Irwin (1977, cited in Burgess and Sharpe, 1981) says that 'if we accept the basic tenet that ecological diversity is a legitimate concern for the future well-being of mankind, we must say so in terms that the public can comprehend and with facts upon which the politicians can act'. An urban conservancy (as established throughout the province by the Natal Parks Board) would be a useful vehicle for achieving an integrated forum for the study area, comprising managers, planners, researchers and the public.

I suggest that the recommended management actions should be treated as 'ecological studies ..... and performed in a manner that incorporates information gathering to promote improvements in decision making' (Hopkins and Saunders, 1987). In addition, there should be a 'better integration of research, planning

and management' (Hopkins ans Saunders, 1987). Wilcove and Robinson (1990) include as a final note, in their review of studies on the forest avifauna of the eastern United States, a plea for the dissemination of findings and recommendations to land planners and managers. Research must be translated into action if isolates like PVP are to reach their maximum potential. Simple monitoring and experiments will allow those involved in managing the natural aspects of the study area to fine-tune their management, in order to maximise the goal of conserving a diverse and sustainable example of a coastal forest ecosystem.

Management of the natural resources of the study area needs an anthropocentric, biocentric and biogeographical approach (sensu Taylor, 1987). For example, the Shepstone Nature Reserve and surrounds is a popular area for jogging and walking dogs. These needs must be addressed without forfeiting the opportunity of creating a biocentric reserve for the conservation of the Spotted Thrush and a biogeographical reserve for the conservation of a viable coastal forest ecosystem. At present the human-based function is creating disturbance and edge conditions to the extent that the latter two goals are compromised.

CHAPTER EIGHT

CONCLUSIONS

This study investigated the applicability of selected tenets of the Equilibrium Theory of Island Biogeography (MacArthur and Wilson; 1963, 1967), and the geometric reserve-design principles (Diamond, 1975) derived from this Theory, to fragmented habitats in Durban:

8.1. Species richness and composition

In terms of the Theory, it is the resident breeding species which are relevant to species-area relationships. One hundred and eighteen bird species were recorded at PVP, of which only 41 have been confirmed as breeding, while a further 15 are likely breeders. The remaining 62 species are mainly visitors or vagrants, and although the refuge acts as a 'stepping stone', it does not support permanent populations of these birds. The species total which would therefore be used in investigating species-area relationships is 41.

In addition, of the 118 species, 34 can be considered as species preferring forested habitats, and 39 the forest-edge. This suggests that there are 45 (non-forest) species which are unlikely to have occurred in the unbroken forest expanse which would have covered Durban's Berea Ridge. It might even be argued that a number of the forest-edge species would also have been excluded under such conditions.

8.2. Dispersal corridors

The solution to the problem of certain species requiring large MCAs (where large areas are not available), seems to lie in functionally integrating the various refugia, such that they operate as one big metareserve with metapopulations (e.g. Lynch and Whigham, 1984). This study indicates that at present the

corridors which are supposed to facilitate the dispersal of species, to and from the Reserve, are not effectively realising their intended goal (Chapter 5). Whether this is a result of the inherent reluctance of some species to move from their preferred habitat types (Whitcomb et al., 1981), or because of an inadequacy of the corridor, requires more investigation. It seems intuitive that the corridor should be extensive and it should mirror as far as possible the habitats of the core areas it connects. Roberts (1990), working with plant communities, suggests a corridor width of 151,81 m for the habitat type in question.

Many of the core areas of D'MOSS have now been secured and are under management. Chapter 7 outlines the sorts of specific management actions which might be employed in order to maximise the potential of a particular area as an avifaunal preserve. What concerns me is that scant attention has been paid to corridors, which in an urban context, with its small reserves, may dictate the success or failure of the core refugia (e.g. Lynch and Whigham, 1984). The proposed corridors, connecting core areas, in the D'MOSS often follow river courses, and thus the connecting habitat could differ markedly from the isolates (Poynton and Roberts, 1985), e.g. riverine forest is unlikely to be an effective corridor for grassland species such as Croaking Cisticola Cisticola natalensis, and the corridor connecting PVP to Burman Bush runs along busy arterial roads, with limited potential for improvement in order to enhance forest bird dispersal. Yet there is hope, as demonstrated by Roberts (1990), who identifies all the available open space types which might be manipulated in order to improve dispersal routes, e.g. institutional grounds, gardens, sportsfields, verges and cemeteries. I therefore propose that efforts directed at improving and establishing the proposed corridor network for the city, should be markedly increased in order to establish, within the constraints of small- and medium-sized reserve systems, metapopulations which are resistant to extinction. However, we must be careful not to allow the possibilty of metapopulations,

which are not yet proven to exist for most species, to be used as grounds for dividing up what remaining large tracts that still exist. Lynch and Whigham (1984) provide what seems to be wise advice; 'the most practical management ..... will entail avoidance of practices, e.g. reduction of forest area, increase of isolation, removal of understorey vegetation, that have been shown to have negative impacts on target species of special conservation interest'; this they believe because 'even relatively simple habitat manipulations will be prohibitively expensive if conducted on the geographical scale required for regional preservation'. If metapopulations are not a reality, for many species, such manipulations would become necessary with a dissected landscape. Backhouse (1987) presents a dismal picture of the prospects for the last remaining population of Helmeted Honeyeaters Lichenostomus melanops cassidix in Yellingbo State Nature Reserve in Australia. This morphologically distinct subspecies was confined to a number of small refugia of riverine vegetation with no interpatch dispersal. It has subsequently become extinct on all but one patch. The species' continued existence now relies totally on a very expensive conservation programme which is increasingly difficult to defend.

8.3. Species turnover at PVP

There have, as predicted by the Theory, been extinctions and colonisations at PVP during the past ten years of study. Most of these are attributable to habitat change, and are therefore not evidence of a dynamic equilibrium. Other species gains or losses may be evidence of a constant turnover of breeding species, although levels recorded do not match those reported in the literature. As it is not possible to be sure that a species is not breeding, because it is difficult to find the nests of many forest species, it is possible that turnover rates are higher than observed. Clearly in a forest an annual turnover of 10% or 5-6 species, as predicted in the literature could easily be undercounted.

8.4. Fragmentation sensitive birds and reserve size

It can be seen that measures of richness need to be made carefully when dealing with habitat islands (see 8.1.). Breeding species need to be identified, and care must be taken so as not to fall into the trap of concluding that fragmentation has been beneficial, as it has led to an increase in species richness. This increase, on the study area, has not been in forest bird species, but rather 'generalists' which are exploiting newly created edge habitats, and are equally likely to survive in non-forested localities. Furthermore, it has been shown that a list of 'indicator species' may be defined as susceptible to forest fragmentation, and these are the species that should be weighted for in reserve system design (Roberts, 1990).

Fragmentation at PVP has led to a depauperate forest avifauna. What is worrying is that it is probably the same group of species which would become locally extinct in similar situations. Perusal of the lists presented by Boon (1985) corroborates this conclusion.

What is it about fragmentation which certain species cannot tolerate? Answers would include the loss of microhabitats, critical resources, a 'psychological need' for a buffer zone, introduction of predators and competitors from non-forested habitats, the new area being smaller than that required for one territory, resultant small populations which are susceptible to a loss in genetic diversity, natural catastrophes and variation in reproductive success (Whitcomb et al., 1981; Shaffer, 1987). I believe that all of the above are probably contributing factors when discussing species loss at PVP, both currently and historically, and that these relate directly or indirectly to area.

These factors are relevant to one of the most interesting debates arising from the Theory, i.e. the SLOSS question. The results of this study point strongly to 'single large'

reserves as the better of the two options. There is no doubt that many species are susceptible to habitat fragmentation. These were identified as 'indicator species', most of which would be found in larger forests, e.g. locally: the Hawaan Nature Reserve, Krantzkloof Nature Reserve, Shongweni Dam and surrounds, and regionally: Entumeni Forest, Ngoye Forest, Dukuduku Forest, Vernon Crookes Nature Reserve and Oribi Gorge Nature Reserve. It is realised that the abovementioned forests are not all directly comparable, but they do help to illustrate the point. As further support, in summarising minimum viable population analyses, Soulé (1987b) suggests that populations will need to be of the order of a few thousand individuals to confer an expected persistence time of a few centuries at a 95% probability level. This is very ominous even though such predictions are situation- and taxon-specific, and also exclude the possibility inter-reserve dispersal. The census of Natal Robins at PVP indicates that there are 53 resident birds on 9,7 ha. Extrapolating this, a minimum critical area of 183 ha would be required to provide habitat for just over 1000 individuals. The Natal Robin is common at PVP, and thus such an estimate has to be an underestimation when one considers rarer and more thinly dispersed species. In addition, if the Natal Robin population at PVP exists at an exceptional density, as a result of density compensation in the absence of the Brown Robin, the problem would be exacerbated in pristine situations. Clearly continuous forested tracts of 200 ha or more are very rare in the metropolitan region.

As mentioned above, the crux of the problem in conserving fragmentation sensitive species seems to be related to area. This must therefore be maximised wherever possible.

8.5. Applicability of the MacArthur-Wilson Theory and Diamond's geometric reserve-design principles to fragmented habitats in Durban

The Equilibrium Theory of Island Biogeography (MacArthur and Wilson; 1963, 1967) is now 30 years old, and was originally proposed to explain observations on the biota of oceanic islands. In the past three decades it has been used by many authors to explain what is observed on habitat islands on the mainland. This extension has been criticised by some authors (e.g. Simberloff and Abele, 1982), but alternative comprehensive theories have not been forthcoming from critics. Roberts (1990) justifies the continuing use of the Theory, as 'conservationists in need of theory are thus obliged to resort to the only theoretical tool available to them'.

The Theory ensures focus on breeding species as opposed to transients, while accepting the importance of refugia as 'stepping stones' of natural habitat. The original Theory did not deal with the effect of edge habitat, as this would not have been a factor on oceanic islands. Such edge habitat creates conditions for 'generalist' species, which may distort species-area relationships as predicted by the Theory. In terms of the Theory, islands distant from source areas are likely to suffer species extinctions. On the mainland, this process can be alleviated by providing dispersal corridors of similar habitat and by placing reserves in close proximity. The Theory also predicts that large islands will support more species than small islands, something which is borne out by the current study. Diamond (1975) claims that a single large reserve of equal aggregate area to several smaller reserves, is preferable to the option of a group of reserves of modest size. The current work agrees with his contention. The dynamic equilibrium, which is predicted by the Theory seems to have been observed. However, the Theory suggests that colonisations and extinctions are stochastic. The fact that it is possible to define a group of 'indicator' species, which are susceptible to fragmentation, would seem to refute this.

Blake and Karr (1984) showed that in isolated forest patches in east-central Illinois, long-distance migrants and forest-interior species were poorly represented in small forests. Nilsson (1978) states that it is possible to identify a group of 'easily-dispersed' species which tend to predominate on islands in man-altered landscapes.

Finally, MacArthur and Wilson (1967) were themselves very much aware of the limitations of the Theory-'we do not seriously believe that the particular formulations advanced in the chapters to follow will fit for very long the exacting results of future empirical investigations'. As anticipated, Blondel (1991) calls for recognition of the fact that 'many of its predictions (of the Theory) are to general or simplistic to produce sound working hypotheses for specific situations'. Nevertheless, the Theory and its extension in Diamond's (1975) reserve-design principles, has been found to be a useful descriptor of what is happening in fragmented forested areas in the current study area, and in agreement with Roberts (1990) its continued use in the absence of alternative theories seems justified.

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APPENDIX 1: Status of species recorded at PVP, in the greater study area and in gardens between 1981 and 1992.

