SAND PLAIN FYNBOS CONSERVATION:

THE KENILWORTH RACECOURSE CASE STUDY

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ABSTRACT

The current extent of Sand Plain Fynbos and threats to its survival are examined, with a view to proposing effective means of managing areas of high conservation priority. Extensive depletion of Sand Plain Fynbos has resulted from agricultural development, urbanisation and its susceptibility to invasion by introduced woody plant species. The need to conserve this veld type is apparent in that only 0.05% of the original Cape Flats Sand Plain Fynbos still survives within scattered refugia. A mere 3.8% of this already minute fraction is represented in proclaimed nature reserves, clearly illustrating the neglected conservation status of this veld type. The majority of the remaining habitat owes its survival, albeit in various stages of degradation, to low impact land uses not related to conservation *per se*. The in-fields of the three racecourses on the Cape Flats in total comprise the land use supporting the largest area of Sand Plain Fynbos. This suggests the potential compatibility of such a land use with conservation in the longer term. Of the three racecourses, Kenilworth is the most important in terms of area, diversity and unprecedented numbers of threatened flora and fauna of the fynbos it supports. This provides a case study on which to base an assessment of the trends in species survival on small remnants.

A historical backdrop to the isolation and degradation of the Kenilworth Racecourse and neighbouring remnants is provided. The predictions of conservation theory for the long term viability of such small and isolated remnants are then reviewed. To determine the effects of recent events and processes on the conservation merits of Kenilworth Racecourse, species extinctions and turnover from 1950 to the present are determined for the flora and avifauna respectively. Past and current species checklists form the basis of this analysis. Causes of species loss are investigated by comparing the physical attributes and habitat preferences of the species present with those which have apparently become extinct locally.

The influence of private landownership on the conservation security of Kenilworth Racecourse is of fundamental importance to its future conservation. In this respect, the likelihood of change in land use of the in-field fynbos, as well as the Racecourse area as a whole, is a crucial factor addressed in this study. The present and future operating requirements of the Racecourse Management are also determined and their likely effects on the natural system are assessed.

The study establishes a need for conservation management at Kenilworth Racecourse. The approach adopted to achieve the ongoing conservation of the area is through the

development of a Conservation Management Plan. The latter has been derived through reasoned and personal interaction with the Racecourse Management and is aimed towards integrating the needs of the Management with the ecological requirements for the natural system under its control. The creation of corridors to facilitate migration of biota, as well as the reintroduction of those species which have become extinct locally, are described as an adjunct to these proposals. The implementation of an organised burn programme is proposed as a management procedure to counteract species loss.

Evaluation of initial success resulting from the Management Plan reveals that there is now an improved communication channel with the Management. This encompasses moral obligations for eradication of alien vegetation, abstention from further drainage of wetlands, prevention of future encroachment of parking within the natural system and an agreement to cease indiscriminate dumping of refuse material. A major constraint facing the conservation of the area is the reluctance of the Management to allow public interest groups direct involvement with monitoring and implementation of proposals presented within the Management Plan.

The research findings and conservation management approach generated by the study are important because they have potential for promoting the long term conservation of analogous remnants, not only within the fynbos biome, but in other similar systems further afield. Although threats exist to the ongoing survival of Sand Plain Fynbos remnants, these should not prejudice their selection as areas worthy of sound conservation management. Remnants have inherent value as refugia. They are also of potential importance as sites for reintroduction of species that have become extinct locally, as educational resources and as relatively low-maintenance open spaces within the urban landscape.

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CHAPTER 1

INTRODUCTION

1.1 THE STUDY IN ITS PHYTOGEOGRAPHICAL CONTEXT

The Cape Floristic Kingdom, located in the south western Cape of South Africa, is the smallest of the six floral kingdoms in the world. It is also by far the most floristically diverse per unit area, comprising some 8550 species in a mere 90 000 square kilometres (Goldblatt, 1978; Cowling, 1990). The Cape Floristic Kingdom closely corresponds to the fynbos biome in geographic area (Moll & Jarman, 1984) (Figure 1). The vegetation of the biome is characterised by a predominance of small-leaved, evergreen, schlerophyllous shrublands (Moll & Jarman, 1984) exhibiting a high degree of endemism with 73% of species being endemic to the biome (Goldblatt, 1978).

The Cape Flats, the focus of this study, comprise a sandy isthmus connecting the Cape Peninsula with the mainland of the south western Cape (Taylor, 1976) (Figure 2). The Cape Flats support two distinctive veld types, namely Strandveld and Sand Plain Fynbos, whose distribution is determined by soil substrate (Figure 2). Strandveld is restricted to the alkaline calcareous dune systems in the lowlands of the south western Cape, whereas Sand Plain Fynbos occurs on acid sand areas in the lowlands of the west coast (Moll *et al*., 1984). The latter assemblage corresponds with the Coastal Macchia veld type of Moll & Bossi (1984). Kenilworth Racecourse, the subject of this report, is situated within the southern suburbs of Cape Town on the western extremity of the Cape Flats (Figure 2). As it is on acid sandy flats, the area supports Sand Plain Fynbos. It is also the site of numerous temporary vleis making a large part of the area into a wetland habitat[1]. The vleis form part of a more extensive wetland system interspersed with seasonally marshy areas surrounded by the racing tracks. Mesic Mountain Fynbos occurs on the Cape Peninsula Mountain Chain beyond the western boundary of the Cape Flats (Figure 3). This veld type is largely restricted to areas coinciding with the sandstones and quartzites of the Cape Folded Belt, the major mountain range in the south western Cape[2].

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1 The use of the term 'temporary vlei' in this study refers to depressions overgrown with reeds and sedges which are seasonally inundated to form ponds (Noble & Hemens, 1978).

2 'Mesic' refers to the moisture regime in which the veld type occurs and which suggests an intermediate classification between 'dry' and 'wet' Mountain Fynbos.

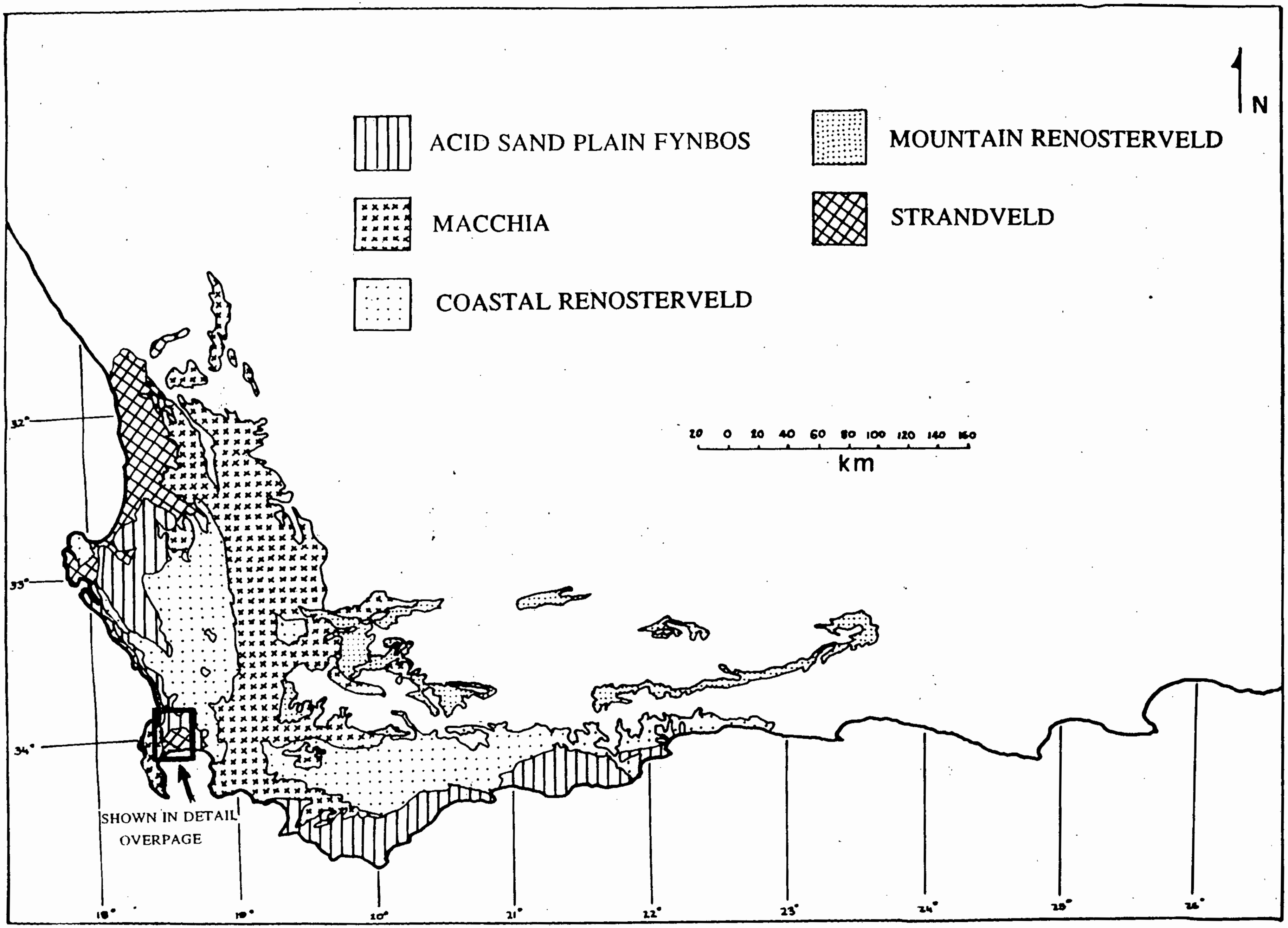

Figure 1: The distribution ranges of major veld types in the south western Cape (after Moll & Bossi, 1984).

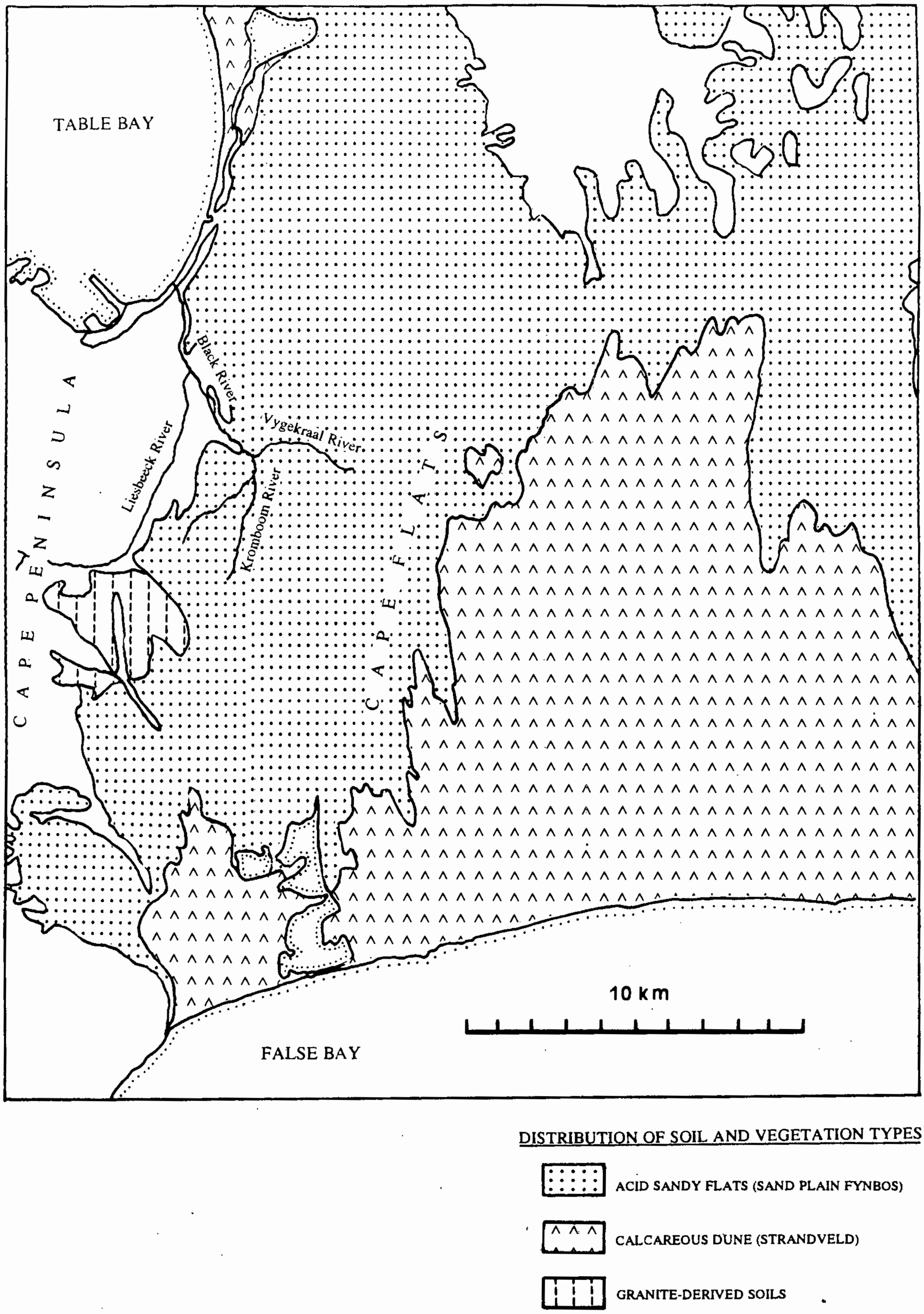

Figure 2: Sand Plain Fynbos remnants on the western Cape Flats in relation to acid sand and calcareous dune zones. These are shown in relation to suburbs mentioned in the text. Existing and recently eliminated (*) remnants are also shown.

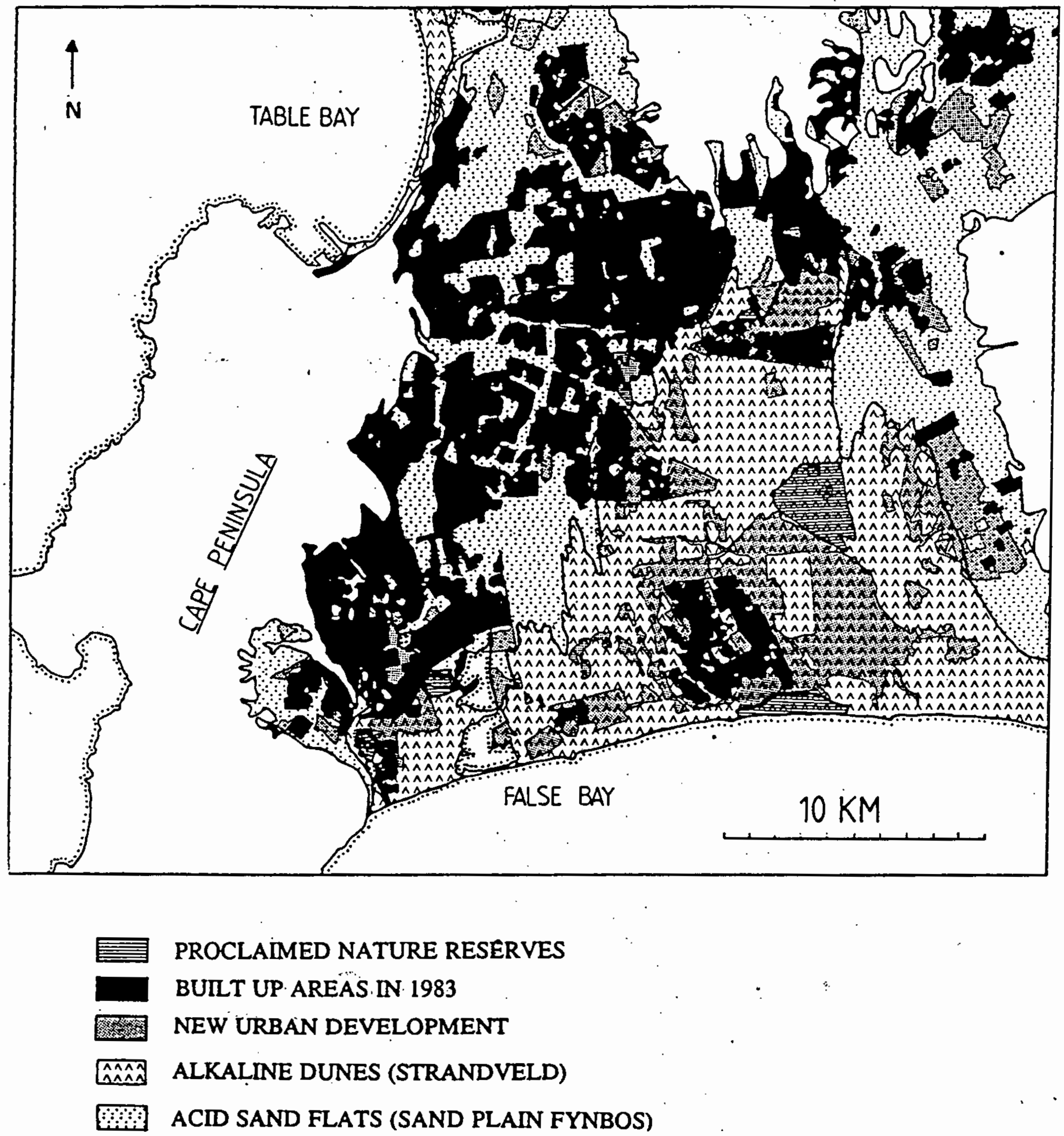

Figure 3: The extent of old and new urban development on acid sandy flats and calcareous dune areas on the western Cape Flats (from McDowell & Low, 1990).