Note:
1) Percentages represent the fraction of 106 visits to PVP that a species was recorded.
2) References to the study area refer to the area described Chapter 2.2., i.e. the L37, L39, N37, N39 1:2000 orthophoto maps, City of Durban series.
3) The status of the species recorded at PVP is indicated immediately after the species common name (no status is indicated for species recorded in the study area but not at PVP):
(PR) - permanent resident; maintain year-round homeranges with at most local 'drift' into nearby habitats.
(SDM) - short-distance migrant; breeding populations move a few hundred kilometres to a different wintering area.
(AM) - intra-African migrant; migrate within the continent, usually to the north of the equator.
(PM) - Palaearctic migrant; migrate to the Palaearctic region for the austral winter.
(V) - visitor/vagrant; species recorded rarely or uncommonly at PVP, and does not breed.
(H) - historical; recorded since 1981 at PVP, but not in the last five years.

BLACKHEADED HERON (V) - Ardea melanocephala

A visitor to PVP, twice recorded feeding on an unmown, grassed bank. It was also seen a number of times feeding in similar habitat at the Shepstone Nature Reserve and in the informal open spaces in the study area.

CATTLE EGRET - Bubulcus ibis

This species was seen fairly commonly, in the study area, feeding on open grassy road verges and on occasion on mown fields. Not recorded at PVP.

HAMERKOP (V) - Scopus umbretta

Recorded twice as a visitor to PVP, where it fed on frogs in the small pond in the centre of the Reserve.(< 1%). Bred at the Shepstone Nature Reserve up until about 1983. The growing popularity of this area as a place to walk dogs, may have caused the nest site to be abandoned.

HADEDA IBIS (PR) - Bostrychia hagedash

This species was a common daily visitor in small groups to PVP, where it fed mainly on mown lawns and the forest-edge. It was also occasionally found in the forest-interior feeding in the leaf litter. A pair used to breed in the Valley, but since the colonisation of the reserve by the Black Sparrowhawk, in 1988, the only possible successful breeding attempt was in 1992.(71%). It was found feeding and breeding throughout the study area, wherever suitable habitat occurs. There are communal roosts at Bulwer Park and in a Fluted milkwood Chrysophyllum viridifolium in MacDonald Road.

SECRETARYBIRD (V) - Sagittarius serpentarius

A bird was reported, to G.R. Nichols, during July 1992, to be feeding in the grassland patch alongside the large reservoir.

YELLOWBILLED KITE (AM) - Milvus parasitus

A breeding intra-African migrant, which arrives in the first days of August and departs in March. A pair bred annually until displaced by a pair of Black Sparrowhawks, which colonised the Reserve in 1988. A late breeding attempt in December 1991 did not get past the nest building stage. In August 1992 a pair built a nest and seemed to be incubating. Harassment by the Black Sparrowhawks probably caused them to abandon both attempts.(39%). Individual birds were often seen quartering the entire study area.

BOOTED EAGLE (V) - Hieraaetus pennatus

A visitor, which was often seen quartering the entire study area, in the manner of a Yellowbilled Kite, during the winters of 1989 and 1990. In both years the bird was of the dark colour morph and presumably of the resident South African sub-population, which is known to disperse during the nonbreeding season from its breeding grounds in the south western Cape.

CROWNED EAGLE (V) - Stephanoaetus coronatus

E. Reynolds noted an immature individual at PVP in April 1988. The closest resident breeding pairs are at the Krantzkloof Nature Reserve, at Kloof and the Hawaan Forest, at Umhlanga.

LITTLE SPARROWHAWK (V) - Accipiter minullus

There were only two records for the study area. This species was recorded once at PVP by H.A. Campbell and R. Cowgill in May 1992. It is probably somewhat overlooked due to its furtive nature. The preferred habitat is more open woodland especially where there are Eucalyptus spp.. An immature was seen taking a House Sparrow at 223 Brand Rd..

BLACK SPARROWHAWK (PR) - Accipiter melanoleucus

A breeding resident at PVP, which colonised the reserve in August 1988 and first bred in the winter of 1989. It has since bred annually with the chick/s leaving the nest in September. During the 1991 breeding season two chicks were found dead of undetermined cause. This was the only nesting failure in four years.(59%). Birds, presumably of this pair, were often seen hunting Redeyed Doves throughout the study area in the early morning and evening. Black Sparrowhawks have rested on a few occasions at 223 Brand Rd..

AFRICAN GOSHAWK (V) - Accipiter tachiro

Formerly bred regularly, but displaced on the colonisation of the Black Sparrowhawk. Now a visitor with mostly singletons, both adult and sub-adult, recorded. Adult birds seen with almost independent young would suggest that breeding continues in the neighbourhood. This species was often recorded in the early morning doing its overhead display flight.(27%). Birds were also recorded in gardens, at Bulwer Park, the Shepstone Nature Reserve and on the 75th Anniversary Avenue corridor.

GYMNOGENE (V) - Polyboroides typus

A visitor, with in most cases a single adult being recorded. On two simultaneous visits an adult was seen with a begging but fully fledged immature bird.(5%). Both immature birds and adults were fairly frequently recorded on the Berea over the past three years. Local breeding sites are not known.

LANNER FALCON - Falco biarmicus

Individuals were recorded flying over PVP on two occasions. A bird was observed feeding on a Feral Pigeon in Cavendish Park. A pair is known to breed on the Natal University buildings.

NATAL FRANCOLIN (V) - Francolinus natalensis

This species was recorded calling once at PVP (May 1991) from a dense thicket.(<1%). A number of records exist for the Shepstone Nature Reserve, where there have been a few observations and aural records. These suggest that it is resident. Two adult birds and a not yet fully grown immature bird were seen drinking at a dripping water tap in this reserve. This population may be vulnerable to disturbance by dogs. A single remarkable record exists for a bird found in a garden in Queen Elizabeth Avenue, Manor Gardens.

BUFFSPOTTED FLUFFTAIL (PR) - Sarothrura elegans

A breeding resident at PVP, where it may be heard calling from September to February. Due to the shy habits of this species it is seldom recorded other than by call. Winter records are therefore rare. In September 1991 a nest with five eggs was found concealed in a patch of exotic groundcover of the Commelinaceae family. It was later destroyed and the eggs eaten, most likely by a Slender Mongoose Galerella sanguineus.(26%). Not recorded elsewhere in the study area.

REDEYED DOVE (PR) - Streptopelia semitorquata

A breeding resident, which was usually recorded on the edge of the forest or in the canopy. A bird was seen collecting nesting material in December 1991. Also seen in the forest-interior feeding on fallen seed of the Forest croton Croton sylvaticus.(92%). This species is very common throughout the study area, where it probably breeds more freely than at PVP. It was recorded breeding successfully throughout the year at 223 Brand Road. Joins communal Indian Myna roosts in Natal Mahogany Trichilia dregeana trees.

LAUGHING DOVE (V) - Streptopelia senegalensis

A visitor, found feeding on the outskirts of PVP and never in forest. Not recorded breeding, but may possibly do so.(27%). Far more common throughout the rest of the study area, where it is commensal with man.

GREENSPOTTED DOVE (H) - Turtur chalcospilos

A visitor, which was recorded once at PVP with G. R. Nichols in 1983. One unsubstantiated report exists for September 1992. With the dry winter experienced during this year the record is plausible, but confusion with the female Tambourine Dove cannot be ruled out. It is likely that this species was more common in the past, but with afforestation of the reserve its habitat has largely disappeared. Not recorded elsewhere in the study area.

TAMBOURINE DOVE (PR) - Turtur tympanistria

A breeding resident of the forest at PVP. Has bred prior to 1983. No nests were found during the study period, but a sub-adult bird was seen in January 1992.(84%). Not recorded in any of the gardens, but was found at the Shepstone N. Reserve and seen flying out of PVP in October 1991.

CINNAMON DOVE - Aplopelia larvata

No records for PVP in the last ten years, however, in 1982, J. Gourley found a bird in his Clair Avenue garden which had been killed by flying into a window.

ROSERINGED PARAKEET - Psittacula krameri

A group of five were seen flying over PVP in September 1992. A single bird was also seen at Bulwer Park in October 1991. These birds are aviary escapees which roost at Mitchell Park and feed mainly in the north of the city. One breeding record was reported from North Ridge Road. Possibly competes with indigenous hole-nesting species.

KNYSNA LOURIE (V) - Tauraco corythaix

One record for PVP, from H.A. Campbell, in September 1991. Usually found at inland localities where it replaces the following species.

PURPLECRESTED LOURIE (PR) - Tauraco porphyreolophus

Resident, with 12 seen at one time during the winter of 1992. Has bred prior to 1983 and probably still breeds at PVP, but no direct evidence exists. A male was observed soliciting a female to mate in January 1992.(88%). Birds are also fairly commonly encountered throughout the study area, where they are mostly nomads searching for or feeding on fruiting trees.

EUROPEAN CUCKOO (V) - Cuculus canorus

A nonbreeding, Palaearctic migrant, which was recorded once at PVP by E. Reynolds in February 1990. Normally a bird of open grasslands with scattered trees or bushclumps. This is therefore an exceptional record.

REDCHESTED CUCKOO (V) - Cuculus solitarius

A breeding intra-African migrant, recorded from September to April. Recorded twice at PVP, once each in February 1983 and in November 1987.(<1%). In addition, an individual of this species or perhaps the European Cuckoo was seen crossing Queen Elizabeth Avenue in April 1992. This cuckoo is normally found at higher altitudes at this latitude. Natal Robins and Kurrichane Thrushes are two recorded host species of this brood parasite.

BLACK CUCKOO - Cuculus clamosus

A breeding intra-African migrant, recorded from September to April. There is one possible record for PVP in 1989 from J. Malan. The Roosfontein Nature Reserve at Westville is the closest that I have seen this species to the coast at Durban. A host, the Southern Boubou, occurs fairly commonly on the study area.

EMERALD CUCKOO (V) - Chrysococcyx cupreus

A breeding intra-African migrant, recorded from September to April, with one male observed at PVP by E. Reynolds. Due to its secretive nature it may be somewhat overlooked. The Bleating Warbler, which occurs at PVP, is one of two authenticated host species.

KLAAS'S CUCKOO (AM) - Chrysococcyx klaas

A breeding intra-African migrant, recorded from September to April, which because of its silent and unobtrusive nature in the nonbreeding season may over-winter more frequently than observed. Mainly recorded at PVP between August and March. A male was seen feeding a female in October 1989. This would suggest breeding, and although suitable hosts are present (e.g. the sunbirds, Puffback, Barthroated Apalis and Tawnyflanked Prinia) no young have been seen.(33%). A bird was recorded on three consecutive days calling from a group of trees near 223 Brand Rd.. Not recorded elsewhere in the study area.

DIEDERIK CUCKOO (AM) - Chrysococcyx caprius

A breeding intra-African migrant, recorded from October to April. Locally parasitises Spottedbacked Weavers. Arrives in October when it begins calling and seems to leave in January, but probably only becomes less conspicuous as calling ceases about then. At PVP this species is found on the forest-edge and never in the interior. It is unlikely to breed here as its favoured host does not.(16%). Occurs in gardens and elsewhere in the study area, especially where Spottedbacked Weavers breed.

GREEN COUCAL (V) - Ceuthmochares aereus

A visitor, first recorded in October 1989, to PVP where no more than one bird was ever observed or heard calling in the forest. Unlikely to be breeding.(10%). Not recorded elsewhere in the study area.

BURCHELL'S COUCAL (V) - Centropus burchellii

A visitor to PVP, where it was flushed on four occasions from rank vegetation on the forest-edge. Unlikely to breed.(4%). Also found at 48 Clair Avenue and 223 Brand Rd., where at the latter one bird spent the winters of 1991 and 1992.

BARN OWL - Tyto alba

A visitor on three occasions to 223 Brand Rd., the second and third records being in August and September 1992 respectively.

SPOTTED EAGLE OWL (PR) - Bubo africanus

One bird was resident at PVP, where it was recorded on a number of occasions between October 1990 and November 1991. Also listed from pre-1983 by G.R. Nichols. Unlikely to be breeding, but only because of the lack of a mate.(4%). A pair were often recorded, between 1983 and the present, roosting in trees in the Shepstone Reserve and hunting in the Natal University grounds. Has been observed at 48 Clair Avenue.

FIERYNECKED NIGHTJAR (H) - Caprimulgus pectoralis

Historically, this species was possibly a breeding resident at PVP, but has not occurred since 1983 as a result of a loss of habitat with reforestation. Has been heard calling from 48 Clair Avenue and from the Shepstone N. Reserve, although the calling bird was in the informal open space area owned by the Natal University on the far side of Francois Rd..

EUROPEAN SWIFT - Apus apus

Recorded over PVP on two occasions by H.A. Campbell at the end of April 1992. These nonbreeding Palaearctic migrants were probably on migration to the northern hemisphere.

BLACK SWIFT - Apus barbatus

Recorded twice feeding high over PVP in June 1989 and September 1992. This bird was not associated with the Valley per se.(2%). Also recorded commonly from 223 Brand Rd. and 426 Frere Rd. In winter birds fly on a daily basis from their inland cliff roost and nest sites to the coast to feed. Described by Maclean (1985) as largely an intra-African migrant which may overwinter.

WHITERUMPED SWIFT - Apus caffer

A breeding intra-African migrant, which was recorded feeding over the Valley from the beginning of September to the end of April.(34%). Breeds in small numbers under the eaves of larger houses. There is a small breeding group nesting opposite 223 Brand Rd.. The number of birds breeding here has decreased in recent years.

LITTLE SWIFT - Apus affinis

A breeding resident, which breeds mainly on bridges outside of the study area, and is sometimes seen feeding high over the Valley.(9%). Also recorded throughout the study area.

ALPINE SWIFT - Apus melba

A breeding resident, recorded By G.R. Nichols prior to 1983. It probably occurs fairly commonly during winter in mixed apodine flocks, when it flies daily from Drakensburg roost and nest sites to the coast to feed.

PALM SWIFT (PR) - Cypsiurus parvus

A breeding resident, which nests in the Royal Palms Roystonea regia lining Princess Alice Avenue on the northern side of PVP.(46%). Also known to breed in Royal Palms at Durban Girls' High and Howard Avenue, where 25 birds were counted of an evening, in July 1992. Commonly seen away from nest sites throughout the study area, especially during winter. Concentrations may be seen around fruiting figs when the symbiotic wasp pollinators are emerging after pupating.

SPECKLED MOUSEBIRD (PR) - Colius striatus

A breeding resident at PVP. Tends to be found in groups on the forest edge, wherever trees are fruiting. Observed collecting nesting material in November 1991.(71%). Also common throughout the study area, where it has bred at 223 Brand Rd..

NARINA TROGON (V) - Apaloderma narina

A nonbreeding visitor to PVP. A male and female were present during September and October 1991, with the male soliciting to mate. The birds left soon afterwards with the breeding attempt unsuccessful.(8%). Not recorded in the study area outside of PVP.

PYGMY KINGFISHER (V) - Ispidina picta

Formerly, prior to 1983, a breeding intra-African migrant, which is recorded from October to April. With reforestation, there has been a loss of suitable breeding habitat, as the original nesting bank has become covered in vegetation. The species has only been recorded three times recently as a passage migrant. It is probably more common than records would indicate, but due to its unobtrusive nature and sibilant call it is easily missed.(3%). It has been recorded as a brief visitor at 48 Clair Ave. and once at 223 Brand Rd..

MANGROVE KINGFISHER (V) - Halcyon senegaloides

A nonbreeding, short-distance migrant which spends the winter in mangrove habitats and breeds, in summer, along wooded streams. Recent breeding records in central Natal are unknown. Recorded twice at PVP; in March 1990 when it was seen feeding on a pill millipede and in October 1987 by E. Reynolds.(<1%). Also recorded in 1989 at 223 Brand Rd. Birds are known to rest in Berea gardens on their migration to and from mangrove stands.

BROWNHOODED KINGFISHER (PR) - Halcyon albiventris

A resident at PVP, which was known to breed prior to 1983. A pair were also recorded mating in September 1986. It is not clear whether this species still breeds in the Valley, but its activities are confined to the edges.(33%). Occurs fairly regularly though sparsely throughout the study area.

LITTLE BEE-EATER (V) - Merops pusillus

A former, prior to 1983, breeding resident at PVP. Breeding habitat has now disappeared through forest encroachment. Records at the Valley are scarce although two birds were seen in September 1991 initiating a nesting hole in a mound of sand, which had been dredged from the silted pond. This attempt was unsuccessful. (2%). Observed once on 75th Anniversary Avenue. It is common on the grassland spur in the Shepstone N. Reserve.

HOOPOE (V) - Upupa epops

A former, prior to 1983, breeding resident at PVP. This species underwent a dramatic population crash throughout Durban as a result of the indiscriminate use of insecticides. Although the population seems to be on its way to recovery, it is no longer often recorded at PVP because of habitat loss through forest succession.(4%). Also recorded from 48 Clair Ave., 426 Frere Rd. and the eastern campus Natal University sportsfields.

REDBILLED WOODHOOPOE (V) - Phoeniculus purpureus

A former, prior to 1983, breeding resident at PVP. Now an uncommon visitor, possibly due to reforestation.(14%). Recorded on occasion throughout the study area. One old record at 223 Brand Rd..

CROWNED HORNBILL (H) - Tockus alboterminatus

Visitor, recorded once at PVP, by G.R. Nichols in 1981. Not recorded elsewhere in the study area.

BLACKCOLLARED BARBET (PR) - Lybius torquatus

Resident, recorded breeding at PVP on three occasions. Tends to remain on the forest-edge.(94%). Occurs and breeds throughout the study area.

WHITE-EARED BARBET (V) - Stactolaema leucotis

A relatively recent addition (October 1988) to the Valley's species list, where its status at present is most likely best described as nonbreedin!g resident. Tends to remain on the forest-edges and high in the trees. There may be competition between this species and the Blackcollared Barbet.(10%). Found at 48 Clair Ave.. Not recorded elsewhere in the study area.

REDFRONTED TINKER BARBET (PR) - Pogoniulus pusillus

Breeding resident, prior to 1983, at PVP, with no recent breeding records. This species may have undergone a decline in numbers in recent years. Mostly recorded by call in summer, while in winter the calls are difficult to distinguish from the Goldenrumped Tinker Barbet.(43%). Recorded at 48 Clair Ave. and once on the 75th Anniversary Avenue.

GOLDENRUMPED TINKER BARBET (PR) - Pogoniulus bilineatus

Breeding resident, with the most recent breeding record being the summer of 1989/1990. Further evidence of breeding are the nestholes, observed in dead branches, of this or possibly the previous species.(75%). Also recorded at the Shepstone Reserve, at 48 Clair Avenue and on the 75th Anniversary Ave.. A bird which flew into a flat in Glengariff Avenue, was an exceptional record.

GREATER HONEYGUIDE (V) - Indicator indicator

A visitor, recorded twice at PVP; once calling on the forest edge in 1990 and on the second occasion by H.A. Campbell in August 1992. Also found at the eastern campus Natal University sportsfields as well as at 48 Clair Ave.. Potential hosts of this non-specific brood parasite include the Hoopoe and the Southern Black Tit.

SCALYTHROATED HONEYGUIDE (V) - Indicator variegatus

A visitor, recorded calling in October 1988. Due to its shy nature it is possibly under-recorded. Goldentailed and Cardinal Woodpeckers are known hosts. Not recorded elsewhere in the study area.

LESSER HONEYGUIDE (V) - Indicator minor

Probably a visitor, recorded six times at PVP. Unlikely to be breeding as there are no known regular calling sites in the study area. Suitable hosts such as the Blackcollared Barbet are present.(<1%). Also recorded on the 75th Anniversary Avenue and at the Shepstone N. Reserve.

SHARPBILLED HONEYGUIDE (PR) - Prodotiscus regulus

There is possibly one resident breeding pair at PVP, as birds have been seen doing their nuptial display flight.(9%). Not recorded elsewhere in the study area, although it may be overlooked. The Bleating Warbler is a recorded host.

GOLDENTAILED WOODPECKER (PR) - Campethera abingoni

Breeding resident, at PVP, where it has been recorded breeding on a number of occasions.(92%). Also occurs throughout the study area, including gardens. At 223 Brand Road a male displaced a pair of Blackcollared Barbets from a nesting log.

CARDINAL WOODPECKER (PR) - Dendropicos fuscescens

Breeding resident, seen feeding recently fledged chicks in November 1986. A pair or so may still breed, although in time reforestation will not favour this species.(42%). Also seen, albeit sparsely, throughout the study area, where it was recorded breeding at 426 Frere Rd..

EUROPEAN SWALLOW - Hirundo rustica

A nonbreeding summer migrant from the Palaearctic, which arrives at the end of September and leaves at the beginning of April. Not directly associated with PVP.(14%). Recorded more commonly throughout the study area wherever suitable open spaces, such as sportsfields, for feeding occur.

WHITETHROATED SWALLOW - Hirundo albigularis

A breeding intra-African migrant, which is sometimes found hawking insects over open fields. Not recorded at PVP.

LESSER STRIPED SWALLOW (AM) - Hirundo abyssinica

A breeding summer migrant, which arrives in late July and departs in March.(49%). Recorded more commonly throughout the study area, wherever suitable open spaces for feeding occur. Commonly feeds over the forest/grassland ecotone at the Shepstone N. Reserve. No known nest sites, although probably breeds on the Natal University buildings.

ROCK MARTIN - Hirundo fuligula

Breeding resident, which breeds on the Natal University buildings and is only recorded as flying over PVP.(3%). In winter feeds over fields and other open spaces throughout the study area.

BROWNTHROATED MARTIN - Riparia paludicola

Breeding resident, which is sometimes found, in winter, hawking insects over open spaces in the study area.

BLACK SAWWING SWALLOW (V) - Psalidoprocne holomelas

A breeding intra-African migrant, which only rarely visits PVP to feed on the forest-edge. Suitable breeding habitat in the form of exposed banks does not exist.(3%). Not recorded elsewhere in the study area.

BLACK CUCKOOSHRIKE (V) - Campephaga flava

Probably a scarce nonbreeding visitor to PVP, but it may breed. Due to their similarity to other black birds such as the Forktailed Drongo, males are not often recorded.(9%). Also recorded at 48 Clair Ave., 75th Anniversary Ave. and the Shepstone N. Reserve.

GREY CUCKOOSHRIKE (V) - Coracina caesia

One bird was recently recorded at PVP from June to September 1992. This species is known to be nomadic and would probably only breed in the larger urban nature reserves, e.g. Stainbank and Silverglen.(3%). Not known from elsewhere in the study area.

FORKTAILED DRONGO (V) - Dicrurus adsimilis

A common breeding resident at PVP, occurring mostly at the forest- edge.(94%). Also found throughout the study area, where it is sure to breed.

SQUARETAILED DRONGO (PR) - Dicrurus ludwigii

A sparse breeding resident, with the population at PVP probably not numbering more than between four and six birds. This species replaces the Forktailed Drongo in the forest-interior, where it is often associated with bird parties. Recorded commonly due to its vociferous nature.(98%). Only recorded at the Shepstone N. Reserve outside of PVP.

BLACKHEADED ORIOLE (V) - Oriolus larvatus

A nonbreeding visitor, to PVP, from inland areas, where it breeds.(7%). Recorded at 48 Clair Ave., 75th Anniversary Ave. and the Shepstone N. Reserve. The winter of 1992 produced more records than any other year.

PIED CROW - Corvus albus

Does not directly use PVP, but is often seen flying overhead. (32%). Common throughout the Study Area where it breeds in Norfolk Pines Araucaria heterophylla.

HOUSE CROW - Corvus splendens

Singletons are seen on occasion throughout the study area, barring natural areas such as PVP. This species is an alien and is normally found in the southern suburbs of the city, where it has its communal roost sites. Recent occurrences seem to be less frequent, possibly as a result of the success of the eradication programme waged by the Durban Parks Department.