1.2. RATIONALE FOR THE STUDY

The value of conservation in the urban environment of Cape Town has recently been acknowledged (Anon., 1982; Poynton & Roberts, 1985; McDowell & Low, 1990). An effort has been made in and around the Cape Peninsula to ensure that natural areas are conserved, but a disparity exists in the extent to which the different veld types have been represented in reserves. The difference in conservation status between Mesic Mountain Fynbos on the one hand, and the lowland vegetation (Sand Plain Fynbos and Strandveld) on the other hand is particularly marked. Mesic Mountain Fynbos is relatively well conserved (McDowell *et al.*,1990). Pressures to develop, or otherwise degrade, this veld type have been offset by difficult terrain and poor agricultural soil (McDowell *et al.*, 1990). Furthermore, official conservation status has been awarded to a large proportion of the Peninsula Mountain Chain.

The lowland vegetation types of the Cape Flats, namely Sand Plain Fynbos and Strandveld, present a more daunting conservation challenge. The Cape Flats have now become prime development land within the Greater Metropolitan Region of Cape Town. Recent conservation efforts on the Cape Flats have been after-the-event crisis responses to urban expansion which has resulted in the rapid dwindling of this veld type.

Although both Sand Plain Fynbos and Strandveld are under-represented in proclaimed reserves on the Cape Flats, the former veld type has been accorded higher conservation priority because it has suffered a greater degree of fragmentation and degradation (Table 1). Its poor conservation status in comparison to Strandveld has been caused by its close proximity to the historical centre of Cape Town (Figure 3) and its greater susceptibility to invasion by alien woody vegetation (McDowell *et al.*, 1990). Strandveld, on the other hand, remained largely undeveloped until the need for housing the urbanising population of Cape Town came to be more fully addressed, particularly during the 1970's and 1980's. Nevertheless, greater opportunity still exists at present for reserve creation in the Strandveld compared with the Sand Plain Fynbos of the Cape Flats (McDowell *et al*,, 1990).

The majority of remnants of Sand Plain Fynbos on the Cape Flats occur on land

Table 1: Rates of displacement of Cape Flats' habitats by urbanisation (after McDowell et al,, 1990).

	BUILT % '83	BUILT % '89	% CHANGE	% REMAINING
Sand Plain Fynbos	45.16	56.06	24.93	43.09
Strandveld	10.35	36.59	253.53	73.18
Whole Cape Flats	31.72	48.07	51.54	48.46

(Original ratio of Sand Plain Fynbos habitat to Strandveld habitat = 61.4%: 38.6%)

other than proclaimed reserves (Table 2). The three racecourses are all established within the acid sandy flats. They comprise the single most important land use to have preserved sectors of Sand Plain Fynbos (Table 2). The racecourses are, however, privately owned, a situation which raises important issues for the possibility of the ongoing *de facto* conservation of these areas. If means can be found whereby the requirements of the landowner, as well as the natural biota and habitat can be met, a reasonable chance exists that the remnants of Sand Plain Fynbos will survive.

Seasonal vleis have also been highlighted as a severely depleted natural resource on the Cape Flats, deserving high conservation priority status (Day & King, 1980; McDowell *et al.*, 1990). The largest concentration of remaining natural seasonal vleis within the Cape Flats exists within Kenilworth Racecourse.

The poor conservation status accorded to natural habitats on the Cape Flats mirrors other areas in the lowlands of the Fynbos Biome (Jarman, 1986; Siegfried, 1989). The biogeographically fragmented condition of the lowland natural plant communities of the Fynbos Biome is, in turn, symptomatic of global trends in habitat destruction (*sensu* Soule, 1987a). The need to conserve remnant 'islands' has become increasingly important because they have become the only source of conservation land for many ecosystems. Recent conservation literature has attempted to consolidate understanding of the implications of the isolation process as it relates to habitat conservation (Diamond, 1975; Simberloff & Gotelli, 1984; Soule, 1987a and Burgman *et al.*, 1988). Researchers in the Fynbos Biome have also turned their attention to this problem (Rebelo, 1987; Bond *et al*, 1988 and Tansley, 1988). Because the field of research is new, there are few data documenting the results of isolation. These data are needed to formulate prescriptive management procedures with specific application to the Fynbos Biome.

In this report, Kenilworth Racecourse (18^{o} 29' E; 34^{o} 00' S) is used as a basis to illustrate some of the issues raised above. It is hoped that answers arrived at may have application to similar areas elsewhere in the biome. McDowell & Low (1990) identified Kenilworth Racecourse as a top priority conservation site because:-

1) It supports highly threatened Cape Flats habitat types, namely Sand Plain Fynbos and seasonal vlei habitat.

Table 2: Good quality Sand Plain Fynbos areas on the Cape Flats (after McDowell *et al.*,1990).

CATEGORY	PERCENTAGE OF TOTAL	NAME		± AREA IN HECTARES
RACE-COURSES	27.7%	Kenilworth		56.0
		Milnerton		27.5
		Durbanville		6.2
			total	89.7
MILITARY AREAS	24.4%	Six B.O.D. NHS		50.0
		Wingfield		25.0
		Youngsfield		5.0
			total	80.0
POWER-LINE SERVITUDES	18.4%	Edgemead-MonteVista NHS		60.0
			total	60.0
URBAN COMMONAGES	12.7%	Rondebosch Common		40.5
		Northpine Common		2.0
		Meadowridge Common		1.0
			total	43.5
ROAD VERGES	8.3%	N7-N1 Interchange		8.0
		Voortrekker Road		15.0
			total	22.0
PROCLAIMED NATURE RESERVES	3.8%	Rondevlei NR (northern sector)		15
		Edith Stevens NR		3.5
			total	18.5
FORESTRY	3.1%	Tokai		9.0
			total	9.0
		Total		323.7
LARGE SAND PLAIN FYNBOS SITES WITH RECOVERY POTENTIAL				
Kraaifontein Forestry Area				ca 140
Penhill				ca 20
		Total		ca 483.8

RED DATA SPECIES/KM^2 = 15.3

NHS = natural heritage site
NR = nature reserve

2) An exceptionally large proportion of the species assemblage is threatened *sensu* Red Data classifications produced by Hall & Veldhuis (1985) and Branch (1988).

3) It fulfills a multiple land use role as a recreational and as a conservation resource. The latter is, however, more through fortuitous circumstance than through design. This factor might enhance its future security as a *de jure* conservation area within metropolitan Cape Town, where undeveloped land is an increasingly scarce resource.

1.3 AIM AND OBJECTIVES

The aim of this study was to evaluate the importance of Kenilworth Racecourse as a conservation asset and to formulate strategies whereby its future conservation may be assured. The following were the objectives of the study:

1) To investigate the processes that have resulted in the diminution of the Cape Flats' Sand Plain Fynbos, with reference to the southern suburbs and vicinity.

2) To determine the factors associated with the incidental preservation of fragments of Sand Plain Fynbos on the Cape Flats.

3) To review the effects of isolation and fragmentation on natural habitats.

4) To determine, with a view to forestalling, present and future threats to nature conservation at Kenilworth Racecourse.

5) To derive a management plan for Kenilworth Racecourse which complements the requirements of both the landowner and the natural habitat, in order to achieve long term conservation.

6) To evaluate applications of the findings of this study to further high conservation priority systems.

1.4 STRUCTURE OF THE REPORT

CHAPTER 2 characterises the Sand Plain Fynbos environment and the environmental factors that have influenced its distribution on the Cape Flats. The present conservation status of Sand Plain Fynbos on private and public land in comparison with that of the adjacent Strandveld is reviewed.

CHAPTER 3 provides a historical backdrop to anthropogenic influence on local Sand Plain Fynbos. The manner and timescale over which urban development has destroyed and fragmented natural systems within the Southern Suburbs is investigated. Factors contributing to the preservation of Sand Plain Fynbos in the Southern Suburbs are explored.

CHAPTER 4 gives a critical review of the explanations provided by Equilibrium Island Biogeography (EIB) and the Minimum Viable Population concept (MVP) for species extinctions in small reserves with varying degrees of isolation from other systems. The current level of understanding of the causes of species extinction in fynbos habitats is assessed critically in terms of MVP. The usefulness of the following is investigated: 1) how MVP can provide practical guidelines to managers in fynbos environments 2) the relevance of theoretical investigations into optimum design of nature reserves.

CHAPTER 5 presents an objective evaluation of how the quality of the natural systems present on Kenilworth Racecourse can be rated. In this report, 'conservation quality' is defined as the extent to which the system approaches the hypothetical pristine level of an ecosystem prior to the influence of humankind. The greater the amount of human-related disturbance and the poorer the species diversity as a result of anthropogenic or natural processes, the poorer the conservation quality of the area. The chapter also assesses change in species composition on Kenilworth Racecourse during this century. Possible causes of species extinctions are proposed.

CHAPTER 6 draws conclusions on the reasons for the survival of certain remnants of Sand Plain Fynbos to date and the long term survival prospects. The selection of Kenilworth Racecourse as an area worthy of conservation initiative is justified and both the needs and the objectives of conservation management are established. Major threats, and the solutions to those threats, are then outlined. Means of counteracting anthropogenic and natural processes degrading the Kenilworth

Racecourse vegetation, including the possible creation of 'corridors' to link Sand Plain Fynbos remnants in the Southern Suburbs are then presented. The success of the conservation approach adopted here, as it applies to the case study, is assessed. Finally, the possible application of the findings of this study to other island habitats worthy of conservation is explored.

CHAPTER 2

A CHARACTERISATION OF THE SAND PLAIN FYNBOS ENVIRONMENT ON THE CAPE FLATS

2.1 INTRODUCTION

Kenilworth Racecourse, the conservation case study used in this report, needs to be placed in the context of the natural environment existing on the Cape Flats. This chapter thus aims to: 1), characterise the environmental factors determining the occurrence of Sand Plain Fynbos on the Cape Flats 2), describe the habitat types within Sand Plain Fynbos with reference to the communities on Kenilworth Racecourse and 3) evaluate the conservation status of the Cape Flats vegetation types, (Sand Plain Fynbos and Strandveld), by determining the incidence of Red Data species and the percentage (%) area that has been conserved.

2.2 ENVIRONMENTAL CHARACTERISTICS

2.2.1 Climate

The climate of the south western Cape can be broadly classed as mediterranean. More specifically, the Cape Flats are classified by Fuggle (1980) as having a Humid Mesothermal Climate. A strong gradient in rainfall occurs, from approximately 1300 mm per annum near to Table Mountain, decreasing to approximately 550 mm/annum on the central Cape Flats in the vicinity of D.F. Malan Airport. Most of this precipitation occurs over the relatively cool months of May, June and July, whilst drought prevails during the summer months. Evaporation is maximised during the latter period (Fuggle, 1980). High wind velocities are experienced on the Cape Flats for much of the year, predominantly from the south-east during summer and the north-west during winter.

2.2.2 Soil type

The soils of the Cape Flats comprise two distinct substrates, namely acid sand plain flats and calcareous dune systems. These influence the distribution of the vegetation types in the area. Sand Plain Fynbos is restricted to the acid sand plain flats, whereas Strandveld occurs on the calcareous dune systems (McDowell & Low, 1990). Figure 3 (p. 4) shows the distribution of these soil types with associated vegetation types. The calcareous soils supporting Strandveld differ from acid sand plain soils with respect to nutrient availability, pH value (often greater than pH7) and the presence of shell fragments (Low, 1988).

Soils in the south western Cape supporting fynbos are strongly leached, sandy, deficient in most nutrients and of relatively low pH (Specht & Moll, 1984). These features also characterise the Cape Flats soils supporting Sand Plain Fynbos, where Boucher (1980) found a pH range of 4.5 to 6.5. Ellis (1981) also notes the particularly low clay content of the topsoils on the Cape Flats, a situation analogous to soils supporting Mountain Fynbos.

Kenilworth Racecourse appears to have a duplex soil formation (*sensu* MacVicar *et al.*, 1977). Acidic aeolian sandy topsoil overlies a clayey subsoil derived from the granitic parent rock underlying these soil horizons (Theron, 1984). Poor drainage associated with the duplex soil is likely to have contributed to the high water table, resulting in waterlogging and the creation of seasonal vlei areas. The remnant on the south-easterly extremity is better-drained and appears to be underlain by a substrate of deeper aeolian sand than on other parts of the Racecourse.

2.2.3 Hydrology/Limnology

The Cape Flats lack well-defined drainage channels and there is consequently a great number of marshes, temporary and perennial vleis (Wessels, 1981). The seasonal vleis of the Cape Flats are fed with surface flow and in some cases are filled by groundwater seepage associated with the high water table (Wessels, 1981). The water of pristine vleis in the areas of acid sand plain soil is typically dark in colour due to the presence of tannins, is acidic and contains low levels of dissolved nutrients (Davies & Day, 1986).

Kenilworth Racecourse has nine seasonal vleis which comprise 4% of the area of the undeveloped area [Figure 4 (p. 14). The Racecourse in-field also is the source of the Kromboom River. The Kromboom River has since been canalised as it proceeds through Lansdowne into the Black River Complex (Day and King, 1980) [Figure 2 (p. 3)].

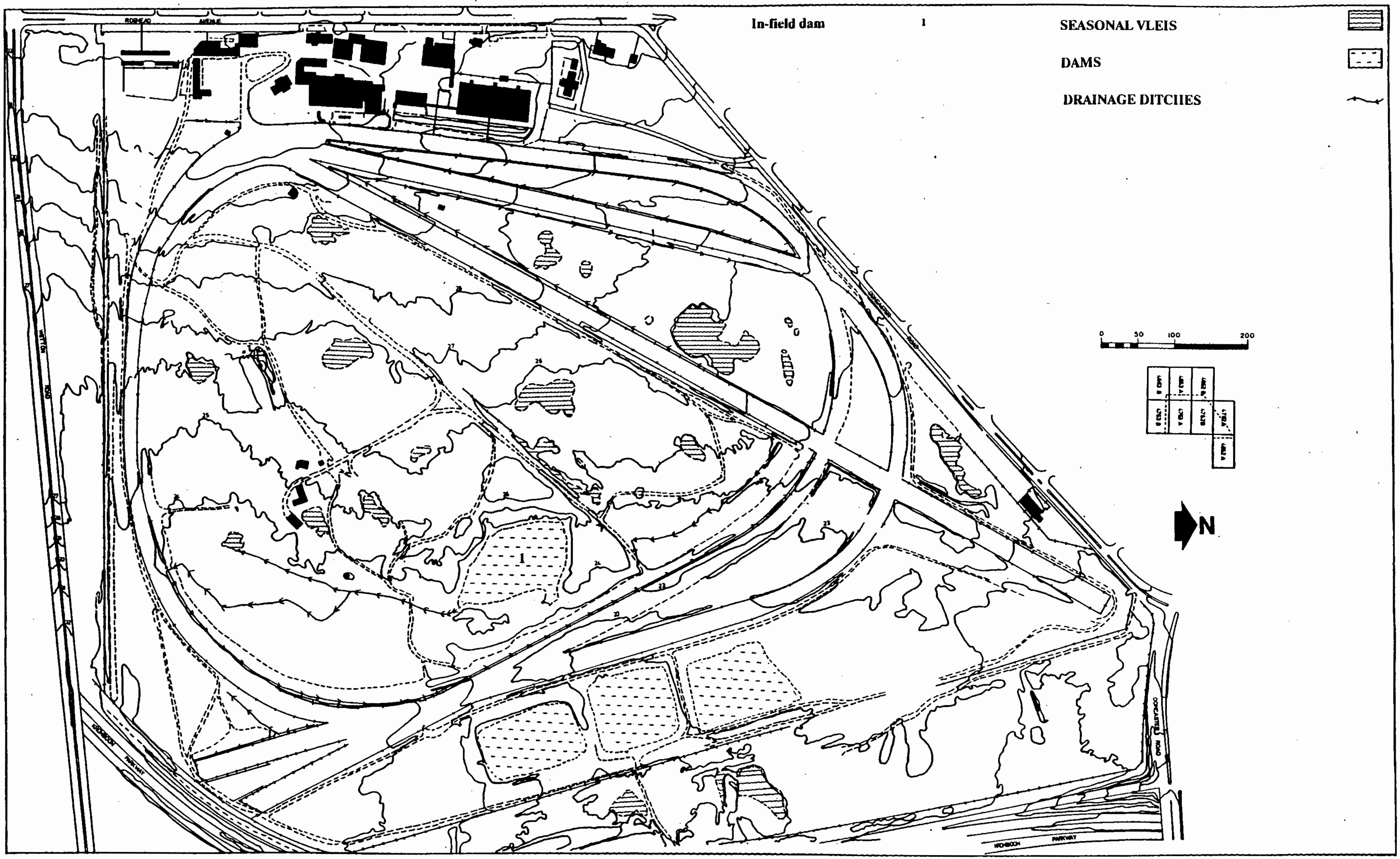

Figure 4: Conservation management zones for the Kenilworth Racecourse and vicinity.

2.2.4 Vegetation type

South western Cape lowland vegetation, as defined by Moll, *et al.* (1984) is categorised into four types, based on substrate. The vegetation of the Cape Flats corresponds to two of these types, namely Sand Plain Fynbos and Strandveld, occurring on acid sand flats and calcareous dunes respectively [Figure 3 (p. 4)]. Sand Plain Fynbos occurs predominantly on the deep acid sands of the west coast and on localities on the south coast (Moll *et al*,,1984) [Figure 1 (p. 2)]. This study centres on the Sand Plain Fynbos of the Cape Flats , which forms approximately 6% of the total area of Sand Plain Fynbos in South Africa. Throughout its distribution range, this veld type has been severely depleted. The survey by Jarman (1986) indicated that only 1.4% of the remaining Sand Plain Fynbos is officially conserved.