SOUTHERN BLACK TIT (PR) - Parus niger

Formerly, prior to 1983, known to breed. No records since, but as the species is resident, breeding is probable.(86%). Occurs fairly commonly throughout the study area. Although once a fairly regular visitor to 223 Brand Rd. it has not been recorded for at least five years, this possibly indicating a local decline in numbers.

BLACKEYED BULBUL (PR) - Pycnonotus barbatus

A common breeding resident at PVP, where it keeps to the forest-edge or canopy.(99%). Also recorded as a breeding resident throughout the study area.

TERRESTRIAL BULBUL (PR) - Phyllastrephus terrestris

A common resident at PVP, where it has been recorded breeding in understorey shrubs or saplings, which are covered by a creepers. The population probably numbers more than 50 birds.(100%). Favours the forest- interior. Occurs on 75th Anniversary Avenue as well as the Shepstone Reserve, where there seems to be only one family group. Garden records are scarce, but it has been recorded at 48 Clair Avenue. A ringed bird was recovered dead from the corner of Howard Avenue and Manning Roads.

SOMBRE BULBUL (PR) - Andropadus importunus

A breeding resident at PVP, which is commonly recorded due to its loud call. Feeds mainly within the forest canopy, while remaining hidden.(99%). Occurs throughout the study area, but mainly recorded inland of the Valley. Only recently, September and October 1992, recorded at 223 Brand Rd.

YELLOWBELLIED BULBUL (V) - Chlorocichla flaviventris

A nonbreeding visitor to PVP, where it was only recorded on three occasions; twice in 1988 and once in 1991. E. Reynolds has a further record from July 1988. May have undergone a population decline at PVP.(2%). Was recorded regularly from the Shepstone N. Reserve, but not recorded elsewhere in the study area.

KURRICHANE THRUSH (PR) - Turdus libonyana

A common resident at PVP, where breeding was often evidenced by the observation of dependent young in their typically spotted plumage.(88%). Also recorded throughout the study area, but there are no records from 223 Brand Road, 426 Frere Road or Glengariff Place.

OLIVE THRUSH (H) - Turdus olivaceus

Prior to 1983, recorded as a breeding resident by G.R. Nichols. No conclusive records since then. Seems to have been displaced or replaced by the Kurrichane Thrush, throughout Durban, in the lower altitude coastal forests.

SPOTTED THRUSH (SDM) - Zoothera guttata

A winter visitor, most likely, from the breeding grounds in the Transkei. Four or five birds are recorded annually from March to September. Some of these were previously ringed individuals, thus showing fidelity to their wintering localities.(32%). Elsewhere only recorded from the Shepstone N. Reserve.

CHORISTER ROBIN (SDM) - Cossypha dichroa

A nonbreeding winter visitor from inland temperate forests. Single birds have been recorded by various observers over the past four years.(<1%). No other records from elsewhere in the study area.

NATAL ROBIN (PR) - Cossypha natalensis

A common breeding resident at PVP, found mainly in the forest interior. Numbers are augmented, in winter, by an influx of the subspecies C. n. egregior, which breeds in the south.(100%). Recorded elsewhere in the study area, wherever sufficient vegetation cover exists.

CAPE ROBIN (SDM) - Cossypha caffra

A scarce, nonbreeding, altitudinal winter migrant to the coast, where it has been recorded at PVP three times; in October and November 1989 and by H.A. Campbell during the winter of 1992.(2%). Not recorded elsewhere in the study area.

STARRED ROBIN - Pogonocichla stellata

Reputedly an altitudinal migrant to the coast. No records at PVP. The two birds seen on two occasions at the Shepstone N. Reserve, in August 1982, were the first that I have observed in ten years of birding in Durban. Both birds were in the first year transitional plumage, which this species attains, and were being constantly harassed by a Natal Robin.

WHITEBROWED ROBIN (H) - Erythropygia leucophrys

Previously possibly a breeding resident, although it was not recorded at PVP during the study period. This is most likely as a result of habitat loss through reforestation. Recorded on two occasions on the 75th Anniversary Avenue. H.A. Campbell reported a bird singing, in July 1992, outside the Reserve on the opposite side of King George V Avenue. Also heard singing from 48 Clair Avenue. Regular at the Shepstone N. Reserve, where suitable habitat exists.

EUROPEAN MARSH WARBLER (PM) - Acrocephalus palustris

A late-summer Palaearctic migrant to PVP, where it is unobtrusive and revealed on the forest-edge only by its contact call. Arrives in late November/December and leaves in March.(9%). Not recorded elsewhere in the study area, but probably overlooked at the Shepstone N. Reserve.

BARRATT'S WARBLER (SDM) - Bradypterus barratti

A nonbreeding altitudinal migrant, recorded low down on the forest-edge in the winters of 1991 and 1992. The birds started giving their full calls just before leaving for their midland breeding grounds.(3%). Not recorded elsewhere in the study area.

WILLOW WARBLER (PM) - Phylloscopus trochilus

A nonbreeding Palaearctic migrant, recorded from September to early May. Sporadic at PVP, where it was observed in 1983 as well as October and November 1990. Possibly under-recorded due to its quiet nature.(2%). Also recorded once at 223 Brand Road, but not elsewhere in the study area.

YELLOWTHROATED WARBLER (SDM) - Seicercus ruficapillus

A nonbreeding altitudinal migrant, which only seems to move from inland forests to the coast in some winters. This species was first recorded at PVP, in 1992, when it arrived in some numbers in March and was still present in September.(14%). Outside of PVP, it was only recorded once at Bulwer Park during the same period. I have only one other old record for Durban, that being from Stainbank Nature Reserve.

BARTHROATED APALIS (PR) - Apalis thoracica

A common breeding resident of the forest at PVP, where it was recorded breeding annually.(100%). Recorded at Bulwer Park, 75th Anniversary Avenue, the Shepstone N. Reserve and at 48 Clair Avenue.

YELLOWBREASTED APALIS (PR) - Apalis flavida

A breeding resident at PVP, where there are at most two or three pairs. A pair were seen feeding two young in January 1992.(69%). Recorded outside the reserve only on the opposite side of King George V Avenue and along the 75th Anniversary Ave.

BLEATING WARBLER (PR) - Camaroptera brachyura

A common breeding resident of the forest at PVP, where it was recorded breeding annually.(99%). Outside of the reserve, it was only found on the inland side; at 48 Clair Avenue, on 75th Anniversary Avenue and at the Shepstone N. Reserve.

RATTLING CISTICOLA - Cisticola chiniana

Not recorded at PVP, but was found on three occasions on the 75th Anniversary Avenue as well as on occasion elsewhere on the University grounds. It is probably a visitor to the study area from the informal open space on the far side of Francois Road.

TAWNYFLANKED PRINIA (PR) - Prinia subflava

A common breeding resident of the forest-margin. A pair breeds regularly at the little dam.(97%). Recorded commonly outside of PVP, but virtually exclusively on the inland side. Found once at 223 Brand Rd..

SPOTTED FLYCATCHER - Muscicapa striata

A nonbreeding Palaearctic migrant to the region. Not recorded at PVP, but seen once during the summer of 1989 near the Natal University Science block, where a bird was seen hawking small alates in competition with dragonflies.

DUSKY FLYCATCHER (SDM) - Muscicapa adusta

A common, nonbreeding altitudinal or short distance-migrant to PVP from about March to September. The few birds which may spend the summer do not seem to breed. Interestingly, this is a breeding species in the Palmiet Nature Reserve, which is approximately 10 km inland from PVP.(66%). Found throughout the study area, but far more commonly inland of PVP. Occurred in all gardens excepting that at Glengariff Place.

BLUEGREY FLYCATCHER (V) - Muscicapa caerulescens

Fairly common at PVP, where it is mostly a visitor. It was, however, recorded breeding successfully in a natural cavity in a Forest croton Croton sylvaticus in October 1991. Tends to keep to the edge of the forest, but requires a fair amount of cover.(20%). Recorded commonly on the 75th Anniversary Corridor, yet not elsewhere in the study area.

BLACK FLYCATCHER (PR) - Melaenornis pammelaina

Common breeding resident at PVP, where it keeps to the mown glades at the forest edge. Adult birds are observed feeding young each breeding season.(49%). Also found fairly commonly throughout the study area, although not at 223 Brand Rd., Glengariff Place and 426 Frere Rd..

FISCAL FLYCATCHER - Sigelus silens

A female was recorded as a winter visitor, in 1992, to the grassland spur at the Shepstone N. Reserve. This record coincided with an influx of this species into Durban during the dry winter of 1992.

CAPE BATIS (PR) - Batis capensis

A commonly recorded, but sparse breeding resident of the forest at PVP. The entire population probably consists of two or three pairs.(54%). Also recorded at 48 Clair Ave. and once, in May 1992, on 75th Anniversary Ave..

CHINSPOT BATIS (PR) - Batis molitor

Exact status is uncertain, but possibly not resident, however it is rather a common visitor to PVP. This species keeps to the forest margins, and thus occupies a different niche to the Cape Batis. Breeding has not been recorded, but is likely. Most observations are of single birds.(32%). Not noted at Bulwer Park, or any of the gardens seaward of PVP. It was found at 48 Clair Ave., commonly on 75th Anniversary Ave. and in the bushclumps on the grassland spur at the Shepstone N. Reserve.

BLUEMANTLED FLYCATCHER (V) - Trochocercus cyanomelas

A female was recorded once in 1984 at PVP. Also found at the Shepstone N. Reserve in July 1992. Nowhere common in Durban.

PARADISE FLYCATCHER (SDM) - Terpsiphone viridis

A regular breeding intra-African migrant to the forest and edge at PVP, mostly occurring between September and April. A few birds over-winter, making exact arrival and departure times difficult to determine.(89%). Also recorded throughout most of the study area, but not at 426 Frere Rd.. Resident at 223 Brand Rd. for the last three summers, probably because of an increase in vegetation cover, but not yet shown to breed.

CAPE WAGTAIL (V) - Motacilla capensis

Recorded once at the small pond at the entrance to the Valley. Also occurs in fair numbers throughout the study area, even in built-up parts. Numbers are once more on the increase in Durban after a decline because of the indiscriminate use of insecticides.

FISCAL SHRIKE (PR) - Lanius collaris

Breeding resident at PVP, with one pair holding a territory on the large reservoir and its surrounds. The Reserve itself does not provide suitable habitat.(5%). Common breeding resident throughout the rest of the study area, including gardens.

SOUTHERN BOUBOU (PR) - Laniarius ferrugineus

Breeding resident at PVP, where it tends to keep to dense cover. Judging from the calling pairs, there may be as many as 20 individuals in the Reserve at any one time.(100%). Not found seaward of PVP in the study area, but has been noted at most of the inland sites.

PUFFBACK (PR) - Dryoscopus cubla

Common breeding resident of the forest at PVP, where it spends much time feeding in the canopy. Recorded breeding every year.(97%). Also found at Bulwer Park, 48 Clair Ave., the 75th Anniversary Ave. Corridor and the Shepstone N. Reserve.

SOUTHERN TCHAGRA (PR) - Tchagra tchagra

A resident at PVP, where it is less frequently recorded in winter due to its secretive nature and the fact that it does not give its characteristic territorial call during this period. It inhabits one particular patch of tangles on the forest-edge. There is only one pair at PVP, and it is expected that with time reforestation will remove its habitat. Breeding is likely but as yet unproven.(67%). Also occurs sparsely on the 75th Anniversary Ave. and at the Shepstone N. Reserve. Sparse throughout the rest of Durban.

GORGEOUS BUSH SHRIKE (V) - Telophorus quadricolor

Recorded for the first time in June 1992, and was still present in August 1992. The bird/s observed were immature, which began to attain adult plumage during this period.(2%). Not recorded elsewhere in the study area. Only occur in small numbers in scattered localities throughout Durban.

ORANGEBREASTED BUSH SHRIKE (V) - Telophorus sulfureopectus

Recorded, once in 1983, as a visitor. Habitat at PVP is suitable, but not ideal. Possibly occurs more often than recorded, but like the other bush shrikes their skulking nature means they are not often observed. Not found elsewhere in the study area even though the Shepstone Reserve seems suitable.

OLIVE BUSH SHRIKE (SDM) - Telophorus olivaceus

A visitor, which was first recorded in November 1987. One bird spent some time in the Valley during November 1991. Two birds of the olive form were seen by J. Gourley in September 1992. This species is more commonly found in temperate forests. The resident Natal Robins learnt this species' call, which they used in their imitations.(2%). Not found elsewhere in the study area, and is generally uncommon on the coast.

INDIAN MYNA (V) - Acridotheres tristis

A common, breeding alien species of the suburbs, which almost never enters the Valley.

WATTLED STARLING - Creatophora cinerea

Recorded twice in the study area. Once at the end of August 1992, feeding on Natal fig Ficus natalensis fruits in MacDonald Rd., and secondly in September 1992 at 223 Brand Rd..

PLUMCOLOURED STARLING - Cinnyricinclus leucogaster

A breeding intra-African migrant recorded from October to April. Not found at PVP, but observed once at the Natal University Jubilee Gardens.

GLOSSY STARLING (V) - Lamprotornis nitens

An uncommon visitor to PVP, where it was recorded once in October 1991. It has also been reported on other occasions, but possible confusion with the next species may mean it is under or over-recorded.(1%). Not recorded elsewhere in the study area.

BLACKBELLIED STARLING (V) - Lamprotornis corruscus

Nowadays, a non-breeding visitor, which was recorded prior to 1983 as breeding by G.R. Nichols.(49%). Recorded at 48 Clair Ave. and at various localities inland of PVP.

REDWINGED STARLING - Onychognathus morio

Does not use the Valley proper, but was observed flying overhead on a number of occasions. Common throughout the study area, especially so on the University buildings, where it breeds. Numbers possibly increasing as a result of adaptation to nesting on buildings, which substitute for natural cliffs.

PURPLEBANDED SUNBIRD (SDM) - Nectarinia bifasciata

Only recently recorded, from September 1989 onwards, as a winter visitor to PVP. All records are of birds in nonbreeding plumage, which makes them difficult to distinguish from other sunbirds. This has probably led to under-counting.(5%). Not recorded elsewhere in the study area.

WHITEBELLIED SUNBIRD (PR) - Nectarinia talatala

A common resident, which has not been observed breeding recently at PVP, although records prior to 1983 do exist. It is expected that this species breeds undetected in the more open areas of the Valley.(89%). It is also the commonest sunbird throughout the study area, where it breeds annually at 223 Brand Rd..

GREY SUNBIRD (PR) - Nectarinia veroxii

Common resident of the forest at PVP, where it breeds every year. Nests, as with other sunbirds, are particularly susceptible to predation by Vervet Monkeys Cercopithecus aethiops.(91%). Found commonly at the Shepstone Reserve and on the 75th Anniversary Ave. Less common seaward of PVP, but was recorded at Bulwer Park and on three occasions, in 1992, at 223 Brand Rd.

OLIVE SUNBIRD (PR) - Nectarinia olivacea

A common, though thinly distributed resident of the forest at PVP. There are no breeding records after 1983, although breeding almost certainly still occurs. Quieter than the previous species, which may be the reason it is recorded less frequently.(78%). Recorded at all localities inland of PVP, but at none on the seaward side.

BLACK SUNBIRD (SDM) - Nectarinia amethystina

A common predominately winter visitor to PVP, where it is found at the forest-edge. Almost all individuals are seen in female, immature male or eclipse plumage. Never recorded breeding, but may possibly do so. Large numbers may sometimes congregate at a food source.(69%). Common, again mainly in winter, throughout the study area, but not recorded at Glengariff Place. Overall the second most common sunbird species.

COLLARED SUNBIRD (PR) - Anthreptes collaris

Common breeding resident of the forest at PVP. One of the most conspicuous breeding species, seen feeding fledglings as early as July. Nests are often destroyed by Vervet Monkeys.(100%). Outside of PVP it was found at 48 Clair Ave., 75th Anniversary Ave. and at the Shepstone N. Reserve. Scarce seaward of PVP, where a single bird was recorded once at 223 Brand Rd. during the winter of 1992.

CAPE WHITE-EYE (PR) - Zosterops pallidus

Very common breeding resident at PVP, where it is found in all habitats.(98%). Also occurs and breeds commonly throughout the study area.

HOUSE SPARROW (V) - Passer domesticus

Occasionally recorded at the office at the entrance to the Valley, but never within the forest. Occurs and breeds throughout the study area in association with buildings.

THICKBILLED WEAVER (V) - Amblyospiza albifrons

Common daily visitor to PVP, where it feeds within the forest on fallen Thorny Elm Chaetacme aristata fruits and in the canopy on Natal Elm Celtis mildbraedii fruits. Breeds in reedbeds, and as soon as the young are old enough to fly they follow their parents to feeding areas.(92%). Also occurs throughout the study area particularly in association with the favoured foodplants. Not recorded at Glengariff Place.

FOREST WEAVER (PR) - Ploceus bicolor

Occurs as a breeding resident of the forest-interior at PVP, where it was recorded breeding in 1986 and 1987. No recent records, although breeding is still possible. Thinly distributed, with perhaps two or three pairs resident.(69%). In the remainder of the study area it was recorded at the Shepstone N. Reserve, 48 Clair Ave. and once on the 75th Anniversary Ave..

SPECTACLED WEAVER (PR) - Ploceus ocularis

A resident at PVP, which regularly breeds successfully. Nests are susceptible to Vervet Monkeys. Found mainly at the forest edge.(93%). Common throughout the study area, where it has bred at 223 Brand Rd..

SPOTTEDBACKED WEAVER (V) - Ploceus cucullatus

A nonbreeding visitor to PVP, which favours the more open areas.(12%). Far more common elsewhere in the study area, where the species breeds where there are palms, Fever trees Acacia xanthophloea or Leopard trees Caesalpinia ferrea and water.

CAPE WEAVER - Ploceus capensis

Not recorded at PVP, but mainly a winter visitor to the coast, where it was recorded at 223 Brand Rd. and 426 Frere Rd..

YELLOW WEAVER (V) - Ploceus subaureus

A winter visitor, which was first recorded at PVP in the winter of 1992, when it was common even within the forest. This species breeds in reedbeds, the closest of which are to be found on the Umkumbaan River. The similarity of the non-breeding plumage to the other Ploceus weavers may mean that it has previously been overlooked.(9%). Also recorded on 75th Anniversary Ave. and at the Shepstone N. Reserve.

RED BISHOP - Euplectes orix

Birds seen in the study area where mostly individuals flying over. They may feed at bird feeders, as recorded once at 223 Brand Rd.

GREEN TWINSPOT (V) - Mandingoa nitidula

A nonbreeding visitor to PVP, which may be under-recorded due to its elusive nature and subdued call. Feeds mainly on seeding forest grasses, e.g. Setaria megaphylla.(11%). Recorded outside of PVP at 48 Clair Ave., and once, in August 1992, when two birds were seen flying over 223 Brand Rd.

BLUEBILLED FIREFINCH (V) - Lagonosticta rubricata

Nowadays an uncommon visitor to PVP, where its favoured scrubby habitat has largely disappeared because of the regrowth of the forest.(5%). Not common outside of the Park, but was found once each at the Shepstone N. Reserve and 75th Anniversary Ave.. Two birds were seen once at 223 Brand Rd..

COMMON WAXBILL (V) - Estrilda astrild

A nonbreeding visitor to PVP, where it was recorded on the forest edge feeding on Setaria megaphylla seeds. Usually found near water amongst sedges and grasses. Habitat of this description, only exists in two small patches at PVP.(2%). Recorded outside of PVP at 48 Clair Ave..

GREY WAXBILL (V) - Estrilda perreini

A nonbreeding winter visitor to PVP, where like most of the other small seedeaters it has a preference for seeding S. megaphylla and Panicum maximum plants.(4%). Outside of PVP, only recorded at 48 Clair Ave..

BRONZE MANNIKIN (PR) - Spermestes cucullatus

Common breeding resident at PVP, where it is found feeding on the forest- edges.(90%). Also common as a breeding resident throughout the rest of the study area.

REDBACKED MANNIKIN (V) - Spermestes bicolor

An uncommon visitor to PVP, where it was observed building a roosting nest in July 1989. Not recorded at all during 1992.(5%). Not recorded elsewhere in the study area.

PINTAILED WHYDAH (V) - Vidua macroura

Found as a nonbreeding visitor to PVP, mainly on the edge of the forest. Usually utilises the Reserve as a resting stopover and not to feed.(5%). Found throughout the study area, although more often than not flying overhead. Also sporadically recorded in the last two years at 223 Brand Rd., where it feeds at a bird feeder. One male took up residence here for the whole of the 1990/91 summer.

BLACK WIDOWFINCH (H) - Vidua funerea

Recorded as a visitor at PVP, prior to 1983, and not since. Also recorded once in August 1991 on 75th Anniversary Ave..

YELLOWEYED CANARY (PR) - Serinus mozambicus

Common breeding resident of the forest-edge. Breeding since 1983 has not been proven but seems likely.(68%). Common throughout the study area.

CAPE CANARY - Serinus canicollis

Recorded, once each, flying over PVP and the 75th Anniversary Ave., during the winter of 1992. This species is known to be an altitudinal migrant but wintering grounds at this latitude are not usually so close to the coast.

BULLY CANARY (V) - Serinus sulphuratus

Fairly commonly recorded as a visitor to the fringes of PVP, where it may even breed.(19%). Common throughout the rest of the study area.

STREAKYHEADED CANARY (V) - Serinus gularis

Found, since 1989, as a visitor to the fringes of PVP, where it is unlikely to be breeding.(12%). Also occurs fairly commonly throughout the study area, but less so than the Bully Canary.

GOLDENBREASTED BUNTING (V) - Emberiza flaviventris

Recorded once by H.A. Campbell in April 1992 at the entrance to the reserve.

APPENDIX 2: SUGGESTED HISTORICAL LISTS (c. 1850) FOR DURBAN'S BEREA RIDGE FORESTS VS CURRENT (PVP) AND LAWSON'S (DURBAN, 1956) SPECIES LIST.

LIST 1 = FULL LIST FOR PVP AS AT 17/6/92 TOTAL = 118 WHICH EXCLUDES SPECIES FLYING OVER, EXCEPT FOR BLACK SAWWING AND LESSER STRIPED SWALLOWS AND PALM SWIFT.
LIST 2 = W LAWSON (1956) CHECKLIST OF THE BIRDS OF DURBAN (extraction of forest and forest margin species).
LIST 3 = G.R. NICHOLS HISTORICAL. SUGGESTED LIST OF SPECIES WHICH MAY HAVE OCCURRED AROUND 1850.
LIST 4 = P.A. CLANCEY HISTORICAL. SUGGESTED LIST OF SPECIES WHICH MAY HAVE OCCURRED AROUND 1850.
LIST 5 = R. COWGILL HISTORICAL. SUGGESTED LIST OF SPECIES WHICH MAY HAVE OCCURRED AROUND 1850.
LIST 6 = A. BERRUTI HISTORICAL. SUGGESTED LIST OF SPECIES WHICH MAY HAVE OCCURRED AROUND 1850.
LIST 7 = K. COOPER HISTORICAL. SUGGESTED LIST OF SPECIES WHICH MAY HAVE OCCURRED AROUND 1850.
LIST 8 = AUTHOR'S HISTORICAL. SUGGESTED LIST OF SPECIES WHICH MAY HAVE OCCURRED AROUND 1850.