2.3 THE QUALITY OF NATURAL SYSTEMS ON THE CAPE FLATS

2.3.1 Conservation quality of the Sand Plain Fynbos

Hall & Veldhuis (1985) calculated that on average 0.44 Red Data species existed per km^2 on the Cape Peninsula Mountain Chain. This is, in itself, an extremely high proportion of Red Data species in comparison with other areas within South Africa and the rest of the world. However, it would appear that the Cape Flats have an even higher concentration of threatened species than the Cape Peninsula Mountain Chain, as indicated by the work of McDowell & Low (1990). Within the Cape Flats, their survey showed that the Red Data species are concentrated in the Sand Plain Fynbos, rather than the Strandveld. McDowell *et al* (1990) calculated an index of 15,3 Red Data plant species per km^2 in the mere 0.05% of Sand Plain Fynbos remaining on the Cape Flats. This high concentration is partially a function of the very high level of endemism in Sand Plain Fynbos and the extent to which its habitat has been depleted. In contrast, Strandveld of the Cape Flats supports only approximately ten Red Data plant species and has a relatively low number of endemic species (McDowell, 1989a). This clearly indicates that Sand Plain Fynbos should be the conservation priority on the Cape Flats.

Strandveld on the Cape Flats is, however, currently under great pressure for development (McDowell & Low, 1990) [Table 1 (p. 5)]. Notwithstanding this situation of vulnerability, the veld type appears to be in a relatively well conserved state, provided that the *de jure* current reserves are not deproclaimed (C. McDowell, pers. comm.). Approximately 1500 to 2000 hectares of Strandveld presently fall into reserves (McDowell & Low, 1990). Furthermore, Strandveld appears to be relatively resistant to degradation pressures, including the invasion by alien species and effects of fertilizers (C. McDowell, pers. comm.).

Sand Plain Fynbos, on the other hand, is extremely poorly conserved. The results of the inventory by McDowell & Low (1990) on the Cape Flats show that although 43.09% of the area of Sand Plain Fynbos is not under built environs, a mere 324 hectares survives as reasonably high quality vegetation [Table 2 (p. 5); Figure 3 (p. 4)]. This figure comprises a mere 0.05% of the original extent of Sand Plain Fynbos on the Cape Flats. The vast proportion of the undeveloped habitat has been susceptible to degradation by anthropogenic influence, such as the invasion of alien species (mainly by Port Jackson, *Acacia saligna*), agriculture and dumping.

Red Data species of the Sand Plain Fynbos on the Cape Flats are extremely poorly represented in the inadequately small reserves. Of the 40 threatened plant species that were included in their 1981 survey (now considered an underestimate of the number of threatened species), Hall & Manchip (1981) observed that none of the species were adequately conserved in reserves on the Cape Flats. This reflects the poor conservation status of Sand Plain Fynbos in the south western Cape as a whole (Jarman, 1986).

The majority of the 1.4% was found to be privately owned, as is the case with surviving Sand Plain Fynbos on the Cape Flats. Only 3.8% of the surviving good quality Sand Plain Fynbos vegetation is conserved in proclaimed nature reserves on the Cape Flats. The remainder survives in racecourses, military areas, powerline servitudes, urban commonages, road verges and on forestry land [Table 2 (p. 8)] (McDowell & Low, 1990). The racecourses occurring in the area (Milnerton, Durbanville and Kenilworth) comprise the largest proportion of high quality Sand Plain Fynbos (27.7%) [Table 2 (p. 8)] (McDowell *et al.*, 1990; McDowell & Low, 1990).

Unlike virtually all other lowland fynbos surviving on privately owned land in the south western Cape (Cowling, 1990), the racecourses have been kept free of alien vegetation so as to maintain the low-growing Sand Plain Fynbos and thereby retain a field of view for the racing tracks. Kenilworth Racecourse is the largest of the racecourse remnants (42.6 hectares) followed by Milnerton (27.5 hectares) and

Durbanville (6.2 hectares) (McDowell *et al*, 1990). This emphasises the pivotal role that Kenilworth Racecourse plays as a reservoir for Sand Plain Fynbos including the greatest proven concentration of Red Data species within the Cape Flats remnant.

2.3.2 Conservation Quality of Sand Plain Fynbos Wetlands

A global pattern of degradation exists for natural wetlands. Maltby (1986) proposed that natural wetlands are amongst the world's most endangered habitat types because a vast proportion has been converted to alternate uses or else has been susceptible to anthropogenic degradation. A similar situation prevails for South African wetlands (Walmsey, 1988). Various authors also note the particularly threatened nature of the Cape Flats wetlands (Day & King, 1980; Hall & Manchip, 1981; McDowell *et al.*, 1990). In 1929, Edith Stephens, a limnologist who worked on the Cape Flats, was able to say that it was a "paradise for the aquatic biologist". However, even at that early stage she had noted that:

> "Some of the vleis and pools have gone within the writer's [Stephen's] memory, drained or filled in. ... the large triangle bounded by the main and Wynberg lines and the Liesbeeck River, once a particularly happy hunting ground, now lies buried under several feet of city rubbish. ... There is thus real need to save some of the particularly interesting and accessible areas (such as Isoetes Vlei near St Joseph's shrine and the beautiful vlei near Crawford station) for the use and enjoyment of future generations of naturalists" (Stephens, 1929, cited in Day & King, 1980 p 2).

Verification for the concerns of Stephens is demonstrated in the disappearance of the above-mentioned vlei near Crawford and the severe degradation of Isoetes Vlei (Day and King, 1980; Hall & Manchip, 1980). Immediate threats to wetland habitat on the Cape Flats include the upgrading of the drainage network in the surrounding area, and invasion by exotic grasses (Campbell *et al.*, 1980). This trend is symptomatic of the wetlands of the entire Cape Flats which have experienced the side effects of urban expansion. Most of the wetlands which survive have suffered the effects of pollution, canalisation and other forms of degradation, making seasonal wetlands the scarcest natural feature on the Cape Flats (McDowell *et al*, 1990).

Day and King (1980) emphasise the uniqueness of the temporary vleis on the Cape Flats, because of their seasonal nature, physical characteristics and the species associated with them. The low amount of degradation that has occurred in the case of Kenilworth Racecourse seasonal vleis raises its importance as a conservation resource on the Cape Flats.

2.4 CONCLUSIONS

The vegetation supported by acid sand on the Cape Flats can broadly be classed as Sand Plain Fynbos. The environmental characteristics of the Cape Flats have resulted in a high incidence of seasonal vleis and marshes which contribute to the species richness of the area. Despite the high incidence of Red Data plant species with narrow distribution ranges, Sand Plain Fynbos on the Cape Flats has been given negligible representation in proclaimed reserves. Privately owned areas carrying Sand Plain Fynbos thus have an important role to play in conserving the veld type. The racecourses support the largest proportion of high quality vegetation and of these, Kenilworth Racecourse is the largest thus highlighting it as a conservation priority.

The following chapter assesses anthropogenic influence in the destruction of Sand Plain Fynbos in the Southern Suburbs, and accounts for the survival of some remnants, including Kenilworth Racecourse.

CHAPTER 3

ANTHROPOGENIC INFLUENCES ON THE NATURAL SYSTEM IN THE KENILWORTH VICINITY

3.1 INTRODUCTION

A description of anthropogenic disturbances in Sand Plain Fynbos on the Cape Flats and its role in depleting this veld type is given. Attention is centred on the creation of remnants in the Southern Suburbs including, as established in the previous chapter, the remnant of high conservation value at Kenilworth Racecourse. An assessment is made of the extent of isolation of Kenilworth Racecourse since its establishment in 1882. Recent impacts on this and other remnants in the Southern Suburbs are also then ascertained. A description of neighbouring remnants is included in this chapter. This is justified on the basis of their possible crucial role in the ongoing conservation of Kenilworth Racecourse (Chapter 4). The Rondebosch Common remnant is of additional interest to the study because it demonstrates the value that the public places on natural open space (Chapter 6).

The chapter thus gives a historical perspective to 1) anthropogenic influence on Sand Plain Fynbos on the Cape Flats prior to urban development, 2) the pattern of urbanisation in the Kenilworth vicinity, which has fortuitously given rise to three biogeographically isolated natural remnants and 3) events and processes instrumental in shaping the present condition of these surviving island remnants.

3.2 ANTHROPOGENIC INFLUENCES PRIOR TO URBAN DEVELOPMENT

3.2.1 Pre-colonial Impacts on the Cape Flats

The high level of disturbance due to urban expansion on the Cape Flats has caused archaeologists to under-research the area during the 20th century (A. Smith, pers. comm.). Certain Middle Stone Age sites were uncovered during the last century on the acid sand plain flats of Maitland and Pinelands (Goodwin, 1952) [Figure 2 (p. 3)]. Study was largely restricted to the implements found at the sites, with little information gathered about the manner in which the natural environment was utilized by the Early and Middle Stone Age residents of the Cape Flats.

Archaeological records thus give little information on pre-colonial utilisation of the environment on the Cape Flats.

Diaries of early colonial settlers at the Cape therefore represent the major readily available source of information concerning the lifestyles and customs of the Khoikhoi resident at the time of arrival of European settlers. The Khoikhoi did not practice much cultivation, but were predominantly nomadic pastoralists who herded domestic livestock (Schapera, 1933). It is likely that selective grazing by livestock would have altered the relative abundance of species. The practice of increasing fire frequency with respect to the natural fire regime, in order to maintain quality pasturage (Cowling, 1990), is also likely to have had a significant impact on species composition.

The writings of Dapper (1668) indicate that the staple food of the Khoikhoi, harvested during winter months, comprised various types of root. He also noted that

> "they eat little by way of vegetables except for certain species of bulbs, as big as ground nuts. This is their daily provender ..." (p 55).

The writings of the settlers need to be treated with a certain degree of caution, as the observations made were frequently inaccurate (Schapera, 1933). For example, observations were not necessarily made throughout the year. It can, nevertheless, be deduced from the above quotation that certain plant species are likely to have been heavily exploited. The species from which the bulbs were obtained are, unfortunately, not described. Another harvesting practice likely at that time on the Cape Flats was the cutting of thatching reeds (D. Sleigh, pers. comm.), for which various species of the Restionaceae were utilised.

From these early records, it can be deduced that the Khoikhoi probably had a significant impact on the functioning of ecosystems and the relative abundance of species on the Cape Flats. The work of Meadows & Sugden (1990) indicates that the Khoikhoi herders certainly had a marked impact on fynbos communities of the Cedarberg. On the whole, however, impacts on veld quality were most likely ameliorated by their nomadic lifestyle. Large scale destruction of the natural biota was only to follow the arrival of European settlers at the Cape.

3.2.2 The Early Colonial Era: 1652 - *circa* 1795

European influence in the Cape began in 1652 with the arrival of Dutch settlers. This may be regarded as the start of the phase of large-scale degradation of the vegetation of the Cape Flats, but still primarily in the form of veld harvesting, and not totally destructive cultivation or other forms of development.

Within the Southern Suburbs, cultivated farms were initially established on the alluvial soils of the Liesbeeck River in the vicinity of Rondebosch during 1657. Thereafter, farming activity progressed southwards along the Liesbeeck River [Figure 2 (p. 3)] shows the locality of this river) (Pienaar, 1957), but did not extend on to the Cape Flats, the latter remaining free of cultivated farmland until the 1870's. The sandy and nutrient-deficient soils (Theron, 1984) may have accounted for the delay in the establishment of ploughed lands on the Cape Flats. Shaughnessy (1980a) also suggests that the swampy conditions which prevailed during winter and the shortage of water during summer contributed to creating an environment unsuitable for agriculture.

The notes of Ten Rhyne (1668) indicate that high species diversity was still present on the Cape Flats during the late 17th century:

> "... if one strolls across the flats, there is again an immense variety of plants, especially comely ericas, house-leeks of various kinds, luxuriant Star of Bethlehem plants, and narcissi. The bulbs of these equal a human head in size, and specimens were long ago sent to Holland to satisfy the curious. There are also geraniums that smell sweetly... " (p 107).

Nevertheless, there are indications of a high degree of exploitation of biotic resources on the Cape Flats by the Dutch settlers during the 17th and 18th centuries. Denudation of the Cape Flats for firewood collection, including the thick, underground rooting systems of plants (D. Sleigh, pers. comm.), rapidly became a serious problem in that it caused localised destabilisation of the dunes. Shaughnessy (1980a) outlines the numerous prohibitions on firewood collection that were made during the 18th century in an attempt to arrest this problem. Besides firewood removal, D. Sleigh (pers. comm.) believes that thatching reed harvesting and grazing of domestic stock would have occurred in the Kenilworth area. He also suggests that, since the present-day Kenilworth Racecourse forms the source of the Kromboom River, it is likely that the Dutch East India Company oxen were grazed in its vicinity at that time. Shaughnessy (1980a) makes reference to the importance of such communal grazing areas on the Cape Flats, these tracts of land being used as outspans for cattle in transit to Cape Town from outlying farming areas.

3.2.3 Natural Resource Exploitation: *circa* 1795 - *circa* 1880

In assessing the level of impact on Cape Flats habitat during this period, it is necessary to consider the major forms of landownership, namely 'Crown Land' (land owned by the British Sovereign) and private farmland with their associated land uses.

The greater part of the Cape Flats fell under the category of Crown Land until the late 1800's (Shaughnessy, 1980a), although on its western extremity much land was privately owned. However, the exact extent of private landownership is unclear due to conflicting information. A *circa* 1865 map (Anon., *circa* 1865) leaves the form of landownership, whether Crown or private land, unspecified for a large area including the present-day Kenilworth Racecourse. The reason for this is unclear, but may indicate that it was intended to depict this area as Crown Land. Later sources (Kuys, 1874; Anon, 1897) show that parts of this area were indeed privately owned farmland in the early part of the 19th century[1].

If the later information is correct, by far the largest proportion of the western extremity of the Cape Flats had become privately owned or leased farmland by 1865.

Two (tentative) pieces of evidence suggest that during the 19th century, Crown Land supported predominantly natural vegetation. Firstly, intensive use of Crown Land was only likely to have been in the form of (albeit illegal) rough grazing for livestock from neighbouring farms and was unlikely to have been cultivated (M. Cairns, pers. comm.). Secondly, the Crown Land which was to become Kenilworth Racecourse supported indigenous vegetation, as evidenced by its presence today. Once disturbed, fynbos is unlikely to become re-established (*sensu* Romoff, 1989). The inference that can be made is that the rest of the Crown Land of the vicinity was also supporting Sand Plain Fynbos.

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1 Some of the leases and sales shown in a later map produced in the Surveyor General's Office (Anon., *circa* 1897) dated from the start of the 19th century.

Farmland in the Cape existed in the form of Cape Freehold (a form of landownership) and Cape Quitrent (a temporary leasehold tenure). The first Cape Freehold farms granted on the Cape Flats (in *circa* 1795) were restricted to its western extremity (D. Sleigh, pers.comm.). Thereafter, a relatively rapid process of leasing and selling occurred, as indicated by dates of acquisition on the map produced by the Surveyor General's Office (*circa* 1897).

It is difficult to assess the level of impact that private ownership might have had on veld quality. Shaughnessy (1980a) observes that many of the private farms remained unoccupied during the 19th century, with absentee landowners merely using the land for rough grazing for their stock. With rough grazing being a relatively low-impact land use in comparison to cultivation, it may be inferred that Sand Plain Fynbos was supported on the majority of farms of the western sector of the Cape Flats during this period.

Unfortunately, no benchmark data on species loss are available for this period to support any suppositions on the general level of impacts on Sand Plain Fynbos during this phase. However, sources do describe localised denudation through overgrazing and firewood collection (Shaughnessy, 1980b). Repeated imposition of restrictions on firewood collection during the 18th and 19th centuries indicates the seriousness with which the authorities viewed the level of exploitation that was occurring. Shaughnessy (1980b) also notes that in 1836 and 1846, laws were passed demanding compulsory acquisition of permits for grazing and thatching reed collection. A further ruling applicable to private landowners prohibited vegetation removal from properties on the western part of the Cape Flats. The fact that restrictions were imposed at all would indicate the extent of the degradation which had taken place during the 19th century. These restrictions may have played a crucial role in maintaining Sand Plain Fynbos in the Kenilworth vicinity.

Farmland spread in an easterly direction on to the Cape Flats in the mid-1870s, as vacant Crown Land became auctioned off. In 1878, small allotments located on sand plain acid soils were granted on the Wynberg Flats (later to become Philippi) and the Claremont Flats (later to be known as Rylands) to German immigrants (Shaughnessy, 1980a). Cultivation on the Cape Flats became important at this stage and thus perhaps for the first time, large scale destruction of Sand Plain Fynbos was occurring. Initially, various types of imported wattle were grown, but in the 1890's market-gardening became the popular farming activity (Shaughnessy, 1980a). According to H. Robinson (pers. comm.) market-gardening for the cultivation of vegetables was one of the predominant types of farming undertaken in the proximity of Kenilworth. Only a small proportion of each allotment was generally cultivated, the rest presumably being retained as rough grazing land. It is thus possible that the processes of progressive insularisation, (see Chapter 4), were likely to have been minimal during the 1880's.

Of major significance to the destruction of Sand Plain Fynbos on the Cape Flats was the active planting of woody alien plant species to control the problem of driftsand on the Cape Flats during the 19th century. This was soon to be followed by the invasive spread of certain of the planted Australian wattle species, particularly the Port Jackson (Shaughnessy, 1980b).

3.3 DEVELOPMENT IN THE KENILWORTH VICINITY *CIRCA* 1875 - PRESENT

In the mean time urban development, in the area later to become known as the 'southern suburbs', was taking place on the western fringe of the Cape Flats. By the 1880's, the suburb of Kenilworth was already well established, as was neighbouring Wynberg (*Anon., circa* 1897). This was later followed by development of suburbs on the Cape Flats lying to the east of Kenilworth Racecourse (Ottery and Lansdowne), during the first part of the 20th century [Figure 2 (p. 3)]. The area immediately to the east of the Racecourse had been placed under a pine plantation by the 1940's. Beyond the plantation, also in an easterly direction, a polo field had been created (later to become the Kromboom Freeway). Land directly south of the Racecourse has remained largely undeveloped (notably Youngsfield) whereas the land due north of the Racecourse was developed in the mid-1970's (see section 3.5.1).

3.4 THE KENILWORTH RACECOURSE REMNANT

3.4.1 Establishment

Kenilworth Racecourse (established in 1882) was granted, without fee, to the Chairman of the South African Jockey Club (SAJC) and his Successors in Office in December of that year (Title Deed, 1882). It is evident that the government of the Cape Colony was keen that the horse racing industry should expand. The preamble to the Turf Club Act 20 of 1882, promulgated to enable the establishment of the Kenilworth Racecourse, affirmed that it was "expedient to encourage efforts to improve the breed of horses within the [Cape] Colony".

3.4.2 Conditions Facilitating Preservation

Sand Plain Fynbos in the surrounding area had mostly been destroyed shortly after Racecourse establishment, but the enclosure of the Racecourse incidentally preserved the remnants it supported. The preservation of the biota may have been facilitated by provisions made in the now repealed Turf Club Act 20 of 1882. Section 16 states that:

> "whoever shall remove any ... post, fence, tree or shrub, upon any such land, shall, upon conviction thereof before the said Resident Magistrate, be liable to a penalty of not exceeding ten pounds over and above the amount of the injury done.

The Turf Club Act of 1882 was repealed in 1967 by the Pre-Union Statute Law Revision Act 78 of 1967. Certain other provisions embodied in the Act which were incorporated into the title deed (also dating from 1882) are still binding:-

> "1) That the land hereby granted shall be used as a course upon which horse races may be run with the consent, or under the direction and control of the said club, 2) As a training ground for the purpose of training horses intended to race, and also for the erection of training stables and dwellings for the use of persons engaged in training race horses and 3) For any other purpose which His Excellency, the Governor may. upon the application of the South African Jockey Club [renamed the South African Turf Club (hereafter referred to as SATC)], be pleased to declare a public amusement or purpose for which the said land may be used ..."

Thus it was legally binding that the area should be used only for the purposes of horse racing and related activities. A further legal requirement, stipulated in the title deed, was that the land could not be "alienated". This provision ensured the continued existence of the Racecourse in the area concerned, in place of alternative developments.

The natural remnants on Kenilworth Racecourse have thus, for the most part, been protected from degradation. The policy of alien vegetation removal by the SATC as well as strict access control to the in-field of the Racecourse have been instrumental in this process. The same situation has been true for natural remnants on Milnerton and Durbanville Racecourses [Figure 2 (p. 3) indicates the locality of the suburbs in which they occur], also situated on the acid sand plain flats (Chapter 6).

3.4.3 Fragmentation

Successive changes have gradually contributed to the fragmentation and reduction in extent of the remnants on Kenilworth Racecourse. The initial oval-shaped track was replaced and extended on several occasions during the 20th century. A portion of the original track (now the in-field dam and dumping site) [Figure 4 (p. 14)] had fallen into disuse and had become overgrown. The most recent track, constructed during 1975, constituted a significant setback to the remnant as it further fragmented the site, so that it now comprises seven fragments of relatively high conservation quality, separated by race tracks and roads [Figure 4 (p. 14)].

3.4.4 Processes Causing Degradation of the Remnants

The land on which the Racecourse was established had previously been Crown Land, presumably used for the purpose of rough grazing. This may have caused a significant impact on the quality of the veld (Section 3.2.3). The area had also been used for social horse-riding in the decades preceding Racecourse establishment (M. Cairns, pers. comm.), but this is unlikely to have been an important source of impact.

A small Cape Quitrent farm of 1,5 hectares which had been granted to Moses Eyssen in 1815 (Title Deed, 1882) fell within the land granted for the Racecourse [Figure 4 (p. 14)]. M. Cairns (pers. comm.) believes that the farm was most likely used for market gardening and would therefore have been ploughed. Its small size would have rendered other agricultural practices non-viable. It was later purchased in 1898 by the South African Jockey Club (Tredgold, undated). Although the farm fell into disuse, evidence of anthropogenic disturbance in the form of a high incidence of alien vegetation in the area is evident. Two sheds and an occupied house also still remain on the old farm.

During the Second World War, Kenilworth Racecourse was requisitioned by the Defence Force (Tredgold, undated). Although the exact purpose for this action was not ascertained, it can be deduced that the area was being heavily utilised. An aerial photograph dating from 1944 indicates that the area was covered with a network of footpaths more extensive than is now present. Defence Force activity may also have accounted for some small fires that apparently occurred during this period.

The process of dam construction for the provision of irrigation water has been a major source of impact on the natural quality of the area. The dams themselves have replaced 4.9 hectares of Sand Plain Fynbos, but have had more far-reaching effects. The in-field dam (constructed during 1968) and the two dams on the eastern periphery of the area (constructed during the mid-1970's) are supplied by a system of drainage ditches which may have significantly lowered the naturally high water table of the area (Chapter 5). Excavated granitic material was dumped on the surrounding indigenous vegetation during dam construction. A further major effect has been in the inadvertent spread of alien vegetation. The field of view for racing events is not influenced by the eastern extremity of the Racecourse. Thus, alien vegetation (mainly Port Jackson), invading due to the disturbance accompanying dam construction, was not kept in check (Appendix 1). The indigenous plant population was therefore completely eliminated in this area.

Dam construction coincided with the building of the Kromboom Freeway on the eastern side of the course. The Cape Town City Council expropriated approximately 15 hectares of SATC land in order to construct the road. Road construction was responsible for elimination of the last locality of *Protea cynaroides* on the Cape Flats. It is quite likely that other species were eliminated at that stage.

The most significant impacts to have influenced the Racecourse in the past decade have been, firstly, the removal of topsoil and subsoil material for the purpose of upgrading of the racing tracks and, secondly, the gradual encroachment of the in-field parking areas into the fynbos [Figure 4 (p. 14)]. Other impacts of lesser importance include rubbish disposal and the influence of horse-eventing in the natural areas of the Racecourse. The pressure of alien vegetation in the in-field has been alleviated by the need to maintain a field of view.

The importance of fire for the maintenance of diversity in fynbos is well-documented (Kruger, 1979; Gill & Groves, 1981; Cowling, 1987). The frequency of burns prior to Racecourse establishment is unknown, but aerial photographs indicate that only a small area has experienced fire post-Racecourse establishment. The photographs indicate that the few accidental fires that have occurred after Racecourse establishment have been small and rapidly extinguished by human intervention, and no burns to improve species diversity have been undertaken in the area. A 1944 aerial photograph shows that a fire occurred in 1944 inside the main track to the south-east of the old farm [Figure 4 (p. 14)]. Following this, no fires took place until two occurred in quick succession during 1981, but both of these were areas alongside the M5 (Kromboom) Freeway, within disturbed habitat supporting Port Jacksons[2]. Of greater ecological interest were fires which occurred in more pristine areas, one of which occurred in the most northerly fragment, at some stage during 1986 or 1987, the other of which took place in the south-eastern fragment during November of 1988.

The prevention of burns on the centre of the Racecourse is likely to have had significant effects on the diversity of the vegetation (see Chapters 4, 5 and 6). This, as well as other ongoing threats to the conservation of the Kenilworth Racecourse remnant, are elucidated in more detail in the Conservation Management Plan included in Appendix 1.

3.5 ACID SAND PLAIN REMNANTS PROXIMAL TO KENILWORTH RACECOURSE FROM *CIRCA* 1880

The only other significant remnants of Acid Sand Plain Fynbos now in existence within the Southern Suburbs are the Rondebosch Common and Youngsfield [Figure 2 (p. 3)]. Some other remnants were also surviving earlier this century. Outlined below are the impacts which have shaped the conservation quality of these remnants, adding or detracting from their possible role as 'stepping-stones' facilitating colonisation by species (Chapter 4 and Chapter 6).

3.5.1 The Rondebosch Common Remnant

Rondebosch Common [Figure 2 (p. 3)] is the largest remnant of Acid Sand Plain Fynbos within the Southern Suburbs (40.5 hectares). However, it appears relatively degraded compared with Kenilworth Racecourse, due to more intensive utilisation. Kuffel (1957) reports that from 1806, six English regiments were encamped on the site. Prior to this date, an army during the period of Dutch occupation had utilised the site as a campground (Kuffel, 1957).

The Rondebosch Common was progressively diminished with the development of the surrounding area. Various impacts, such as the conversion of the southern edge

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2 Records held by the Wynberg Fire Department.

of the Common into a small golf course (Kuffel, 1957) have reduced the extent and diversity of the natural remnant. Furthermore, a large proportion of the Common now supports invasive alien vegetation, in particular kikuyu grass (*Pennisetum clandestinum*). Another major pressure is the current use of the area as public open space. Freedom of access within a densely populated residential area and lack of control on access have contributed to this pressure.

If one takes into account the extensive use made of the area for recreation, it is not surprising that the Rondebosch Common has become somewhat degraded. Examination of a recent aerial photograph of the area revealed that the entire area has been covered with a network of paths. However, despite the history of exceptionally intensive use of the area, plant species diversity is still unusually high on the Common, although several species have undoubtedly been lost in recent years (McDowell, pers. comm.).

The Common has come to be viewed by the public as an important open space, not only by the local residents, but also by people living in suburbs slightly further afield. Its importance in this regard is demonstrated and discussed in Chapter 6.

3.5.2 The Youngsfield Remnant

Previously termed 'The Tannery' according to maps dating from the last century, the current land use of Youngsfield is a military base. The area still supports a small area of Sand Plain Fynbos (5 hectares) [Figure 2 (p. 3)]. Although Youngsfield has since been considerably degraded, several people resident in the Kenilworth area earlier this century provide anecdotal evidence which supports the previous existence of relatively undisturbed vleis and natural vegetation at Youngsfield up until the 1950's. Species such as *Leucadendron salignum*, *Protea repens* and *Protea cynaroides* are remembered as having been abundant during in the earlier part of this century (T.S. Brown, pers. comm.; M. Cairns, pers. comm.).

The greatest proportion of species have since been lost from the area (C. McDowell, pers. comm.). A recent preliminary assessment of the species richness of the area identified only 30 indigenous plant species on Youngsfield [Table 3 (p. 30)]. This is unfavourable in comparison to the Racecourse which carries over 200 plant species. The majority of the surviving species are those that tend to be

Table 3: Indigenous plant species presently occurring at Youngsfield.

	FAMILY	SPECIES
	AIZOACEAE	*Adenogramma lichtensteinia*
+	ASTERACEAE	*Chenia turbinata*
	ASTERACEAE	*Galenia africana*
+	ASTERACEAE	*Stoebe plumosa*
+	ASTERACEAE	*Ursinia anthemoides*
	CYPERACEAE	*Chrysithrix capensis*
	CYPERACEAE	*Ficinia stolonifera*
+	ERICACEAE	*Scyphogyne muscosa?*
	FABACEAE	*Aspalathus hispida*
	FABACEAE	*Aspalathus spinosa*
	FABACEAE	*Lessertia* sp.
+	GERANIACEAE	*Pelargonium myrrhifolium*
+	GERANIACEAE	*Pelargonium multicaule*
+	GERANIACEAE	*Pelargonium tristae*
+	IRIDACEAE	*Geisshorrhiza aspera*
+	IRIDACEAE	*Hesperantha falcata*
	IRIDACEAE	*Moraea edulis*
+	JUNCAGINACEAE	*Triglochin bulbosa*
	ORCHIDACEAE	*Holothrix villosa*
	ORCHIDACEAE	*Monadenia micrantha*
+	ORCHIDACEAE	*Pterygodium catholicum*
+	ORCHIDACEAE	*Satyrium bicorne*
	POACEAE	*Ehrharta calycina*
+	POACEAE	*Eragrostis curvula*
+	POACEAE	*Pentaschistus thunbergii*
+	POACEAE	*Plagiochloa uniolae*
	RESTIONACEAE	*Leptocarpus sp.*
+	ROSACEAE	*Cliffortia juniperina*
	THYMELAEACEAE	*Gnidia viridis*
+	THYMELAEACEAE	*Passerina vulgaris*

\+ Species occurring on Kenilworth Racecourse resistant to perturbation, a function of the extent to which the area has apparently experienced disturbance in recent years. The existence of the surviving species is merely fortuitous owing to the relatively low-impact land use that the area has experienced in comparison to most open space in urban Cape Town. However, the future of the Youngsfield remnant remains uncertain, as it has not been awarded formal or informal conservation status to date. At the time of writing, a proposal is being put forward to develop the entire area as a housing estate (*Cape Argus*, 22 September, 1990), clearly a land use which is incompatible with conservation.

3.5.3 Recently Eliminated Remnants

Another area which may have been biogeographically important to Kenilworth Racecourse possibly existed where the Kenilworth Centre was built approximately 16 years ago [Figure 2 (p. 3)]. A previous resident in the vicinity stated that the area "looked much like Rondebosch Common, although there were Port Jacksons present" (A. Jones, pers. comm.). The accuracy of this statement is, however, open to question. The source of the above quotation also stated that a remnant in the Lansdowne area "was used as rough grazing for cattle up until about 15 years ago", possibly indicating that indigenous vegetation still occurred there at that time.

A remnant was apparently in existence in upper Kenilworth and could have comprised a significant natural element during the latter part of the 19th century and possibly into the early part of the 20th century [Figure 2 (p. 3)]. Evidence for this supposition was obtained from an article which appeared in the *Cape Argus*, written by Sir James Molteno, on October 28, 1922:

> "Between Tennant Road and the Herschel Avenue was a bit of the 'Darkest Africa', a jumble of native trees and bush, gigantic proteas, silver trees and wild asparagus called 'wacht-een-beetji'."

According to the map of Theron (1984) the above area falls on granitic soil. It is thus likely to have carried a different suite of species, as demonstrated, for example, by the presence of silvertrees (*Leucadendron argenteum*). Nevertheless, along with other remnants such as the natural vegetation of Wynberg Hill (also on granitic soil) it may have been an important stepping-stone up until the time it was transformed into a residential area in the early 1900's.

3.6 CONCLUSIONS

The Cape Flats have had a history of anthropogenic disturbance which escalated with the arrival of the colonists. Within the limits of the available information, it was ascertained that during the 19th century, anthropogenic influence was mostly restricted to localised areas of degradation caused mainly by overgrazing and firewood collection. This was followed by progressive fragmentation of Sand Plain Fynbos as establishment of cultivated lands occurred on the acid sand plain flats. The establishment of suburbs then finally caused the elimination of the greater part of the remaining fragments, commencing in the 1880's and spreading from the western fringe of the Cape Flats, eastwards, so that by the 1930's and 1940's, the extent of urban expansion in that area was more or less complete. The only significant remnants of natural vegetation remaining at that stage in the Southern Suburbs were Kenilworth Racecourse, Rondebosch Common and Youngsfield. They were, therefore, by this stage effectively geographically isolated from neighbouring natural vegetation.

The land use of the Kenilworth Racecourse has been instrumental in preserving the remnants on that site. Nevertheless, there has been ongoing fragmentation and degradation of the remnants. The implications of the degree of isolation of the remnants and population sizes surviving on them are discussed in the following chapter (Chapter 4). The importance of the neighbouring remnants is elucidated in Chapter 4 and Chapter 6.

CHAPTER 4

FACTORS INFLUENCING THE SURVIVAL OF BIOTA WITHIN AN ISOLATED REMNANT HABITAT

4.1 INTRODUCTION

Intensive and fast-growing human land requirements constitutes a stress unique in evolutionary history (Hall, 1987a). Siegfried (1989) found that 64% of the proclaimed reserves in Southern Africa are spatially isolated and that most of the land surrounding the reserves has been anthropogenically transformed to the extent that no interchange of genetic material can occur between areas. The isolated fynbos remnant surviving on Kenilworth Racecourse exemplifies this process of isolation. (See Chapter 3, which places the insularisation of this and other nearby islands in a historical context.)

The aim of this chapter is to review aspects of modern conservation theory and its predictions for the future of natural habitat islands that are under pressure, both in terms of their small size and their geographical isolation from neighbouring natural habitats. In this context, the minimum area and population requirements for viably functioning ecosystems need to be examined.

Hypotheses derived from Equilibrium Theory have been much vaunted as well as criticised as the basis for the design of nature reserves during the last two decades (Margules *et al.*, 1982; Simberloff & Abele, 1982). The validity and worth of this theoretical application is critically assessed with reference to recent literature. The Minimum Viable Population (MVP) concept (Shaffer, 1981; Soule, 1987a; Burgman *et al*, 1988) is the so-called 'state-of-the-art' theoretical basis for conservation planning (Soule, 1987a). This is also examined with emphasis on predictions *vis-a-vis* long term conservation of remnant islands of natural habitat.

Conclusions are then drawn with reference to the implications of biogeographic isolation of Kenilworth Racecourse. The appropriateness of the emphasis on reserve design, is also questioned, in the light of the scarcity of areas available for selection as reserves.

4.2 CONSERVATION BASED ON ISLAND BIOGEOGRAPHICAL THEORY

The Equilibrium Theory of Island Biogeography was formalised by MacArthur & Wilson (1967). The theory is based on the premise that the number of species that survive on an island results from a dynamic equilibrium between immigration and extinction of species. The immigration rate is dependent on the degree of isolation of the island from other islands and the mainland; the more remote the island, the slower will be the rate of immigration. Extinction rate, on the other hand, is a function of island area; the smaller an island, the higher will be the rate of extinction and the less stable with respect to environmental disturbance. Attaining equilibrium implies that immigration and extinction are balanced and species number remains relatively constant (Gorman, 1979). Furthermore, the theory predicts that decline in species numbers after the creation of an island occurs when extinction rate exceeds immigration rate, the so-called process of 'relaxation'. Extinction continues until a new and lower equilibrium number of species for the smaller area is achieved (Diamond, 1975).