KEY:

F - Forest bird.
M - Forest margin bird.
N - Non-forest species.
x - Species not differentiated between forest and margin.
? - Occurrence questionable.
O - Overfly.
- - Status not indicated.
* - Indicator species.
E - Extinct as a breeding species at PVP.
Br - Breeds at PVP.
NBr - Not expected to breed at PVP.
NR - Not recorded at PVP, in the last five years.
R - Red Data Species. (R) Rare, (I) Indeterminate and (V) Vulnerable.

	1	2	3	4	5	6	7	8	
Blackheaded Heron Ardea melanocephala	N	M						M	
Hamerkop Scopus umbretta	N								
Hadeda Ibis Bostrychia hagedash	M	M	M	x	F	M	F	?	
Secretary Bird Sagittarius serpentarius	N								
Yellowbilled Kite Milvus parasitus	M	M	?	x	F	M	M	F	
*Cuckoo Hawk R(I) Aviceda cuculoides		F	F	x		M	F	F	Locally extinct and regionally not at all common. E NR
Bat Hawk R(R) Macheiramphus alcinus		M						M	Used to breed in Durban.
Wahlberg's Eagle Aquila wahlbergi				x		?		M	
Booted Eagle Hieraaetus pennatus	N	M						M	
*Longcrested Eagle Lophaetus occipitalis		M	F	x		M	F	M	Locally extinct, but numbers increasing regionally due to the utilisation of exotic plantations. E NR
*Crowned Eagle Stephanoaetus coronatus	F		F	x	F	F	F	F	No longer breeds in the study area. Vulnerable due to forest destruction as it has a large home range. E

	1	2	3	4	5	6	7	8	
*Southern Banded Snake Eagle R(R) Circaetus fasciolatus		?	F	x		F		F	May possibly have occurred historically. Recent Durban records very rare.
Steppe Buzzard Buteo buteo	O	M		x		M		M	
Lizard Buzzard Kaupifalco monogrammicus		M	F			M	F	?	
Redbreasted Sparrowhawk Accipiter rufiventris				x					
*Little Sparrowhawk Accipiter minullus	F	F	F	x	F	F	F	M	Rare in the study area, although it may be overlooked. Probably not in danger as it utilises exotics for breeding. E
Black Sparrowhawk Accipiter melanoleucus	F	F	M	x	F	F		F	
Little Banded Goshawk Accipiter badius		M				?			Used to breed at this the southernmost extreme of its range. Records in Durban are now rare.
African Goshawk Accipiter tachiro	F	F	F	x	F	F	F	F	
Gabar Goshawk Micronisus gabar		M	M					M	Occurs sporadically in and around Durban. May formerly have been more common.
*Gyymnogene Polyboroides typus	F	F	M	x	F			F	Not common in the inner suburbs where it probably no longer breeds due to a lack of suitable large tracts of forest. E
Lanner Falcon Falco biarmicus	O			x					
*Natal Francolin Francolinus natalensis	M	M	M	x	M	M	M	M	Vulnerable in the study area. No longer occurs at PVP. The small covey at the Shepstone Reserve is harassed by dogs. E
*Buffspotted Flufftail Sarothrura elegans	F	F	F	x	F	F	F	F	Due to its habitat specificity it may be vulnerable in the study area. Br
*Rameron Pigeon Columba arquatrix		F		x	F	?	F	F	Used to occur in numbers during winter. Locally extinct though still found in the inland areas of Durban. NBr
*Delegorgue's Pigeon R(I) Columba delegorguei		F	F	x	F	?	F	F	Extinct as a breeding bird, in Durban, although once fairly common. E NR
Redeyed Dove Streptopelia semitorquata	M	F	M	x	F	F	F	F	
Laughing Dove Streptopelia senegalensis	N	M					F		
Greenspotted Dove Turtur chalcospilos	N		M			?	M	M	
*Tambourine Dove Turtur tympanistria	F	F	F	x	F	F	F	F	Within the study area, mainly restricted to PVP. Generally common where suitable habitat exists. Br
*Cinammon Dove Aplopelia larvata		F	F	x	F	F	F	F	Previously probably found in all forests in Durban. Locally extinct at PVP. E NR
*Green Pigeon Treron calva		F	F	x	F	F	F	F	Probably extinct as a breeding species in Durban. Once common, records nowadays are rare. E NR
Cape Parrot R(V) Poicephalus robustus		F			F				Does not occur. Previous status uncertain. Possibly a winter visitor.
Knysna Loerie Tauraco corythaix	F		F	x	F			F	
Purplecrested Loerie Tauraco porphyreolophus	F	F	F	x	F	F	F	F	
European Cuckoo Cuculus canorus	M	M		x				M	
Redchested Cuckoo Cuculus solitarius	F	F			F	F	F	F	

	1	2	3	4	5	6	7	8	
Black Cuckoo Cuculus clamosus		F	F	x	F	F	F	F	Coastal records at Durban are rare. Previous status uncertain.
Emerald Cuckoo Chrysococcyx cupreus	F	F	F	x	F	F	F	F	Possibly more common in the past although tends to be centred at somewhat higher altitudes.
*Klaas's Cuckoo Chrysococcyx klaas	F	F	F	x	F	F	F	F	Small numbers at PVP. Rarely recorded elsewhere in the study area. Br
Diederik Cuckoo Chrysococcyx caprius	N	M	?	x	M	M	F	M	
*Green Coucal Ceuthmochares aereus	F	F	F	x	F	F	F	F	Thinly distributed throughout Durban. In the study area only recorded at PVP. E
Burchell's Coucal Centropus burchellii	M	M	M	x	M		F	M	
*Wood Owl Strix woodfordii		F	F	x	F	F	F	F	Locally extinct, with small numbers remaining in large forested tracts in Durban. E NR
Spotted Eagle Owl Bubuo africanus	M	M	M	x	F	M	F	M	
European Nightjar Caprimulgus europaeus			F	x				M	
Fierynecked Nightjar Caprimulgus pectoralis	N		M	x	M		M	M	
Mozambique Nightjar Caprimulgus fossii				x				?	
Palm Swift Cypsiurus parvus	N	O		x	-	-	-	O	
Speckled Mousebird Colius striatus	M	M	M	x	M	M	F	M	
*Narina Trogon Apaloderma narina	F	M	F	x	F	F	F	F	Possibly vulnerable due to small populations and habitat specificity. E
*Pygmy Kingfisher Ispidina picta	M	M	F	x	F	M	F	F	Locally extinct, as a breeding species at PVP, where it previously bred. Suffers losses on migration. E
*Mangrove Kingfisher R(I) Halcyon senegaloides	M	F		x			F	M	If it bred formerley, there has been a loss of breeding range in Durban. NBr
Brownhooded Kingfisher Halcyon albiventris	M	M	?	x	M	M	F	M	
Little Bee-eater Merops pusillus	M	M	?	x	M		M	M	
European Roller Coracias garrulus		M			M			M	
Broadbilled Roller Eurystomus glaucurus						?		?	
Hoopoe Upupa epops	M	M		x	M		M	M	
Redbilled Hoopoe Phoeniculus purpureus	M	M	F	x	F	M	F	M	
*Trumpeter Hornbill Bycanistes bucinator		F	F	x	F	F	F	F	Extinct in the study area, but still found in the larger inland forested tracts. E NR
*Crowned Hornbill Tockus alboterminatus	F	F	F	x	F	F	F	F	Extinct in the study area as a breeding species. E NR
Blackcollared Barbet Lybius torquatus	M	M	M	x	F	F	F	F	
White-eared Barbet Stactolaema leucotis	F		F	x		F	F	F	

	1	2	3	4	5	6	7	8	
Redfronted Tinker Barbet Pogoniulus pusillus	F	F	F	x	F	F	F	F	
Goldenrumped Tinker Barbet Pogoniulus bilineatus	F	F	F	x	F	F	F	F	
*Greater Honeyguide Indicator indicator	M	M	F	x	F		F	M	Sparse in the study area and the rest of Durban. Margin species. E
*Scalythroated Honeyguide Indicator variegatus	F	F	F	x	F	F	F	F	Locally extinct, at PVP, and vulnerable in the rest of Durban. Occurs only in larger forests. E
*Lesser Honeyguide Indicator minor	M	M	F	x	F	M	F	M	Sparse in the study area and the rest of Durban. Margin species. E
*Sharpbilled Honeyguide Prodotiscus regulus	M	M	F	x	M	?	M	M	Sparse in the study area and the rest of Durban. Br
Goldentailed Woodpecker Campethera abingoni	F	F	F	x	F	F	F	F	
Cardinal Woodpecker Dendropicos fuscescens	M	M	M	x	F	M	F	M	
Olive Woodpecker Mesopicos griseocephalus		F	F	x	F		F	F	Former status uncertain but does not occur in the study area.
Redthroated Wryneck Jynx ruficollis		M		x	M		M	M	
*African Braodbill R(V) Smithornis capensis		F	F	x	F	F	F	F	Locally extinct in the study area and the rest of Durban. Once a common breeding resident. E NR
Lesser Striped Swallow Hirundo abyssinica	N			x			O	O	
*Black Sawwing Swallow Psalidoprocne holomelas	M	M	M	x	F	M	F	M	Uncommon in the study area. Would probably have been common in the past. E
*Black Cuckooshrike Campephaga flava	F	F	F	x	F	F	F	F	Probably not resident in the study area. Present only as individuals. E
*Grey Cuckooshrike Coracina caesia	F	F	F	x	F	F	F	F	Only recently recorded at PVP (1992). Not recorded elsewhere in the study area. Sparse in the rest of Durban. E
Forktailed Drongo Dicrurus adsimilis	M	M	M	x	F	F	F	F	
*Squaretailed Drongo Dicrurus ludwigii	F	F	F	x	F	F	F	F	Small numbers, limited dispersal and an isolated population at PVP make this population vulnerable. Br
European Golden Oriole Oriolus oriolus		F		x	F	?	F	M	
Blackheaded Oriole Oriolus larvatus	F	F	F	x	F	F	F	F	
Pied Crow Corvus albus	O	M		x			M	M	
Southern Black Tit Parus niger	M	M	M	x	F	M	F	M	
Blackeyed Bulbul Pycnonotus barbatus	F	F	?	x	M	M	F	F	
Terrestrial Bulbul Phyllastrephus terrestris	F	F	F	x	F	F	F	F	
Sombre Bulbul Andropadus importunus	F	F	F	x	F	F	F	F	
*Yellowbellied Bulbul Chlorocichla flaviventris	F	F	F	x	F	F	F	F	Numbers have dwindled at PVP such that its status, today, is that of rare visitor. E
Kurrichane Thrush Turdus libonyana	F	F	M	x	F	F	F	F	