Burgman *et al.* (1988) believe that there are severe shortfalls in extrapolating a theory applicable to oceanic islands to terrestrial ecosystems. Gilbert (1980) and Margules *et al.* (1982) go further in their criticism by arguing that the equilibrium theory of island biogeography, even as it applies to islands, remains insufficiently substantiated at an empirical level. Nevertheless, island biogeographic principles have in the past been applied to terrestrial habitats by academics and conservation managers alike. The main conservation application has been in respect of habitats becoming isolated and thereby forming islands, due to the transformation of the surrounding habitat, causing increasing isolation of the remnants (Margules *et al.*, 1982). The importance placed on equilibrium theory and its application to terrestrial habitats is reflected in the way in which it became an integral part of the biological theory that has been taught in tertiary curricula during the past two decades. For example, Futuyma (1979) in his textbook on evolutionary biology states that:

> "the principles of island biogeography apply not only to islands, but to any localized area. The number of species approaches an equilibrium determined by the rates at which species enter the community and become extinct" (p 47).

Diamond (1975) attempted to demonstrate that the number of species a reserve could hold is, as apparently found on oceanic islands, a function of the area and degree of its isolation. He also contended that if an area of natural habitat undergoes a reduction in size, it will initially carry more species than it would eventually hold in a state of equilibrium due a situation of over-saturation.

Much attention has also been given to the question of shape and arrangement of reserves, notably by Diamond (1975), who based his premises on the principles of established island biogeographic theory. Optimal reserve design was aimed at achieving minimal extinction rates with a maximal equilibrium number of species. He proposed the hypothesis that regularly shaped reserves would retain more species than irregularly shaped reserves. At the outset it should be stated that Burgman *et al.*(1988) express doubt at the existence of a state of dynamic equilibrium between species arrivals and extinctions on habitat islands. Furthermore, they argue that shape is not an important determinant of species richness, although perimeter size can become an important consideration where reserve size is small and edge effects become significant. For example, the chance of invasion by alien species is enhanced by a large perimeter.

Support for island biogeographic theory in its application to conservation planning continued into the 1980's. This is confirmed by its inclusion in the World Conservation Strategy, produced under the auspices of the IUCN (1980). In the Strategy, it is proposed that a single large reserve is preferable to several small reserves, based on the suppositions of Diamond (1975) . Diamond (1975) argued that a large reserve could hold more species at equilibrium and fewer species extinctions would occur than would be the case for an archipelago of smaller reserves. The stance that a single large reserve is more effective was also taken up within the Fynbos Biome where, for example, Kruger (1977) proposed that single large reserves ought to be created in preference to several small reserves.

There has been widespread disagreement to the argument that single large reserves are more effective than several small reserves, as shown in the review article of Simberloff & Abele (1982) (the SLOSS debate). In support of this disagreement, Soule & Simberloff (1986) have observed that at the time of founding of reserves, or soon thereafter, single large reserves do not necessarily contain more species than several small reserves. Simberloff & Gotelli (1984) undertook a study on plant species richness of remnants in a prairie-forest ecotone, the results of which are in agreement with this concept. They found no evidence for the hypothesis that species richness is maximized by a single large refuge. No species were excluded from the small sites and groups of small sites tended to have more species than single large sites of the same area.

Area, *per se*, has come to be viewed as a less significant determinant of species richness than is heterogeneity of habitat [see, for example, Margules *et al* (1982)]. Pimm (1986) demonstrates this point. The species-area relationship (Darlington's Rule of Thumb in Gorman, 1979) would predict that a twenty times reduction in area should cause species numbers to drop to 50% of former levels. In the United States, forest area has been reduced by 20 times but this has been associated with a loss of only 2% of the plant species formerly occurring. Conversely, in Hawaii, there has been a loss of plant species far in excess of what would be expected for the mere 2% loss of forest area that has occurred (Pimm, 1986). Clearly, if species have wide distribution ranges, there is less risk of their being eliminated when habitat is destroyed. In the South African context, Siegfried (1989) observes that species diversity is exceptionally high per unit area in reserves in the south western Cape, compared to other regions in southern Africa. Furthermore, because of high levels of beta-diversity and narrow endemism in the south western Cape, it can be expected that a disproportionately high loss in species diversity would occur per unit area lost. Even so, Siegfried (1989) concludes that a remarkably high percentage of species are, in fact, found within the bounds of reserves in this region.

In agreement with authors such as Jarvinen (1982), Simberloff and Gotelli (1984) find that, besides supporting more species as a whole, more endangered species generally seem to occur on archipelagos of small islands rather than single large islands. An explanation for these phenomena is that variation in habitat plays a vital role in determining the occurrence of species. In their study, Simberloff & Gotelli (1984) did not establish beyond doubt that this is the case. Furthermore, it would be expected that, where an archipelago of remnant habitat remains, as opposed to a single large reserve, a higher degree of destruction of intervening habitat would occur, causing the creation of more endangered species (C. McDowell, pers. comm.). This argument may be used to account for the high incidence of endangered species on Kenilworth Racecourse. The veld type 'Sand Plain Fynbos' with its large numbers of endemics is, as a whole, severely reduced in extent due to urban and agricultural development and many of the species have acquired red data status because of this.

The SLOSS debate is of little relevance if the probability of long term species survival is not assessed. Equilibrium Theory predicts a decrease in species number after isolation until a new equilibrium is reached. Simberloff & Gotelli (1984), in their case-study, found no evidence to suggest that species numbers had relaxed to a greater extent on older islands. However, insularization in this example (between 80 and 100 years) was perhaps still too recent to adequately judge the degree to which species would become extinct in the future. Kenilworth Racecourse, in the approximately 100 years in which it has been isolated, has apparently experienced loss of several species. Although this loss may be due to the effect of relaxation, this cannot be verified and could equally well be explained by unfavourable environmental conditions (see Chapter 5).

Although evidence has been presented that suggests that several small reserves could maintain as many, if not more species than a single large reserve, there must obviously be a limit to the extent to which the argument relating to smallness of reserve size can be taken. An area so small that it cannot remain a viable functioning system in the long term is not a conservation option. Factors such as sensitivity to disease outbreak and invasion by alien organisms become more critical in a small area.

Another major issue to be considered when conserving species is their requirement of minimum area or population size. Equilibrium Island Biogeography is ecologically naive in that it does not take cognizance of the individual requirements of species for long term survival. Decisions on reserve design should be informed by such considerations. This incorporates the minimum viable population size concept and autecological requirements of target, or alternatively keystone, species (Burgman *et al*.,1988).

Burgman *et al.* (1988) criticise the application of island biogeography in making predictions about species number at the ecosystem or community level as a function of degree of isolation and area. They observe that the theory cannot predict with any degree of accuracy species number in a particular habitat type, optimum reserve shape or size, nor the species that are likely to survive or become extinct in a particular area. Burgman *et al.* (1988) thus find that the theory of island biogeography is of little practical value in the management and conservation of wildlife populations. They also claim that there is little to conclude about the minimum areas that are viable for conservation. In summary, Burgman *et al.*(1988) conclude that:

> "island biogeography cannot describe the best way to select or design nature reserves, given that their [nature reserve] function is to stave off extinction of species" (p 13).

The Minimum Viable Population concept attempts to redress shortcomings in Equilibrium Theory.

4.3 THE MINIMUM VIABLE POPULATION CONCEPT

The study of viable population sizes for conservation is a very new field. Soule (1987a) observes that it is only in the past decade that the complexity of the field has been grasped, because the determination of minimum viable populations (MVPs) for long term persistence and adaptation "is one of the most difficult and challenging subjects in conservation biology". Realisation that there is an element of chance in the extinction and survival process gave rise to the MVP concept (Ewens *et al*, 1987). Population size, as well as time increase the chance of extinction (Shaffer, 1987). Shaffer (1981) was the first to use the term 'Minimum Viable Population' (MVP). He arbitrarily defined the MVP as the smallest population that has a 99% chance of remaining extant for 1000 years, despite the effects of environmental, genetic and demographic stochasticity, as well as natural disaster.

Soule & Simberloff (1986) broadly classify the elements that influence chance of survival into extrinsic and intrinsic factors. Extrinsic factors incorporate deleterious interactions with other species, as well as harmful impacts on the population by the physical environment. Intrinsic factors comprise processes of random genetic variation and environmental interaction with these. Genetic variation in this instance was classed as follows: a) maladaptive behaviour, b) demographic stochasticity, and c) genetic deterioration incorporating processes such as genetic drift and inbreeding. Despite the obvious interrelatedness of demographic stochasticity and genetic deterioration, these two concepts have traditionally been treated separately in attempts to derive MVP, because adequate means of integration have not yet been achieved (Ewens *et al.*,1987). Neither has sufficient attention been paid to incorporating environmental uncertainty into an overall MVP. These three subjects are treated separately below.

4.3.1 Genetics and the Minimum Viable Population Concept

Of all the components of the MVP question, the genetic requirements for survival, particularly for faunal species, have received the most attention. As defined by Soule & Simberloff (1986), the genetic MVP is the minimum population size that can offset the deleterious effects of genetic deterioration by means of genetic drift. Whilst the precise mechanisms of extinction remain poorly understood, we can be reasonably sure that the two major factors precipitating its occurrence are isolation and the small size of populations (Soule, 1983 and Schonewald-Cox, 1983). Both of these factors are known to play key roles in influencing the genetics of small populations. The determination of genetic MVP is aimed at overcoming these hazards by forming the basis on which reserves should then be designed. An integral part of maintaining a genetic MVP seems to be the influx of genes from other populations.

a) The effects of inbreeding

A presumed factor in loss of fitness within a population that is undergoing a bottleneck (a drastic reduction in population size) is inbreeding. The major long term effect of this process is a loss of heterozygosity, supposedly resulting in a deleterious change in faunal species because homozygous individuals have reduced potential to evolve (Soule, 1986). Inbred faunal populations also suffer from 'inbreeding depression'. Defined as "the permanent or temporary reduction in fitness or vigour due to the inbreeding of normally outbreeding organisms" (Schonewald-Cox, 1983), inbreeding depression causes high mortality due to general loss of vigour (Soule & Simberloff, 1986). For example, alleles that confer resistance to disease may be lost (Hamrick, 1983) and fecundity may decrease following inbreeding (Soule, 1983). Charlesworth & Charlesworth (1987) indicate that the effect of inbreeding depression on evolution of natural populations may generally have been underestimated in the literature.

Immigration of genes overcomes the threats of inbreeding. However, this process in itself poses a serious threat to small populations, because 'outbreeding depression' may result from breeding between totally unrelated individuals (Soule, 1986). Co-adaptations of gene complexes of populations that suit the local environmental conditions could be swamped and offspring fitness reduced by injection of genes from other populations (Burgman *et al.*, 1988; Schonewald-Cox, 1983). Conservation managers thus need to understand whether inbreeding or outbreeding is more likely to have a beneficial effect on the population. In plant species, less evidence has been formulated which proves that inbreeding has negative side-effects.

b) Genetic drift

Genetic drift is a further source of concern in isolated populations, because it also leads to homozygosity (Burgman *et al.*, 1988). The effect is especially pronounced in small populations because the sample of genes present in the population is not necessarily representative of the species gene pool (Allendorf, 1983). As with inbreeding, the major effect is an increase in mortality and a decrease in fecundity (Burgman *et al.*, 1988).

Inbreeding and genetic drift are problems, at least for faunal species, arising from isolation and small population size. Their deleterious effects are reduced if populations have access to new sources of genetic material. Gene flow pattern is therefore an integral part of the genetic MVP problem.

c) Benefit of isolation

Low levels of gene flow need not always be deleterious for a species. Genetic isolation would have the effect of avoiding the danger of 'outbreeding depression' discussed in the above section. As shown by Slatkin (1985), well-adapted gene combinations in local populations can arise as a result of genetic drift and natural selection. The effect of this process is likely to be particularly pronounced in small populations. If the level of gene flow is always high, well-adapted gene combinations are 'swamped' and cannot become established in any population.

For the species to benefit from isolation, occasional gene transfer among populations may often be beneficial in a proportion of cases (but exactly what this proportion is cannot be ascertained as we lack the data to make generalisations).

d) Fynbos and gene flow

Little is known about gene flow in fynbos (Rebelo, 1987) and the small amount of data that does exist has not produced a clear overall trend in inbreeding/outbreeding patterns (Steiner, 1987). Hall (1987b) cites research that indicates that the Ericaceae (a major taxon in the Fynbos Biome) is likely to be outbreeding. Two subfamilies of the Iridaceae exhibit different breeding patterns: the Iridoiae (including *Galaxia* and *Moraea*) are generally self-incompatible, whereas the Ixioidae (such as *Hesperantha*, *Ixia* and *Watsonia*) are predominantly self-compatible. The extent to which pollination agents result in outbreeding is also inadequately known. The best studied pollination systems are of plant species that are bird-pollinated (Rebelo, 1987). These species would clearly stand a high chance of inter-population gene flow. Less research has been performed on other forms of flower visitation by agents such as bees or rodents, whereas wind-pollination, of which there is a high incidence in the fynbos, notably in the Restionaceae (Steiner, 1987), is virtually unstudied.

Seed dispersal is another vital link in understanding gene flow patterns. Myrmecochory (diaspore dispersal by ants which devour the elaiosome of the seed or fruit) is an interesting seed dispersal mechanism that has been cited to be of importance in the fynbos, but only takes place over distances of up to 20 metres (Bond & Slingsby, 1984). Thus it does not seem a likely means of fulfilling a role in inter-population gene-flow.

e) Gene flow and Kenilworth Racecourse

It is possible that, after track establishment in the 1880's, gene interchange for plant and animal species with the closely neighbouring indigenous vegetation (Chapter 3) was continuing. This source of gene transfer had largely been eliminated by the start of the twentieth century with the establishment of the suburbs surrounding the track.

The last remaining likely source of gene flow is Youngsfield, situated beyond a road adjacent to the Racecourse [location in proximity to Kenilworth Racecourse shown in Figure 2 (p. 3)]. A spot survey of the species richness of the area identified plant species on Youngsfield [Table 3 (p. 30)]. Although there may be more species present than were identified, the total number per unit area is still low, in comparison to the adjacent Racecourse which carries well over 200 plant species. The majority of the surviving species on Youngsfield are those that tend to be resistant to perturbation. Nevertheless, the potential still exists whereby the area may become an important source of gene flow for the Racecourse. Interchange of genetic material between Youngsfield and Kenilworth Racecourse by chance events may still be occurring, since there is a high degree of overlap in species between the Racecourse and Youngsfield, with 21 (or more) of the 30 indigenous species recorded on Youngsfield occurring on Kenilworth Racecourse [Table 3 (p. 30)]. The implication of the existence of natural remnants neighbouring Kenilworth Racecourse is further elucidated when the role of natural 'corridors' in conservation in urban areas is discussed in Chapter 6.

f) What can be concluded about genetic MVPs?

There is growing consensus that population sizes should be large enough so genetic gain through mutation should balance the loss through genetic drift. Hall (1987a) believes that a small, isolated population will fail as populations undergo genetic drift, resulting in species that cannot withstand selective forces and which consequently become extinct. There has, however, been little empirical evidence to verify that this is the case.

The exact minimum size of populations required to avert genetic deterioration has largely been determined by means of mathematical models. The major application of mathematical models, using population genetics, has been in determination of MVPs of captive breeding populations in faunal species (Burgman *et al*, 1988). Generalised guidelines as to the genetic MVP of natural populations have not been forthcoming and Soule (1987b) warns against misapplication of data to populations for which they were not specifically determined. The genetic MVP needs to be determined for each specific case, requiring in-depth autecological studies. Furthermore, the importance of inbreeding in plant species is even less well understood than in faunal species and, in fact, it has been found that outbreeding and hybridisation in plant species can cause infertility (C. McDowell, pers. comm.).

4.3.2 Demographic Stochasticity

'Demographic stochasticity' is the random variation in the survival and fecundity of a population (Burgman *et al.*, 1988). It contributes to population fluctuations and may be the cause of extinction in some cases. Ewens *et al.* (1987) propose that demographic uncertainty is an important consideration for relatively small populations, whereas it does not pose a threat to larger populations. It may thus be an important consideration for populations in remnant Sand Plain Fynbos.

4.3.3 Environmental Uncertainty

'Environmental stochasticity' or 'environmental uncertainty' is the random variation in population parameters, such as survival and fecundity, that occur as a result of change in the environment. The manner in which environmental uncertainty affects population dynamics remains poorly understood, according to Burgman *et al.*

(1988). Ewens *et al* (1987) nevertheless regard the phenomenon as being a major threat to any population. They contend that there is no critical population size above which environmental uncertainty becomes unimportant (Ewens *et al., 1987*). At the scale of environmental catastrophe, population size becomes irrelevant, as even very large population size yields small return in terms of survival.

Goodman (1987) reviewed a mathematical means for representing the effects of random fluctuations of the environment on the persistence of populations. The model incorporating environmental fluctuations indicated that extremely large population sizes may be required in order to stave off the effects of environmental fluctuation. Furthermore, when the threat of environmental uncertainty is considered along with that of demographic uncertainty, the threat is vastly increased, especially for small populations (Ewens *et al.*, 1987).

Not only is population size important when considering environmental catastrophe, but so is area over which the population is distributed. Soule & Simberloff (1986) argue that size of habitat is a crucial factor in terms of events such as storms, which may completely eliminate a small habitat. The smaller the refuge, the greater the chance of complete elimination. This has obvious implications for the ongoing survival of Kenilworth Racecourse.

Environmental stochasticity implies that there may also be long periods where no disturbance-generating events occur. This presents a severe threat to small habitats, because species may be dependent on natural disturbance for their survival. In the fynbos, for example, fire has been shown to be a crucial form of natural disturbance for maintenance of species diversity and essential ecological processes (Bond *et al.*, 1988). Its importance for islands of fynbos is evaluated in Chapter 5.

Goodman (1987) concludes that environmental stochasticity must be considered when reserves are designed. To be sure of species' survival in the light of these threats, it is necessary to have population sizes in the order of millions (or more), or to have numerous separate populations (Ewens *et al.*, 1987). It is untenable to suggest that such large population sizes can be conserved and therefore that most species are doomed to extinction in the future.

4.4 EXPLAINING SPECIES EXTINCTION

Small reserves have frequently been shown to experience accelerated species loss (Soule & Simberloff, 1986). What are the causes of this extinction process and what are the requirements for persistence?

The Equilibrium Theory of Island Biogeography proposes that reduced area, *per se*, is the cause of species extinction and that initial loss in species after isolation is a result of 'relaxation'. More species extinctions than arrivals occur on the 'island' until a new and lower equilibrium number of species for the reduced area is reached. However, the Equilibrium Theory cannot predict the minimum size of a reserve necessary to achieve a state of equilibrium, except within a habitat where species/area curves may be of use (Bond *et al.*,1988); nor, is the existence of a state of equilibrium between species arrivals and extinctions itself beyond dispute. Soule (1987a) observes that until we can reach a stage whereby ecological processes necessary for persistence at the community level are adequately understood, the usefulness of island biogeography for determining long term conservation potential is diminished. As previously mentioned in this chapter, little can be concluded about the optimum arrangement of reserves in order to maximise species survival. Island biogeography thus neither adequately explains species loss, nor has it provided a framework on which to base decisions on minimum area of reserves.

The MVP concept is the preferred alternative for explaining species extinction in small reserves. Rather than deciding on an effective reserve area, minimum population size is the solution proposed for staving off extinction. Genetic, demographic and environmental threats to the survival of populations are thereby overcome.

Attempts have been carried out by some researchers to derive rough estimates for long term effective populations. These figures range from the 100's to in excess of a million (Ewens *et al*, 1987; Schonewald-Cox, 1983). The upper range figures take into account the threat of environmental stochasticity, from which even very large populations are at risk of extinction (Ewens *et al.*,1987). Smaller populations than these figures would presumably run the risk of extinction.

However, Soule & Simberloff (1986) caution against such use of the MVP as a 'magic number' because it is frequently fallible. Ewens *et al.* (1987) also remark on the lack of empirical evidence for the MVP as well as our lack of understanding of the extinction process. Extinction, at least on a local scale, may be more likely than has been previously recognised, but our ability to predict time to extinction or its causes is not far advanced. An additional limitation in understanding of MVP's in plant species exists at present. The level of understanding of MVP's in faunal species is far advanced over floral species.

4.5 CREATING VIABLE RESERVES

Earlier in this chapter, the overwhelming amount of literature negating the relevance of the SLOSS debate and Equilibrium Island Biogeography in its application to conservation, was reviewed. The current preferred theoretical basis for ensuring the creation of viable reserves uses in-depth autecological assessment of the minimum requirements for long term evolution of keystone or critical populations of species as its basis. This is encapsulated in the following quotation from Higgs (1990):

> "While the mathematical basis for nature reserve design provides a useful illustration, it is no substitute for biological research. ... Once the natural history has been done, then the decision on the selection of which areas to conserve can be based on other more meaningful grounds" (p 99).

There are shortcomings in the autecological approach, notably that the requirements of the majority of species in a community, each with its own life history and ecological requirements, are not necessarily taken into account. Nevertheless, Soule (1987b) proposes that the analysis of such life histories and requirements of critical or keystone species remains the only practical means for assessing MVPs readily at our disposal at present. Despite present shortcomings in understanding of MVP, Soule (1987b) is confident that in the second half of the 1990's, we may have reached a stage where more reliable 'rules of thumb' may be derived for MVP determination.

4.6 LESSONS FOR VIABLE RESERVES IN FYNBOS

Little is as yet understood about the demographic and genetic requirements for survival of populations in the Fynbos Biome. It cannot be conclusively demonstrated that the increasingly isolated nature of Kenilworth Racecourse over the past 100 years (see Chapter 3) has deleteriously affected the genetics of the plant species. Such effects are likely to be more important in the long term future (perhaps thousands of years). Fynbos flora is characterised by a high degree of narrow endemism (Hall, 1987a). This may assist in offsetting the negative genetic and demographic repercussions of isolation of plant communities and may ultimately be important to species conservation on remnant 'islands' (Goldblatt, 1978, cited in Bond *et al.*, 1988). However, the populations surviving on Kenilworth Racecourse may be too small to stave off extinction. Possible means of overcoming deleterious effects (by means of corridors and introduction of propagules to the area) are discussed in Chapter 6.

More is understood about the effect of environmental uncertainty on the survival of fynbos species. Observations made by Bond *et al.*(1988) in 'islands' of varying degrees of isolation and size in the southern Cape indicates that lack of fire was a major cause of species absence. In the fynbos biome, the chance of non-occurrence of burns for extended periods constitutes a form of environmental uncertainty because the species have evolved a certain degree of dependence upon it. If absence of fire was the only apparent cause for absence of species from 'islands' in the southern Cape study, the same may be true for Kenilworth Racecourse. No fires have occurred in approximately 90% of the area for the past 100 years. This may at least partially account for recent loss of species from the area. The implications of absence of fire on species survival on Kenilworth Racecourse are discussed in Chapter 5.

Using a simple species-area relationship, Bond *et al.*(1988) ascertained that the effects of insularisation were important with respect to 'mainland' fynbos in fynbos 'islands' smaller than 300 hectares. The area of the Kenilworth Racecourse remnant is approximately thirty times smaller than this figure and species loss would thus be expected. However, Bond *et al.*(1988) warn against extrapolation of the figure derived in their Southern Cape study to other fynbos environments.

With a carefully managed burning programme simulating the natural fire regime, the current species diversity on Kenilworth Racecourse could be maintained, or perhaps improved. Other possible causes of species loss from 'environmental threats' (for example alien vegetation invasion, habitat destruction and alteration of the water table) may also be avoided with improved management of the area (see Appendix 1).

4.7 IS RESERVE DESIGN PRACTICAL?

Equilibrium Theory and the MVP concept represent attempts to influence the design of nature reserves. However, in reality, areas that can still be selected for conservation are becoming few and far between and they are most likely to be small in size. This has been the case in the Fynbos Biome, where, for example, the Renosterveld and Sand Plain Fynbos veld types have been severely depleted (Jarman, 1986) and the natural remnants survive in 'islands'. Few of the areas available for conservation will thus be viable. On the other hand, viability of populations need not be the only criterion by which an area is deemed to be worthy of conservation. This may be true particularly where a habitat is rare or unique. The value of conservation areas is discussed further in Chapter 6.

Caution must thus be exercised before areas are rejected as not being worthy of conservation, due to uncertainty about their long term evolutionary potential. With improved technology and methods for re-establishment of species, areas previously thought to be worth little in terms of their long term conservation potential may be restored.

4.8 CONCLUSIONS

Opportunities for reserve creation are now limited, particularly in the lowlands of the south western Cape. Kenilworth Racecourse provides such an opportunity. However, being small as well as biogeographically isolated, the area would be particularly susceptible to deleterious genetic changes, demographic stochasticity and environmental uncertainty, according to recent MVP theory presented here. Nevertheless, the theory has as yet provided neither empirical answers to the question of minimum populations that are necessary for long term conservation, nor specific information on management procedures that need to be adopted. The reserve manager or designer is left to undertake autecological studies of critical or keystone species. Perhaps arguments for reserve design as well as the minimum viable sizes of populations are by-passed by the need to create reserves where this is still possible, and to use the best information available so as to minimise delays in reserve creation. The following chapter attempts a relatively rapid means of assessing species loss. This may provide reasons for species extinctions in the area and therefore provide guidelines for management of the Kenilworth Racecourse 'reserve'.

CHAPTER FIVE

ASSESSING QUALITY OF NATURAL SYSTEMS ON KENILWORTH RACECOURSE: SPECIES PRESENT AND SPECIES LOST

5.1 INTRODUCTION

Natural systems suffer negative impacts from being isolated and reduced in extent (previous chapter). An assessment is made here of whether Kenilworth Racecourse, despite its isolation and small size, has retained elements worthy of being accorded conservation status. Firstly, the level of disturbance of the natural habitat types of the study area is ascertained and checklists of indigenous biota are presented. Secondly, an assessment is made of species loss from Kenilworth Racecourse. This is achieved by comparing previous species records with current checklists. Some attributes of the surviving and extinct species are determined, based on a study by Bond *et al.*(1988), the purpose being to identify possible causes of species loss in the area.

5.2 CURRENT CONSERVATION VALUE OF THE HABITATS AND BIOTA

5.2.1 How Disturbed are the Natural Habitats?

a) Seasonal Vlei Habitat

In contrast to other wetlands on the Cape Flats, the natural vleis of Kenilworth Racecourse within the high conservation quality areas [Figure 4 (p. 14)] are relatively pristine. A recent water quality study of vleis throughout the south western Cape ranked the largest natural vlei of Kenilworth Racecourse with another wetland in the south western Cape as the most pristine of all the 27 wetlands surveyed (Silberbauer & King, in prep.). Pristine, in this case, refers to the low nutrient loads present in the water of the vlei (Davies & Day, 1986). This observation is surprising, considering the extent to which the area surrounding Kenilworth Racecourse has become transformed into an urban landscape.

Although no data are available indicating the effect of drainage ditches around the tracks on the surface hydrology, it is likely that they have lowered the groundwater level within the fynbos area. The three dams [see Figure 4 (p. 14)], constructed between the late 1960's and the mid-1970's, form the collection points of the ditches. Nevertheless, the area still has a high water table during winter, which frequently causes inundation of the race tracks. The *Cape Argus* (8 November, 1989) reported race cancellations at Kenilworth Racecourse because of flooding. Several race days were also cancelled during 1990 for the same reason, leading to substantial loss of revenue (Norton, pers. comm.). The possibility of further drainage of the area could pose a serious stumbling block to ongoing conservation. Cross-country 'horse eventing' takes place on several occasions through the Racecourse in-field, sometimes with more than 50 horses taking part. The routes generally include seasonal vleis [Figure 4 (p. 14)], resulting in paths being left through the vleis, especially if eventing takes place in the wet season. The largest and most pristine of the vleis is, however, avoided at present.

b) Drier Habitats

Areas of Kenilworth Racecourse which do not not receive the same degree of seasonal inundation have suffered extensive disturbance. Types of disturbance include excavation of topsoil, creation of in-field grassed-over parking, the creation of a refuse dump and previously, the cultivation of land. Nevertheless, 28 hectares remain as relativēly high quality fynbos which has suffered little disturbance in the past [Figure 4 (p. 14)], as indicated by the low incidence of weedy species in these areas. It appears that the fynbos has escaped the threat of fertilizers drifting on to adjacent fynbos from the racing tracks, although Witkowski (1989) makes reference to the likely detrimental effects of high dosage of nutrients to Sand Plain Fynbos.

5.2.2 An assessment of the indigenous biota present

a) Approach and Rationale

Checklists are used as a means of annotating the species present. Siegfried (1989) highlights the primary importance of empirical checklists for species preservation and management in nature reserves. Without baseline species data, the effects of management decisions cannot be assessed objectively. Despite the obvious value of checklists, the management of more than half of the proclaimed nature reserves in southern Africa have to date failed to compile them. He adds that "completed lists of species, especially of plants, should be compiled as a matter of urgency" (Siegfried, 1989 p.200).

Checklists are useful indicators of the current conservation value of an area in terms of species present and their Red Data status. Further discussion on the subject of conservation value is given in Chapter 6.

Checklists of two of the groups of biota, namely flora and avifauna, are used below as a basis for the assessment of species loss from Kenilworth Racecourse.

b) Methodology

Checklists of biota present on Kenilworth Racecourse were compiled for all groups, excluding non-vascular plants and non-aquatic invertebrates. Data on aquatic invertebrates were obtained from King and Silberbauer (in prep.). McDowell (unpublished data) compiled a checklist of amphibians present on Kenilworth Racecourse and undertook trapping of *Xenopus* spp..

Small mammals were trapped by the author using sixty traps analogous to 'Sherman live traps', baited with a peanut butter and oats mixture. These were set for four full days during February. Oats were trailed to the mouth of the traps to entice 'trap-shy' species such as Kreb's fat mouse (*Steatomys krebsii*). Checklists of floral species were compiled during repeated visits to the area over the year by the author and McDowell. It was decided not to establish sampling quadrats, but to rather assess species presence over the entire area. This was considered appropriate, considering the small size of the study area. Plant species were identified in the field where possible and specimens of species unknown to the observers were collected and identified using herbarium records. No vouchers of collected specimens were retained.

A checklist of avifauna was compiled from secondary data records collected on Kenilworth Racecourse during 1989 for the Southern African Bird Atlas Project (in prep.). These data were collected by experienced observers, during the winter as well as spring/summer months. The data were augmented by observations during site visits by the author with accompanying observers.

Reptiles were recorded by the author and McDowell during site visits to the area. The checklist was augmented by unpublished records collected by Attwell during the 1950's.

c) Results

Tables 4 to 10 comprise checklists of species currently occurring in the study area. The aquatic invertebrate survey indicated the presence of at least 15 lower taxa (King & Silberbauer, in prep.). These fell within the classes Crustacea, Hydracarina and Insecta. The discovery of a possible new species of *Paramelita*, a small shrimp of the class Crustacea, was of particular importance. This is the first record of the genus from the Cape Flats (C. Griffiths, pers. comm. in McDowell *et al*, 1990) [Table 4 (p. 52)].

Amongst the lower vertebrates, eleven amphibian, three tortoise, three lizard and one snake species were recorded during this study [Tables 5 (p. 53) and 6 (p. 54)].

Overall, 49 bird species were identified during the year of observation [Table 7a (p. 55)]. The only exotic species recorded was the European starling, (*Sturnus vulgaris*). A checklist of avifaunal species from Kenilworth Racecourse after Grindley (1950) is also included in the text [Table 7b (p. 56)].

Trapping success was poorer than expected for small mammals, in comparison to a separate study conducted on the Cape Flats by David (1980). In all, only four species of rodent were captured during this study. The striped fieldmouse (*Rhabdomys pumilio*) was the species most frequently trapped (fourteen individuals). Six individuals of vlei rat (*Otomys irroratus*) were trapped, mainly in the vicinity of the vleis and in-field dam[1]. Both pygmy mouse (*Mus minutoides*) individuals were trapped in an area burnt approximately four years previously. Only one individual of *Dendromys* sp. was trapped[2]. No shrews (*Myosorex* spp.) were trapped, a result unexpected for the area (Jarvis, pers. comm.). Evidence of burrowing activity was seen for both the Cape dune molerat (*Bathyergus suillus*) and the Cape molerat (*Georychus capensis*). There is a possibility that the small-spotted genet (*Genetta genetta*) and the small grey mongoose (*Galerella pulverulenta*) still occur, evidenced by the presence of droppings. Ungulates no longer occur in the area [Table 8 (p. 57)].

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1 Although the species is relatively indistinguishable from *Otomys saundersiae*, the individuals caught are not likely to be the latter because of the unlikely occurrence of the species in the area (Jarvis, pers. comm.).

2 Most of its features bore close resemblance to the grey climbing mouse (*Dendromys melanotis*) and characteristically there was no fifth digit on the fore-paw (Smithers, 1983). However, the coat was unusually red and no white patch was present anterior to the ears. It may thus represent a hybridisation with the species Brant's climbing mouse (*Dendromys mesomelas*) (Jarvis, pers. comm.).

Table 4: Checklist of aquatic invertebrates occurring in a seasonal vlei at Kenilworth Racecourse (after King *et al.*, in prep.).

CLASS	ORDER	FAMILY	SPECIES	OBSERVER	DATE
CRUSTACEA	Amphipoda	?	*Paramelita sp. nova*	King & Silberbauer	/7/89
CRUSTACEA	Cladocera	?	(Unidentified larvae)	King & Silberbauer	/7/89
CRUSTACEA	Cladocera	Calanoidae	*Metadaptomus purcelli*	King & Silberbauer	/7/89
CRUSTACEA	Cladocera	Chydoridae	*Chydorus sphaericus* (group)	King & Silberbauer	/7/89
CRUSTACEA	Copepoda	Chydoridae	*Rak* sp.	King & Silberbauer	/7/89
CRUSTACEA	Ostracoda	Macrothricidae	*Echinisca capensis?*	King & Silberbauer	/7/89
HYDRACARINA	Acarina	Orbatidae	*Hydrozetes* sp.?	King & Silberbauer	/7/89
HYDRACARINA	Acarina	Orbatidae	*Hydrozetes* sp.?	King & Silberbauer	/7/89
INSECTA	Coleoptera	?	*(Unidentified adult)*	King & Silberbauer	/7/89
INSECTA	Coleoptera	Dytiscidae	*Carthyporus* sp.	King & Silberbauer	/7/89
INSECTA	Coleoptera	Dytiscidae	*Hydroporinae* sp.	King & Silberbauer	/7/89
INSECTA	Collembola	Hydrophilidae	*Hydrochus* sp.	King & Silberbauer	/7/89
INSECTA	Diptera	Notonectidae	*Anisopinae* sp.	King & Silberbauer	/7/89
INSECTA	Hemiptera	Pleidae	*Plea pullula*	King & Silberbauer	/7/89
INSECTA	Hemiptera	Sminthuridae	sp.?	King & Silberbauer	/7/89

NUMBER OF INDIGENOUS AQUATIC MICROFAUNA LISTED: 15

Table 5: Checklist of amphibians occurring at Kenilworth Racecourse (after McDowell, 1989a).

	COMMON NAME	SPECIES NAME	OBSERVER	DATE
*	Cape Rain Frog	*Breviceps gibbosus*	McDowell	/88
	Cape River Frog	*Rana fuscigula*	McDowell	/88
	Cape Sand Frog	*Tomopterna delalandii delalandii*	McDowell	/88
	Common Caco	*Cacosternum boettgeri*	McDowell	/88
	Common Platanna	*Xenopus laevis*	McDowell	/88
*	Gill's Platanna	*Xenopus gilli*	McDowell	/88
	Leopard Toad	*Bufo pardalis*	McDowell	/88
*	Micro Frog	*Microbatrachella capensis*	McDowell	/88
	Rattling Kassina	*Kassina wealii*	McDowell	/88
	Sand Toad	*Bufo angusticeps*	McDowell	/88
	Spotted Grass Frog	*Rana grayi*	McDowell	/88

NUMBER OF INDIGENOUS AMPHIBIANS LISTED: 11

* RED DATA FROG SPECIES LISTED: 3

Table 6: Checklist of reptiles occurring on Kenilworth Racecourse, including species recorded by Attwell (1950).