	1	2	3	4	5	6	7	8	
*Olive Thrush Turdus olivaceus	F	F	F	x	F	F	F	F	Formerly occurred at PVP and now extinct in the study area. Probably replaced by the Kurrichane Thrush. E NR
*Spotted Thrush R(V) Zoothera guttata	F		F	x	F	F	F	F	Once a breeding species in Durban. Now a sparse winter visitor with strict habitat requirements. NBR
Stonechat Saxicola torquata				x	M		M		
Chorister Robin Cossypha dichroa	F	F	F	x	F	F	F	F	
Natal Robin Cossypha natalensis	F	F	F	x	F	F	F	F	
Cape Robin Cossypha caffra	F	F	?	x	F		F	F	
Starred Robin Pogonocichla stellata		F	?	x	F		F	F	
Whitebrowed Robin Erythropygia leucophrys	M	M	?	x	M	M		M	
*Brown Robin Erythropygia signata		F	F	x	F	?	F	F	Formerly found throughout Durban. Now only occurs on the outskirts of the city. E NR
Garden Warbler Sylvia borin		M		x	M				
*European Marsh Warbler Acrocephalus palustris	M	M	F	x				F	Habitat requirements within the study area seeem rigid as it has only been recorded at PVP. NBr
Barratt's Warbler Bradypterus barrati	M	M	F	x	F	M	M	F	
Knysna Warbler Bradypterus sylvaticus								M	
Willow Warbler Phylloscopus trochilus	M	M	M	x	F	M	F	M	
*Yellowthroated Warbler Seicercus ruficapillus	F	F	F	x	F	F	F	F	Formerly may have been a breeding resident. Now only occurs sparingly, in Durban, in winter. E
Barthroated Apalis Apalis thoracica	F	F	F	x	F	F	F	F	
Yellowbreasted Apalis Apalis flavida	M	F	F	x	F	F	F	F	
Bleating Warbler Camaroptera brachyura	F	F	F	x	F	F	F	F	
Neddicky Cisticola fulvicapilla		M			M		M	M	
Tawnyflanked Prinia Prinia subflava	M	M	M	x	M	M	M	M	
Spotted Flycatcher Muscicapa striata				x	M	M	F	M	
Dusky Flycatcher Muscicapa adusta	M	M	F	x	M	M	F	F	
*Bluegrey Flycatcher Muscicapa caerulescens	M	F	F	x	F	M	F	F	Not common nor resident at PVP which seems to have suitable habitat. Br
Black Flycatcher Melaenornis pammelaina	M	M	M	x	M	M	F	M	
Fiscal Flycatcher Sigelus silens				x	M		M	M	
*Cape Batis Batis capensis	F	F	F	x	F	F	F	F	Small numbers, little apparent dispersal and habitat specificity threaten this species at PVP. Br

	1	2	3	4	5	6	7	8	
Chinspot Batis Batis molitor	M	F	M	x	F	M	M	M	
*Bluemantled Flycatcher Trochocercus cyanomelas	F	F	M	x	F	F	F	F	Probably common throughout the study area and Durban in the past. Now not common anywhere and study area records are rare. E NR
Paradise Flycatcher Terpsiphone viridis	F	F	F	x	F	F	F	F	
Cape Wagtail Motacilla capensis	N								
Fiscal Shrike Lanius collaris	N	M		x	M		F	M	
Redbacked Shrike Lanius collurio				x				M	
Southern Boubou Laniarius ferrugineus	F	F	F	x	F	F	F	F	
Puffback Dryoscopus cubla	F	F	F	x	F	F	F	F	
*Southern Tchagra Tchagra tchagra	M	M	M	x	M	M	F	M	At most a pair each at the Shepstone Reserve and PVP. Thinly distributed in Durban. Br
Blackcrowned Tchagra Tchagra senegala		M	M	x		M	M	M	
*Gorgeous Bush Shrike Telophorus quadricolor	F	F	?	x	F	F	F	F	Probably common although thinly distributed in the past. Now sparse in Durban and only recently (1992) recorded at PVP. E
Orangebreasted Bush Shrike Telophorus sulfureopectus	M	M	?	x	F	F	F	F	
Olive Bush Shrike Telophorus olivaceus	F	F	F	x	F	F	F	F	
*Greyheaded Bush Shrike Malaconotus blanchoti		F	F	x	F	?	F	F	Formerly probably occurred, albeit, sparsely. Today extinct in the study area and rare in the rest of Durban. E NR
Wattled Starling Creatophora cinerea							M		
Indian Myna Acridotheres tristis	N								
Plumcoloured Starling Cinnyricinclus leucogaster		M			F		M	M	
Glossy Starling Lamprotornis nitens	N	M	?	x	F		F	M	
*Blackbellied Starling Lamprotornis corruscus	F	F	F	x	F	F	F	F	Used to breed at PVP. Now only occurs sporadically although habitat seems suitable. E
Redwinged Starling Onychognathus morio				x			M	M	
Redbilled Oxpecker Buphagus erythrorhynchus				x					
Purplebanded Sunbird Nectarina bifasciata	M	M					F	F	
Lesser Doublecollared Sunbird Nectarinia chalybea		F							
Whitebellied Sunbird Nectarinia talatala	M	M		x	M	M	F	F	
Grey Sunbird Nectarinia veroxii	F	F	F	x	F	F	F	F	
Olive Sunbird Nectarinia olivacea	F	F	F	x	F	F	F	F	

	1	2	3	4	5	6	7	8	
Black Sunbird Nectarinia amethystina	M	M	M	x	F	F	F	F	
Collared Sunbird Anthreptes collaris	F	F	F	x	F	F	F	F	
Cape White-eye Zosterops pallidus	F	F	F	x	F	F	F	F	
House Sparrow Passer domesticus	N								
Greyheaded Sparrow Passer griseus		M	M	x			F		
Yellowthroated Sparrow Petronia superciliaris		M		x		M	F		
Thickbilled Weaver Amblyospiza albifrons	F	F	F	x	F	F	F	F	
*Forest Weaver Ploceus bicolor	F	F	F	x	F	F	F	F	A small population at PVP and restricted dispersal make this species vulnerable here. Br
Spectacled Weaver Ploceus ocularis	M	M	M	x	F	F	F	F	
Spottedbacked Weaver Ploceus cucullatus	N	M		x		M	F	M	
Cape Weaver Ploceus capensis		M		x			F	M	
Yellow Weaver Ploceus subaureus	M	F						M	
*Green Twinspot Mandingoa nitidula	M	F	M	x	F	F	F	F	Possibly more common in the past. E
Bluebilled Firefinch Lagonosticta rubricata	M	M	M	x	M	M	F	M	
Redbilled Firefinch Lagonosticta senegala				x					
Blue Waxbill Uraeginthus angolensis				x					
Common Waxbill Estrilda astrild	N	M		x	M	M	F	M	
*Grey Waxbill Estrilda perreini	M	F	M	x	M	F	F	F	Possibly more common in the past. E
Swee Waxbill Estrilda melanotis		M	M	x		?	F	?	Former status uncertain but no longer occurs in the study area but still found on edges of inland forest.
Orangebreasted Waxbill Sporaeginthus subflavus				x					
Bronze Mannikin Spermestes cucullatus	M	M	M	x	M	M	F	M	
Redbacked Mannikin Spermestes bicolor	M	M	M	x	M	M	F	M	
Pied Mannikin R(I) Spermestes fringilloides		M						M	Former status uncertain but does not occur in the study area.
Pintailed Whydah Vidua macroura	M	M		x	M	M	F	M	
Black Widowfinch Vidua funerea	M	M	M			M		M	
Yelloweyed Canary Serinus mozambicus	M	M	M	x	M	M	F	M	

	1	2	3	4	5	6	7	8
Cape Canary Serinus canicollis	O	M				M		M
Forest Canary Serinus scotops			F	x			F	M
Bully Canary Serinus sulphuratus	M	M	M	x	M	M	F	M
Streakyheaded Canary Serinus gularis	M		?	x	M		F	M
Goldenbreasted Bunting Emberiza flaviventris	M			x	M			

APPENDIX 3: Species recorded on the Pigeon Valley / Bulwer Park Corridor between December 1991 and September 1992.

$ - Denotes ad hoc observation.
? - Inconclusive observation.
O - Species observed flying over the corridor.
* - Bird seen crossing road.
A,B,C - in date columns refer to corridor sections: A - Rhodes Avenue., B - Manning Road., C - Bulwer Park.
A,B,C - In species columns: A - corridor is major part of species range in Study Area.
B - important part of species range in Study Area.
C - species more reliably present in other localities in Study Area.
D - minor part of species range in the Study Area.
#1 - Total number of observations of each species utilising the three sections of the corridor (excludes species flying over the corrido
#2 - Total number of times the species was observed flying over the corridor.
#3 - Number of times the species was observed crossing a road (i.e. a potential barrier).
#4 - Bridge utilisation index. Calculated as the number of times a species was observed utilising the three sections of the corridor as a percentage of the total possible observations (17 visits X 3 corridor sections).

DATE OF VISIT	DEC 91	DEC 91	APR 91	JUL 91	AUG 91	AUG 91	SEP 91	SEP 91	SEP 91	OCT 91	OCT 91	NOV 91	NOV 91	MAR 92	MAY 92	JUN 92	SEP 92	TOT OBS #1	No. Ofly #2	No. Cros #3	Br. Util #4
Hadeda Ibis A	C	C	C	ABC*	C	BC	ABC	AC	AB*	OC	BC	BC	AC	AC*	BC*		BCO	29	2	4	57
Black Sparrowhawk B		C	C							B*				O				3	1	1	6
African Goshawk B			C							O							C	2	1	0	4
Purplecrested Lourie B					C					C	C	C	C		C			6	0	0	12
Diederik Cuckoo A		B																1	0	0	2
Whiterumped Swift			O				O	O	O	O	O	O		O				0	8	0	0
Palm Swift						O	O	O										0	3	0	0
Speckled Mousebird A	AB	BC	AC	BC	AC	ABC*	BC*	AC*	ABC*	ABC*	ABC*	ABC*	AC	C	ABC	AC	ABC	40	0	7	78
Brownhooded Kingfisher A	C		B		C	B	C					B			B		B	8	0	0	16
Redbilled Hoopoe $																					0
Blackcollared Barbet A	C	B	ABC	B	B	B	C		BC	B	C	ABC	AC	AB*	C	AC	BC	25	0	1	49
Goldenrumped Tinker Barbet C											A							1	0	0	2
Goldentailed Woodpecker D	C		B	C				C		C			AB*					7	0	1	14
Cardinal Woodpecker C		C		A		C												3	0	0	6
European Swallow	O	O	O							O								0	4	0	0
Lesser Striped Swallow												O	O					0	2	0	0
Forktailed Drongo B	ABC*	BC*	C	AB*	C	AB*	C	AC	AC*	AB*	C	AC*	AC*	AB*	C	C	ABC	30	0	9	59
Pied Crow	O	O				O		O	O							O		0	6	0	0
Southern Black Tit D						C	C	AC				A*		BC	B		A*	9	0	2	18
Blackeyed Bulbul A	ABC	ABC	AB*	AC	A	ABC*	ABC	ABC	BC*	AC	ABC*	AC	ABC*		ABC	ABC*	AB*	40	0	7	78

DATE OF VISIT	DEC 91	DEC 91	APR 91	JUL 91	AUG 91	AUG 91	SEP 91	SEP 91	SEP 91	OCT 91	OCT 91	NOV 91	NOV 91	MAR 92	MAY 92	JUN 92	SEP 92	TOT OBS #1	No. Ofly #2	No. Cros #3	Br. Util #4
Sombre Bulbul C																AC		2	0	0	4
Kurrichane Thrush B		C	C	C	C	C	C	C	ABC	C	C	AC*	C		C		C	17	0	1	33
Yellowthroated Warbler C															C			1	0	0	2
Barthroated Apalis D							C	C	C				C	C				5	0	0	10
Tawnyflanked Prinia D												A*	A			B		3	0	1	6
Dusky Flycatcher D				C		C									B		B	4	0	0	8
Black Flycatcher A		C		A	AC	AB*	C	ABC	ABC	A*	AC*	AC*	C	ABC*	BC		BC	26	0	5	51
Paradise Flycatcher B	BC	C	C	C		C	C	BC	C	C	BC*	BC	C	C				17	0	1	33
Cape Wagtail B			C															1	0	0	2
Fiscal Shrike A	C			C		BC		BC	BC	BC		C		BC	A	C	A	16	0	0	31
Puffback D			C					C	C	C		C	C		C		C	8	0	0	16
Redwinged Starling C									O									0	1	0	0
Purplebanded Sunbird C																A		1	0	0	2
Whitebellied Sunbird A	ABC	BC	AB*	ABC	ABC	AB	A	AB	AB	AB	AB	B	AC*	ABC*	ABC	ABC*	AB*	38	0	5	75
Grey Sunbird D				C	C*									B		A*	AC	6	0	2	12
Black Sunbird A	C*	BC	C*	B*	ABC	AC	A	C*	BC	AC	ABC*	BC	AC*	AB*	ABC*	AB*	CO	31	1	9	61
Collared Sunbird C						A									C	B		3	0	0	6
Cape White-eye A	ABC*	ABC	BC	B	AC*	ABC*	BC	ABC	ABC*	ABC*	ABC*	ABC*	AC*	ABC*	AC*	ABC*	ABC*	44	0	12	86
Thickbilled Weaver B		A*	B*	C*	C	C	C	B*		BC*	AC*	B*	A*	C	C*	AC*	BC	19	0	10	37
Spectacled Weaver A	ABC*		C	BC		AB	BC*	B	AB	ABC*	A	AB*	AC	A	B*	A	ABC*	27	0	6	53
Spottedbacked Weaver A		AB		AB*	B	B		B	B		B	BC*	B*		B	B*	B	15	0	4	29
Red Bishop C													O					0	1	0	0
Redbacked Mannikin C												A						1	0	0	2
Bronze Mannikin A	ABC	AB*	AB*	BC*	OC	A*	AC*	BC*	AB	ABC*	BC*	BC	AC*	ABC*	ABC*	ABC*	ABC*	38	1	13	75
Pintailed Whydah C	C			O	O											O	O	1	0	4	2
Yelloweyed Canary A		C	B*	C	C	B	B	AB*	BC	C	BC	ABC*	BC*	ABC*	C		AB*	24	0	6	47
Bully Canary B			C	C	AC	A	C					AC*	C		A*	A*		11	0	13	22
Streakyheaded Canary A				A	B				A									3	0	0	6
TOTAL SPECIES SEEN / VISIT	17	20	23	24	20	25	21	23	22	23	19	26	24	19	24	21	23				

APPENDIX 4: Species recorded on the Pigeon Valley Park/Shepstone Nature Reserve Corridor between November 1990 and July 1992.