COMMON NAME	SPECIES NAME	OBSERVER	DATE
TORTOISES			
Angulate Tortoise	*Chersina angulata*	Brown	/88
Cape Terrapin	*Pelomedusa subrufa subrufa*	McDowell	/88
Padloper	*Homopus areolatus*	McDowell	/88
LIZARDS			
Cape Legless Skink	*Acontias meleagris*	McDowell	/88
Common skink	*Mabuya capensis*	McDowell	/88
Gekko	*Phyllodactylus porphyreus*	McDowell	/88
SNAKES			
Aurora House Snake	*Lamprophis aurora*	Attwell	/50
Cape Cobra	*Naja nivea*	Luff	/90
Cape Reed Snake	*Amplorhinus multimaculatus*	Attwell	/50
Cross-marked Sand Snake	*Psammophis crucifer*	Attwell	/50
Herald Snake	*Crotaphopeltis hotamboeia*	Attwell	/50
Mole- snake	*Pseudaspis cana*	Brown	/89
Puff Adder	*Bitis arietans arietans*	Luff	/90
Rinkals	*Hemachatus haemachatus*	Attwell	/50
Slug-eater	*Duberria lutrix lutrix*	Attwell	/50
Spotted Skaapsteker	*Psammophylax rhombeatus*	Attwell	/50
Water Snake	*Lycodonomorphus rufulus rufulus*	Attwell	/50

NUMBER OF INDIGENOUS REPTILES LISTED: 17

Table 7a: Checklist of avifauna recorded at Kenilworth Racecourse during this survey.

	COMMON NAME	SPECIES NAME	OBSERVER	DATE
+	African Sedge Warbler	*Bradypterus baboecala*	Harrison	/89
	Blackheaded Heron	*Ardea melanocephala*	Brown	/89
	Blackshouldered Kite	*Elanus caeruleus*	Harrison	/89
+	Blacksmith Plover	*Vanellus armatus*	Brown	/89
	Bokmakierie	*Telophorus zeylonus*	Harrison	/90
+	Brownthroated Martin	*Riparia paludicola*	Underhill	/89
+	Cape Canary	*Serinus canicollis*	Underhill	/89
+	Cape Francolin	*Francolinus capensis*	Harrison	/89
+	Cape Shoveller	*Anas smithii*	Harrison	/89
	Cape Turtle Dove	*Streptopelia capicola*	Harrison	/89
+	Cape Weaver	*Ploceus capensis*	Harrison	/89
+	Cape White-eye	*Zosterops pallidus*	Underhill	/89
	Cattle Egret	*Bubulcus ibis*	Harrison	/89
	Crowned Plover	*Vanellus coronatus*	Harrison	/89
+	Darter	*Anhinga melanogaster*	Harrison	/89
+	Egyptian Goose	*Alopochen aegyptiacus*	Brown	/89
	Ethiopian Snipe	*Gallinago nigripennis*	Harrison	/89
#	European Starling	*Sturnus vulgaris*	Harrison	/89
	Fiscal Shrike	*Lanius collaris*	Harrison	/89
+	Great Crested Grebe	*Podiceps cristatus*	Harrison	/89
+	Greater Striped Swallow	*Hirundo cucullata*	Underhill	/89
	Hamerkop	*Scopus umbretta*	Underhill	/89
	Hartlaub's Gull	*Larus hartlaubii*	Brown	/89
+	Helmeted Guineafowl	*Numida meleagris*	Harrison	/89
+	Laughing Dove	*Streptopelia senegalensis*	Harrison	/89
+	Levaillant's Cisticola	*Cisticola tinniens*	Harrison	/89
+	Marsh Owl	*Asio capensis*	Harrison	/89
+	Masked Weaver	*Ploceus velatus*	Helme	/89
+	Moorhen	*Gallinula chloropus*	Harrison	/89
+	Olive Thrush	*Tardus olivaceus*	Underhill	/89
	Orangethroated Longclaw	*Macronyx capensis*	Harrison	/89
* +	Peregrine Falcon	*Falco peregrinus*	Underhill	/89
+	Pied Crow	*Corvus albus*	Underhill	/89
+	Rameron Pigeon	*Columba aquatrix*	Underhill	/89
+	Redbilled Teal	*Anas erythrorhyncha*	Brown	/89
+	Redeyed Dove	*Streptopelia semitorquata*	Underhill	/89
	Redknobbed Coot	*Fulica cristata*	Brown	/89
+	Redwinged Starling	*Onychognathus morio*	Underhill	/89
	Reed Cormorant	*Phalacrocorax africanus*	Harrison	/89
+	Rock Pigeon	*Columba guinea*	Underhill	/89
+	Sacred Ibis	*Threskiornis aethiopicus*	Underhill	/89
+	Spotted Dikkop	*Burhinus capensis*	Harrison	/89
+	Spotted Prinia	*Prinia maculosa*	Harrison	/89
+	Spurwinged Goose	*Plectropteris gambensis*	Harrison	/89
+	Water Dikkop	*Burhinus vermiculatus*	Underhill	/89
+	Whitebreasted Cormorant	*Phalacrocorax carbo*	Harrison	/89
+	Whiterumped Swift	*Apus caffer*	Underhill	/89
	Yellowbilled Duck	*Anas undulata*	Harrison	/89
+	Yellowrumped Widow	*Euplectes macrourus*	Harrison	/89

NUMBER OF INDIGENOUS BIRD SPECIES LISTED: 49

* RED DATA BIRD SPECIES LISTED: 1

\# EXOTIC BIRD SPECIES LISTED: 1

\+ NEW ARRIVAL SINCE 1950

Table 7b: Avifauna sighted by Grindley (1950) at Kenilworth Racecourse.

	COMMON NAME	SPECIES NAME
-	African Marsh Harrier	*Circus ranivorus*
-	Alpine Swift	*Apus melba*
-	Black Swift	*Apus barbatus*
	Blackheaded Heron	*Ardea melanocephala*
	Blackshouldered Kite	*Elanus caeruleus*
	Bokmakierie	*Telophorus zeylonus*
-	Boubou Shrike	*Laniarius ferruginius*
-	Cape Bulbul	*Pycnonotus capensis*
-	Cape Robin	*Cossypha caffra*
-	Cape Sparrow	*Passer melanurus*
	Cape Turtle Dove	*Streptopelia capicola*
-	Cape Wagtail	*Motacilla capensis*
	Cattle Egret	*Bubulcus ibis*
	Crowned Plover	*Vanellus coronatus*
-	Dabchick	*Tachybaptus ruficollis*
	Ethiopian Snipe	*Gallinago nigripennis*
-	European Swallow	*Hirundo rustica*
-	Fantailed Cisticola	*Cisticola juncidis*
	Fiscal Shrike	*Lanius collaris*
	Hamerkop	*Scopus umbretta*
	Hartlaub's Gull	*Larus hartlaubii*
	Jackal Buzzard	*Buteo rufofuscus*
-	Kelp Gull	*Larus dominicanus*
-	Little Egret	*Egretta garzetta*
	Orangethroated Longclaw	*Macronyx capensis*
	Redknobbed Coot	*Fulica cristata*
	Reed Cormorant	*Phalacrocorax africanus*
-	Richard's Pipit	*Anthus novaeseelandiae*
-	Southern Boubou Shrike	*Laniarius ferrugineus*
	Spotted Dikkop	*Burhinus capensis*
-	Spotted Eagle Owl	*Bubo africanus*
-	Steppe Buzzard	*Buteo buteo vulpinus*
-	Whitenecked Raven	*Corvus albicollis*
	Yellowbilled Duck	*Anas undulata*
	Yellowbilled Egret	*Egretta intermedia*

NUMBER OF BIRD SPECIES LISTED: 35

- SPECIES NOT SIGHTED DURING THE 1988/1989 SURVEY.

Table 8: Checklist of mammalian fauna presently occurring on Kenilworth Racecourse.

COMMON NAME	SPECIES NAME	OBSERVER	DATE
Cape Dune Molerat	*Bathyergus suillus*	Brown	/2/90
Cape Molerat	*Georychus capensis*	Brown	/2/90
Grey Climbing Mouse	*Dendromys melanotis*?	Brown	/2/90
Pygmy Mouse	*Mus minutoides*	Brown	/2/90
Small Spotted Genet	*Genetta genetta*	Luff	/88
Striped Fieldmouse	*Rhabdomys pumilio*	Brown	/2/90
Vlei Rat	*Otomys irroratus*	Brown	/2/90

NUMBER OF INDIGENOUS MAMMAL SPECIES LISTED: 7

The current survey has recorded 199 indigenous plant species [Table 9 (p. 590)]. Table 10 (p. 62) lists the 36 alien plant species occurring on Kenilworth Racecourse.

d) Discussion

Invertebrates

Invertebrate taxonomy, particularly within the Insecta, has yet to be developed in the Fynbos Biome. No data were collected for the terrestrial invertebrates surviving in the fynbos on Kenilworth Racecourse. The unexpectedly high water quality of the vleis would undoubtedly has been instrumental in maintaining species diversity in the natural vleis of Kenilworth Racecourse.

Amphibians

Few baseline data on diversity and abundance of amphibians on the Cape Flats exist (Greig *et al*, 1981). However, destruction of lowland habitat in the south western Cape is relatively well-documented (Jarman, 1986; Siegfried, 1989) and may account for the high incidence of Red Data species recorded in the relatively undisturbed seasonal vleis of Kenilworth Racecourse during this study. Three of the eleven species recorded in this study have Red Data status, namely the micro frog (*Microbatrachella capensis*), Gill's platanna (*Xenopus gilli*) [both 'endangered' in the Red Data listings (Branch, 1988) as well as the Nature and Environmental Ordinance No. 19 of 1974 (Cape Province)] and the Cape rain frog (*Breviceps gibbosus*) ('vulnerable' in Red Data listings). All three of these species are new records for the Kenilworth Racecourse (McDowell *et al*, 1990) [Table 11 (p. 63)].

The amphibians in general, and in particular the Red Data species present in the study area, are likely to be sensitive to unnatural disturbance of their habitat. For example, *Xenopus gilli* has only been recorded in dark-coloured water which is low in nutrients and rich in tannins (Greig *et al.*, 1981). The importance of the acidic nature of the vleis on Kenilworth Racecourse lies in the fact that it provides a degree of protection for *X. gilli* from the more common *X. laevis* . Where these species are coexisting in non-acidic environments, *X. gilli* tends to be outcompeted. The relatively pristine seasonal vleis of Kenilworth Racecourse are amongst the only ones in which *X. gilli* still survives on the Cape Flats (McDowell, pers. comm.). A recent survey of the Cape Flats (De Villiers, in prep.) reveals that

Table 9: Checklist of indigenous flora recorded at Kenilworth Racecourse

FAMILY		SPECIES	OBSERVER	DATE
ALISMATACEAE		*Alisma plantago*	Jackson	/3/89
AMARYLLIDACEAE		*Amaryllus belladonna*	Brown & McDowell	/7/88
ANACARDIACEAE		*Rhus angustifolia*	Brown & McDowell	/6/88
ANACARDIACEAE		*Rhus glauca*	Brown & McDowell	/6/88
ANACARDIACEAE		*Rhus laevigata*	Brown & McDowell	/6/88
ANACARDIACEAE		*Rhus lucida*	Brown & McDowell	/6/88
ANTHOCEROTACEAE		*Anthoceros* sp.1	Graves	/9/88
APONOGETONACEAE		*Aponogeton angustifolia?*	Brown & McDowell	/7/88
ARACEAE		*Zantedeschia aethiopica*	Brown & McDowell	/6/88
ASPARAGACEAE		*Myrsiphyllum asparagoides*	Brown & McDowell	/7/88
ASPARAGACEAE		*Protasparagus capensis*	Brown & McDowell	/7/88
ASPARAGACEAE		*Protasparagus rubicundus?*	Brown & McDowell	/9/88
ASPARAGACEAE		*Protasparagus thunbergianus*	Brown & McDowell	/7/88
ASPHODELACEAE ?		*Baeometra uniflora*	Brown & McDowell	/10/88
ASPHODELACEAE		*Bulbine* sp.1	McDowell	/5/90
ASPHODELACEAE		*Caesia contorta*	Brown & McDowell	/10/88
ASPHODELACEAE		*Trachyandra ciliata*	Brown & McDowell	/9/88
ASPHODELACEAE		*Trachyandra divaricata*	Brown & McDowell	/9/88
ASPHODELACEAE		*Trachyandra hirsutiflora*	Brown & McDowell	/10/88
ASPHODELACEAE		*Trachyandra revoluta*	Brown & McDowell	/9/88
ASTERACEAE		*Arctopus echinatus*	Brown & McDowell	/7/88
ASTERACEAE		*Athanasia trifurcata*	Brown & McDowell	/6/88
ASTERACEAE		*Cenia turbinata*	Brown & McDowell	/8/88
ASTERACEAE		*Chrysanthemoides incana?*	Brown & McDowell	/6/88
ASTERACEAE		*Chrysanthemoides monilifera*	Brown & McDowell	/6/88
ASTERACEAE		*Cotula coronopifolia*	Brown & McDowell	/10/88
ASTERACEAE		*Helichrysum cymosum*	Jackson	/9/88
ASTERACEAE		*Metalasia muricata*	Brown & McDowell	/7/88
ASTERACEAE		*Senecio abruptus*	Brown & McDowell	/7/88
ASTERACEAE		*Senecio halimifolius*	Brown & McDowell	/9/88
ASTERACEAE		*Senecio littoreus*	Brown & McDowell	/7/88
ASTERACEAE		*Stoebe capitata?*	Brown & McDowell	/7/88
ASTERACEAE		*Stoebe plumosa*	Brown & McDowell	/7/88
ASTERACEAE		*Ursinia anthemoides*	Brown & McDowell	/7/88
BARTRAMINACEAE		*Philonotis* sp.1	Brown & McDowell	/9/8
BRUNIACEAE		*Berzelia abrotanoides*	Brown & McDowell	/7/88
BRYACEAE		*Bryum argentum*	Graves	/9/88
BRYACEAE		*Bryum* sp.1	Graves	/9/88
CAMPANULACEAE		*Lightfootia fruticosa*	Brown & McDowell	/11/89
CAMPANULACEAE		*Lobelia setacea*	Brown,McDowell&Jackson	/11/89
CAMPANULACEAE		*Wahlenbergia capensis*	Brown & McDowell	/11/89
CODONIACEAE		*Fossombronia*	Graves	/9/88
CRASSULACEAE		*Crassula ciliata*	Brown & McDowell	/7/88
CRUCIFERAE		*Heliophila integrifolia*	Brown & McDowell	/9/88
CYPERACEAE		*Chrysithrix capensis*	Brown & McDowell	/9/88
CYPERACEAE		*Cyperus esculenta*	Brown & McDowell	/6/88
CYPERACEAE		*Cyperus lanceus?*	Jackson	/9/88
CYPERACEAE		*Cyperus mundtii*	Brown & McDowell	/6/88
CYPERACEAE		*Cyperus sphaerospermus*	Brown & McDowell	/6/88
CYPERACEAE		*Cyperus textilus*	Brown & McDowell	/10/88
CYPERACEAE		*Ficinia filiformis*	Jackson	/9/88
CYPERACEAE		*Ficinia glomerata*	Brown & McDowell	/6/88
CYPERACEAE		*Fuirena hirsuta*	Brown & McDowell	/9/88
CYPERACEAE		*Schoenus nigricans*	Jackson	/7/89
CYPERACEAE	*	*Scirpus delicatulus*	Brown & McDowell	/9/88
CYPERACEAE		*Scirpus membranaceous*	Jackson	/9/88
CYPERACEAE	*	*Trianoptiles solitaria*	Brown & McDowell	/8/88
DICRANACEAE		*Campylopus*	Thompson	/9/88
DROSERACEAE		*Drosera cystiflora*	Brown & McDowell	/7/88
DROSERACEAE		*Drosera hilaris*	Brown & McDowell	/7/88
DROSERACEAE		*Drosera trinervia*	Brown & McDowell	/9/88
ERICACEAE		*Erica imbricata*	Brown & McDowell	/9/88
ERICACEAE		*Erica lasciva*	Brown & McDowell	/8/88
ERICACEAE		*Erica mammosa*	Brown & McDowell	/11/88
ERICACEAE	*	*Erica margaritacea*	Brown & McDowell	/8/88
ERICACEAE		*Erica mauretanica*	Brown & McDowell	/9/88
ERICACEAE		*Erica multumbellifera*	Brown & McDowell	/3/88
ERICACEAE		*Erica pulchella*	Brown & McDowell	/3/88
ERICACEAE		*Erica subdivaricata*	Brown & McDowell	/7/88
ERICACEAE		*Scyphogyne muscosa*	Brown & McDowell	/9/88
EUPHORBIACEAE		*Euphorbia tuberosa*	Brown & McDowell	/7/88
FABACEAE		*Aspalathus acuminatus*	Brown & McDowell	/7/88
FABACEAE		*Aspalathus angustifolia*	Brown & McDowell	/6/88
FABACEAE		*Aspalathus filicaulis*	Brown & McDowell	/11/89
FABACEAE		*Aspalathus ternata?*	Brown & McDowell	/6/88