$ - Denotes ad hoc observation.
? - Inconclusive observation.
O - Species recorded flying over the corridor.
* - Denotes a bird seen crossing a road
A,B,C - In the date columns refer to corridor sections: A - patch of forest above King George V Ave., B - west side of K. George V Ave. & Mundy Park., C - 75th Anniversary Ave.
A,B,C - In species columns: A - corridor is major part of species range in Study Area.
B - important part of species range in Study Area.
C - species more reliably present in other localities in the Study Area.
D - minnor part of species range in the Study Area.
#1 - Total number of observations of each species utilising the three sections of the corridor.
#2 - Total number of times the species was observed flying over the corridor.
#3 - Number of times a species was observed crossing a road (i.e. a potential barrier).
#4 - Bridge utilisation index. Calculated as the number of times a species was observed utilising the three sections of the corridor as a percentage of the total possible observations (17 visits X 3 corridor sections)).

DATE OF VISIT	NOV 90	DEC 90	MAR 91	APR 91	MAY 91	JUL 91	AUG 91	AUG 91	SEP 91	SEP 91	OCT 91	OCT 91	OCT 91	OCT 91	NOV 91	DEC 91	JAN 92	FEB 92	APR 92	MAY 92	JUL 92	TOT. OBS. #1	No. Ofly #2	No. Cros #3	Br. Util #4
Hadeda Ibis A	O	O	C		BO	C	AB	AO	B	B*		AC		B	A	BC*	C	C		A	CO	20	4	2	32
Yellowbilled Kite B								O				O				B*	O	B*				5	3	2	8
Black Sparrowhawk C			B*	B*		O	C	A*			A*			O	A*			B		O		10	3	5	16
African Goshawk B	C		BO	BC			CO	C				O										9	3	0	14
Lanner Falcon $																						0	0	0	0
Tambourine Dove C											B*											1	0	1	2
Purplecrested Lourie B						B		C	C	C	A	B	C	ABC		B	BC*			B	B	14	0	1	22
Diederik Cuckoo A														C		C						2	0	0	3
Whiterumped Swift	O	O				O		O		O	O	O	O	O	O	O	O		O			13	13	0	21
Little Swift					O																	1	1	0	2
Palm Swift	O	O		O	O	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	18	18	0	29
Speckled Mousebird A			B		C	B		B	B	A	B*	B*	B*	ABC*	B	B*	B*	C		B		17	0	6	27
Brownhooded Kingfisher A			B	B			AC				C		B		C		B				BC	8	0	0	13
Little Bee-eater C												C										1	0	0	2
Redbilled Hoopoe B																	C	B*			AB*	2	0	1	3
Blackcollared Barbet A		A	AB*	AC	C			A	C	A	C	BC	AB	BC	B	AC	BC*	C	C		B	23	0	2	37

DATE OF VISIT	NOV 90	DEC 90	MAR 91	APR 91	MAY 91	JUL 91	AUG 91	AUG 91	SEP 91	SEP 91	OCT 91	OCT 91	OCT 91	OCT 91	NOV 91	DEC 91	JAN 92	FEB 92	APR 92	MAY 92	JUL 92	TOT. OBS. #1	No. Ofly #2	No. Cros #3	Br. Util #4
White-eared Barbet A		B						B*	B	A					C							5	0	1	8
Redfronted Tinker Barbet C			?				C															1	0	0	2
Goldenrumped Tinker Barbet D			?			A			B*		A	C		BC	C	A	AB	BC*	C			13	0	2	21
Lesser Honeyguide C							C															0	1	0	0
Sharpbilled Honeyguide C						C																1	0	0	2
Goldentailed Woodpecker D	A*									A				A	B			B			B	5	0	1	8
Cardinal Woodpecker D					C						B*					B	B					4	0	1	6
European Swallow	O	O	O													O	O					5	5	0	8
Whitethroated Swallow				O																		1	1	0	2
Lesser Striped Swallow		O		O		O	O	O	O		O	O	O	O	O	O	O					13	0	0	21
Black Sawwing Swallow													C									1	0	0	2
Rock Martin					O	O														O		3	3	0	5
Black Cuckooshrike C									C													1	0	0	2
Forktailed Drongo A	AC*		B	B				B	C	B*	BC				B	BC	AB*	ABC*	A	B	BC	19	0	4	30
Blackheaded Oriole $ D																						0	0	0	0
Pied Crow					O				O		O	O		O				O	O	O	O	8	8	0	13
Southern Black Tit A		B	A*	AB	C		B		C	A			A	AB	BC	BC	AB	B		C	C	19	0	1	30
Blackeyed Bulbul A	BC*	ABC	AC	ABC*	BC	C	BC	BC	B*	AC	ABC*	AB	A	ABC	ABC*	ABC*	AC	BC*	ABC	ABC	ABC	45	0	7	71
Terrestrial Bulbul D						A					C	C	C		A*		C	C	C			8	0	1	13
Sombre Bulbul B		B	AC	BC	C	ABC	B	AC	AC	C	AB		AB*		C		B*		BC	ABC*	BC	26	0	3	41
Kurrichane Thrush B	A		A						A	A				B					B		B	6	0	0	10
Natal Robin B	AC		ABC	AC				B	C	A	C	A		C	A*	AC	C		ABC	AB		22	0	1	35
Whitebrowed Robin C									C											C		2	0	0	3
Willow Warbler C					C																	1	0	0	2
Barthroated Apalis B	C							B	C		BC		A	C	C				C	AC		11	0	0	17
Yellowbreasted Apalis B											B	B		B	BC	C				B		7	0	0	11
Bleating Warbler B	C	C	AC				BC	BC	BC	BC	ABC	AC	BC	BC	AC	BC	C	C	C		BC	28	0	0	44

DATE OF VISIT	NOV 90	DEC 90	MAR 91	APR 91	MAY 91	JUL 91	AUG 91	AUG 91	SEP 91	SEP 91	OCT 91	OCT 91	OCT 91	OCT 91	NOV 91	DEC 91	JAN 92	FEB 92	APR 92	MAY 92	JUL 92	TOT. OBS. #1	No. Ofly #2	No. Cros #3	Br. Util #4
Rattling Cisticola A				C	C				B												C	3	0	0	5
Tawnyflanked Prinia B	C	C	C	C		C	BC		C		ABC	BC	C	C	AC	C	C	C	BC	AC	C	24	0	0	38
Dusky Flycatcher B				BC	C	C	BC											A		ABC	BC	10	0	0	16
Bluegrey Flycatcher A			C		C		C			B*			A			A	C	A*				8	0	2	13
Black Flycatcher A			B*		C	C	C		AC*		BC*	BC	B*	A*	AB	AB*	A		C		BC	18	0	5	29
Cape Batis C																				C		1	0	0	2
Chinspot Batis A						A	C		C			B		BC*	B							7	0	1	11
Paradise Flycatcher B	AB	BC	B	A	C	A				B	ABC	BC	BC	AC	BC	ABC*	ABC	BC*	BC			30	0	2	48
Fiscal Shrike A			B															C				2	0	0	3
Southern Boubou D			A								C		C			C	B					5	0	0	8
Puffback B		B	A		C	AC	C		A	A			AB	A	A	A*					B	13	0	1	21
Southern Tchagra C																			C			1	0	0	2
Blackbellied Starling C											A		A			A*			B			4	0	1	6
Redwinged Starling A	C		C		A*							C		C						C	C	6	0	1	10
Whitebellied Sunbird A			C	C	B*	C	C	B	BC	B	ABC	BC	B	BC	BC	AB	B	C	AC*	ABC	ABC*	28	0	2	44
Grey Sunbird B	B	C		B	AC	A*	C	BC	C	B	BC	C*	B	B*		B*	AB*	B*	AB*	AB*	B*	24	0	8	38
Olive Sunbird B				A			C			AB*	BC*	BC*		B	C	B	C	B*	C			14	0	4	22
Black Sunbird A		C		B	C	AC	C	A	AC		BC	BC*	A*		B					B*	BC	16	0	3	25
Collared Sunbird B			B	A*	A*							B*			C	B*		B		C	B	8	0	4	13
Cape White-eye A	ABC*	ABC*	ABC*	ABC*	ABC*	ABC*	AC*	ABC*	ABC*	AB*	ABC*	ABC*	ABC*	ABC*	ABC*	AB*	ABC*	ABC*	ABC	ABC*	ABC*	57	0	19	90
House Sparrow																				A		1	0	0	2
Forest Weaver C																A						1	0	0	2
Thickbilled Weaver B		B*	B*	B*	O		B	A*	B*		BC*	B	B*	B	B*	AB*	B*	B*		B	AB*	18	1	11	29
Spectacled Weaver B		B	BC		C		C		ABC		B	B	B*	B	AB*	ABC	B*	C	BC	AB		23	0	3	37
Spottedbacked Weaver A						C	C		C		C	C	C	C	AC*	C	C			C	C	12	0	1	19

DATE OF VISIT	NOV 90	DEC 90	MAR 91	APR 91	MAY 91	JUL 91	AUG 91	AUG 91	SEP 91	SEP 91	OCT 91	OCT 91	OCT 91	OCT 91	NOV 91	DEC 91	JAN 92	FEB 92	APR 92	MAY 92	JUL 92	TOT. OBS. #1	No. Ofly #2	No. Cros #3	Br. Util #4
Yellow Weaver B																				BC	B	2	0	0	3
Bluebilled Firefinch C											C											1	0	0	2
Redbacked Mannikin C			B*																			1	0	1	2
Bronze Mannikin A		BC	BC*	ABC*	C	C		BC*		B*	BC*	BC	C	BC	C	BC	BC*	ABC*	ABC*	ABC	AB*	33	0	8	52
Pintailed Whydah C					C*						O											2	1	1	3
Black Widowfinch C							C															1	0	0	2
Yelloweyed Canary A	C	BC	BC	C	C	C	BC*	BC	BC		BC	ABC*	ABC	AC*	BC*	C	BC*	B*	C	BC	BC	33	0	6	52
Cape Canary $ D																					O				0
Bully Canary D				B			C															2	0	0	3
TOTAL SPECIES SEEN / VISIT	18	21	31	26	29	26	28	24	32	23	37	33	30	35	35	36	34	28	25	31	31				