* RED DATA SPECIES

Table 9: Checklist of indigenous flora recorded at Kenilworth Racecourse

FAMILY	SPECIES	OBSERVER	DATE
FABACEAE	*Lotonis peduncularis*	Brown & McDowell	/10/88
FABACEAE	*Podalyria sericea*	Jackson	/11/89
FABACEAE	*Psoralea alata*	Brown & McDowell	/3/89
FABACEAE	*Psoralea capitata*	Jackson	/10/88
FABACEAE	*Psoralea laxa*	Brown & McDowell	/11/89
FUNARIACEAE	*Funaria* sp.1	Brown & McDowell	/9/88
GENTIANACEAE	*Orphium frutescens*	Brown & McDowell	/7/88
GENTIANACEAE	*Sebaea aurea*	Jackson	/11/89
GERANIACEAE	*Geranium incanum*	Brown & McDowell	/7/88
GERANIACEAE	*Pelargonium capitata*	Brown & McDowell	/7/88
GERANIACEAE	*Pelargonium multicaule*	Brown & McDowell	/7/88
GERANIACEAE	*Pelargonium myrrhifolium*	Brown & McDowell	/9/88
GERANIACEAE	*Pelargonium triste*	Brown & McDowell	/7/88
HAEMODORACEAE	*Wachendorfia brachyandra*	Helme	/8/89
HAEMODORACEAE	*Wachendorfia paniculata*	Brown & McDowell	/9/88
HALORRHAGIDACEAE	*Laurembergia repens*	Brown & McDowell	/9/88
HYACINTHACEAE	*Albuca canadensis*	Brown & McDowell	/9/88
HYACINTHACEAE	*Ornithogalum thyrsoides*	Brown & McDowell	/10/88
HYPOXIDACEAE	*Spiloxene aquatica*	Brown & McDowell	/6/88
HYPOXIDACEAE	*Spiloxene canaliculata*	Brown & McDowell	/9/88
HYPOXIDACEAE	*Spiloxene capensis*	Brown & McDowell	/9/88
IRIDACEAE	*Aristea africana*	Brown & McDowell	/7/88
IRIDACEAE	*Aristea cuspidata?*	Jackson	/11/89
IRIDACEAE	*Aristea macrocarpa*	Brown & McDowell	/8/88
IRIDACEAE	*Babiana villosula*	Brown & McDowell	/10/88
IRIDACEAE	*Bobartia indica*	Jackson	/11/89
IRIDACEAE	*Bobartia* sp.1	Brown & McDowell	/8/88
IRIDACEAE	*Geissorrhiza aspera*	Brown & McDowell	/8/88
IRIDACEAE	* *Geissorrhiza geminata*	Brown & McDowell	/9/89
IRIDACEAE	*Gladiolus* sp.1	Brown & McDowell	/9/88
IRIDACEAE	*Hesperantha falcata*	Brown & McDowell	/9/89
IRIDACEAE	*Hexaglottis flexuosa*	Brown & McDowell	/10/89
IRIDACEAE	*Ixia dubia?*	Jackson	/9/88
IRIDACEAE	* *Ixia maculata var.maculata*	Brown & McDowell	/9/88
IRIDACEAE	*Ixia paniculata*	Brown & McDowell	/11/89
IRIDACEAE	*Micranthus junceus*	Brown & McDowell	/12/89
IRIDACEAE	* *Moraea elsiae*	Brown & McDowell	/12/89
IRIDACEAE	*Moraea papilionacea*	Brown & McDowell	/10/89
IRIDACEAE	*Moraea ramosissima*	Brown & McDowell	/12/89
IRIDACEAE	*Romulea roseus*	Brown & McDowell	/6/88
IRIDACEAE	*Sparaxis bulbifera*	Brown & McDowell	/6/88
IRIDACEAE	*Sparaxis grandiflora*	Brown & McDowell	/9/88
IRIDACEAE	*Watsonia borbonica*	Jackson	/12/89
IRIDACEAE	*Watsonia meriana*	Jackson	/12/89
JUNCACEAE	*Juncus bufonius*	Jackson	/10/89
JUNCACEAE	*Juncus capensis*	Brown & McDowell	/10/88
JUNCACEAE	*Juncus cephalotes*	Jackson	/10/88
JUNCACEAE	*Juncus filifolius*	Jackson	/10/88
JUNCAGINACEAE	*Triglochin bulbosa*	Brown & McDowell	/10/88
LAURACEAE	*Cassytha ciliolata*	Brown & McDowell	/7/88
MESEMBRYANTHEMACEAE	*Carpobrotus edulis*	Brown & McDowell	/7/88
MESEMBRYANTHEMACEAE	*Erepsia aspera*	Brown & McDowell	?
MESEMBRYANTHEMACEAE	*Erepsia gracilis*	Brown & McDowell	/3/89
MESEMBRYANTHEMACEAE	*Lampranthus filicaulis*	Brown & McDowell	/7/88
MESEMBRYANTHEMACEAE	*Lampranthus glaucus*	Brown & McDowell	/9/88
MESEMBRYANTHEMACEAE	*Lampranthus reptans*	Brown & McDowell	/6/88
MESEMBRYANTHEMACEAE	*Ruschia macowanii?*	McDowell	/89
ORCHIDACEAE	*Holothrix villosa*	Brown & McDowell	/10/88
ORCHIDACEAE	*Monadenia bracteata*	Brown & McDowell	/9/88
ORCHIDACEAE	*Pterygodium catholicum*	Brown & McDowell	/9/88
ORCHIDACEAE	*Satyrium bicorne*	Brown & McDowell	/9/88
ORCHIDACEAE	*Satyrium odorum*	Brown & McDowell	/9/88
OXALIDACEAE	*Oxalis glabra*	Watson	/9/88
OXALIDACEAE	*Oxalis luteola*	Watson	/9/88
OXALIDACEAE	*Oxalis pes-caprae*	Watson	/9/88
OXALIDACEAE	*Oxalis purpurea*	Watson	/9/88
OXALIDACEAE	*Oxalis versicolor*	Watson	/9/88
POACEAE	*Cymbopogon marginatus*	Brown	/3/89
POACEAE	*Cynodon dactylon*	Brown & McDowell	/6/88
POACEAE	*Danthonia cincta*	Brown	/3/89
POACEAE	*Ehrharta villosa*	Brown & Jackson	/10/89
POACEAE	*Eragrostis brizoides*	Brown & McDowell	/9/88
POACEAE	*Eragrostis curvula*	Brown & McDowell	/6/88
POACEAE	*Imperata cylindrica*	Brown & McDowell	/3/89
POACEAE	*Pentaschistus thunbergii*	Brown & McDowell	/3/89

* RED DATA SPECIES

Table 9: Checklist of indigenous flora recorded at Kenilworth Racecourse

FAMILY		SPECIES	OBSERVER	DATE
POACEAE		*Phragmites australis*	Brown & McDowell	/7/88
POACEAE		*Plagiochloa uniolae*	Brown & McDowell	/9/88
POACEAE		*Sporobolus capensis*	Crook	/4/90
POACEAE		*Stenotaphrum familiatum*	Crook	/4/90
POLYGALACEAE		*Muraltia filiformis*	Brown & McDowell	/9/88
POLYGALACEAE		*Muraltia hystera*	Brown & McDowell	/9/88
POLYGALACEAE		*Polygala calyptrata*	Brown & McDowell	?
POLYGALACEAE		*Polygala garcinii*	Brown & McDowell	/10/88
POTTIACEAE		*Tortella* sp.1	Brown & McDowell	/9/88
PROTEACEAE	*	*Leucadendron levisanus*	Brown & McDowell	/7/88
PROTEACEAE		*Leucadendron salignum*	Brown & McDowell	/7/88
PROTEACEAE		*Serruria glomerata*	Brown & McDowell	/7/88
PROTEACEAE	*	*Diastella proteoides*	Brown & McDowell	/7/88
RESTIONACEAE		*Chondropetalum nudum*	Esterhuizen	/10/88
RESTIONACEAE	*	*Chondropetalum rectum*	Esterhuizen	/10/88
RESTIONACEAE	*	*Elegia verreauxii*	Esterhuizen	/10/88
RESTIONACEAE		*Hypodiscus aristatus*	Esterhuizen	/10/88
RESTIONACEAE	*	*Restio micans*	Brown & McDowell	/10/88
RESTIONACEAE		*Restio quadrangularis*	Brown & McDowell	/9/88
RESTIONACEAE		*Restio quinquefarius*	Esterhiuzen	/10/88
RESTIONACEAE		*Restio tetragonus*	Brown & McDowell	/7/88
RESTIONACEAE		*Restio triticeus*	Jackson	/3/89
RESTIONACEAE		*Staberoha cernua?*	Jackson	/10/88
RESTIONACEAE		*Staberoha distachya*	Esterhuizen	/10/88
RESTIONACEAE		*Thamnochortus fruticosus*	Brown & McDowell	/10/88
RESTIONACEAE		*Thamnochortus spicigerus*	McDowell	/5/90
RHAMNACEAE		*Phylica ericoides*	Brown & McDowell	/7/88
ROSACEAE		*Cliffortia ericaefolia*	Esterhuizen & Rickard	/68,/3/88
ROSACEAE		*Cliffortia ferruginea*	Jackson	/9/88
ROSACEAE		*Cliffortia filifolia*	Jackson	/9/88
ROSACEAE		*Cliffortia juniperina*	Brown & McDowell	/11/89
ROSACEAE		*Cliffortia polygonifolia*	Brown & McDowell	/11/89
ROSACEAE		*Cliffortia strobilifera*	Jackson	/7/88
RUBIACEAE		*Anthospermum aethiopicum*	Brown & McDowell	/10/88
RUTACEAE		*Agathosma imbricata*	Brown & McDowell	/10/88
RUTACEAE		*Diosma hirsuta*	Jackson	/9/88
RUTACEAE		*Diosma oppositifolia*	Brown & McDowell	/9/88
SANTALACEAE		*Thesium euphrasioides*	Brown	/7/88
SANTALACEAE		*Thesium scabrum*	Brown & McDowell	/7/88
SCROPHULARIACEAE		*Limosella aquatica*	Jackson	/3/89
SCROPHULARIACEAE		*Orobanche ramosa*	Jackson	/11/89
SELAGINACEAE		*Selago spuria*	Jackson	/11/89
STILBEACEAE		*Stilbe ericoides*	Brown & McDowell	/9/89
TECOPHILACEAE		*Cyanella hyacinthoides*	Brown & McDowell	/11/89
THYMELEACEAE		*Cryptadenia grandiflora*	Brown & McDowell	/10/88
THYMELEACEAE		*Cryptadenia uniflora*	Brown & McDowell	/10/88
THYMELEACEAE		*Gnidia subulata*	Brown & McDowell	/10/88
THYMELEACEAE		*Passerina vulgaris*	Brown & McDowell	/7/88
TYPHACEAE		*Typha latifolia var.capensis*	Brown & McDowell	/7/88
?		*Bulbine* sp.1	McDowell	/5/90

NUMBER OF INDIGENOUS PLANT SPECIES: 199

* RED DATA SPECIES: 12

Table 10: Checklist of alien plant species occurring on Kenilworth Racecourse.

FAMILY	SPECIES
?	*Heliogophora* sp.1
ACANTHACEAE	*Acanthus* sp.1
AGAVACEAE	*Yucca* sp.1
ALLIACEAE	*Agapanthus praecox*
ASCLEPIADACEAE	*Asclepias* sp.1
ASTERACEAE	*Hypochoeris glabra*
CANNACEAE	*Canna indica*
FABACEAE	*Acacia cyclops*
FABACEAE	*Acacia longifolia*
FABACEAE	*Acacia saligna*
FABACEAE	*Lotononis oxyptera*
FABACEAE	*Sesbania punicea*
FAGACEAE	*Quercus ilex*
FUMARIACEAE	*Fumaria* sp.1
LEMNACEAE	*Lemna gibba*
MYRTACEAE	*Eucalyptus lehmannii*
MYRTACEAE	*Leptospermum laevigatum*
PALMEAE	*Phoenix canariensis*
PINACEAE	*Pinus pinaster*
PINACEAE	*Pinus pinea*
PLANTAGINACEAE	*Plantago lanceolata*
POACEAE	*Briza maxima*
POACEAE	*Cortidaria selloana*
POACEAE	*Lagarus ovatus*
POACEAE	*Lolium multiflorum*
POACEAE	*Lolium temulentum*
POACEAE	*Pennisetum clandestinum*
POACEAE	*Pennisetum purpureum*
POACEAE	*Setaria geniculata*
POACEAE	*Sporobolus capensis*
POACEAE	*Stipa trichotoma?*
POLYGONACEAE	*Rumex* sp.1
PONTEDERIACEAE	*Eichornia crassipes*
PROTEACEAE	*Grevillea robusta*
SALICACEAE	*Populus canescens*
SAPINDACEAE	*Dodonea viscosa*

NUMBER OF ALIEN PLANT SPECIES: 36

Table 11: Red Data species at Kenilworth Racecourse (after McDowell *et al*, 1990).

Threatened Plant Taxa:	
CYPERACEAE	*Scirpus delicatulus* (Indeterminate) (conf.)
CYPERACEAE	*Trianoptiles solitaria* (Indeterminate) (conf.)
ERICACEAE	*Erica margaritacea* (Endangered) (conf.)
ERICACEAE	*Erica turgida* (Extinct) (now reintroduced)
ERICACEAE	*Erica verticillata* (Extinct) (now reintroduced)
IRIDACEAE	*Galaxia alata* (Endangered) (conf.)
IRIDACEAE	*Geissorhiza geminata* (Uncertain) (conf.)
IRIDACEAE	*Ixia maculata* (Vulnerable) (new record)
IRIDACEAE	*Moraea elsiae* (Critically Rare) (conf.)
ISOETACEAE	*Isoetes capensis var. stephensii* (Indeterminate) (unconf.)
ORCHIDACEAE	*Herschelianthe barbata* (Endangered) (unconf.)
ORCHIDACEAE	*Monadenia sabulosa* (Critically Rare) (unconf.)
OXALIDACEAE	*Oxalis natans* (Endangered) (certified absent)
PROTEACEAE	*Diastella proteoides* (Vulnerable) (conf.)
PROTEACEAE	*Leucadendron levisanus* (Endangered) (conf.)
RESTIONACEAE	*Chondropetalum rectum* (Vulnerable) (conf.)
RESTIONACEAE	*Restio micans* (Endangered) (conf.)
RUTACEACE	*Macrostylis villosa* ssp. *villosa* (Indeterminate) (unconf.)

Newly Recorded Threatened Frog Species:
Breviceps gibbosus (Vulnerable)
Microbatrachella capensis (Endangered)
Xenopus gilli (Endangered; rated as Vulnerable by CITES).

conf. = confirmed
unconf = unconfirmed

the racecourse is in all probability the last known locality for *M. capensis* on the Cape Flats.

Reptiles

The only snake species observed during this study was the mole-snake (*Pseudaspis cana*). Also included in Table 6 (p. 54) are snake species sighted by Attwell in 1950. The present status of these species on the Kenilworth Racecourse is not known; none were recorded during this study, but being inconspicuous, they may well survive in the area. The possible sightings of the cape cobra (*Naja nivea*) and the puff adder (*Bitis arietans arietans*) on several occasions during recent years by an employee on the Racecourse are unverified. Kenilworth Racecourse falls out of the normal distribution ranges of both these species (Rose, 1962). It is possible, however, that the rinkals (*Hemachatus haemachatus*), a cobra-like species of previously wider distribution on the Cape Flats, was sighted. In this case, the Racecourse is the last locality for the species on the Cape Flats. A specimen was caught during the early 1980's adjacent to Kenilworth Racecourse.

None of the species of reptile recorded on Kenilworth Racecourse have been accorded Red Data status (Branch, 1988). However, all tortoise and lizard species are officially protected according to the Nature and Environmental Conservation Ordinance No. 19 of 1974 (Cape Province). Table 12 (p. 65) indicates the snake species present (or possibly present) on Kenilworth Racecourse which are protected (*ibid*).

Avifauna

The only Red Data bird species (Brooke, 1984) listed for the area is the peregrine falcon (*Falco peregrinus*). Most bird species are protected according to the Nature and Environmental Conservation Ordinance No. 19 of 1974 (Cape Province) [Table 12 (p. 65)]. The change in bird species composition recorded on Kenilworth Racecourse between 1950 and the present is discussed below, and the value of the area as a refuge for bird species is assessed.

Mammalian fauna

The high trap success rate for the striped fieldmouse (*R. pumilio*) may indicate that this species was the least trap-shy. Nevertheless, it is likely that this species was, in

Table 12: Species on Kenilworth Racecourse that have been awarded statutory protection*.

SPECIES	COMMON NAME	STATUS
ANIMALS		
Microbatrachella capensis	Micro Frog	Endangered
Xenopus gilli	Gill's Clawed Toad	Endangered
All other frogs and toads		Protected
All lizards		Protected
All tortoises		Protected
Snakes:		
Water Snake, House Snake, Slug-eater and Mole Snake		Protected
Most bird species		Protected
PLANTS		
Entire Amaryllidaceae Family		Protected
Entire Bruniaceae Family		Protected
Entire Ericaceae Family		Protected
Entire Iridaceae Family		Protected
Entire Orchidaceae Family		Protected
Entire Proteceae Family		Protected
Family Restionaceae:		
All *Chondropetalum* species		Protected
Restio micans		Protected

* Nature and Environmental Conservation Ordinance No.19 of 1974 (Cape Province).

fact, the most common. This corresponds with the survey by David (1980) who observed that this species was the most abundant small mammal on an analogous site at nearby Kuilsriver. The last sighting of a Cape grysbok (*Raphicerus melanotis*) (a small species of buck endemic to the south western Cape) was in 1975 prior to construction of the Kromboom Freeway (Norton, pers.comm.). The reduction in range is a factor that has directly or indirectly caused the demise of this species[3].

David (1980) trapped a total of 18 mammalian (excluding bat) species between 1972 and 1977 at Kuilsriver, an area 16 kilometres away, also within the Cape Flats. The majority of species were small mammals, especially rodents. The species diversity was found to be low compared to other ecosystems (David, 1980). However, species diversity at Kuilsriver was found to be relatively high compared to Kenilworth Racecourse. A partial explanation for the apparently low mammal species diversity at Kenilworth Racecourse is the relatively short time period over which trapping was carried out. It is likely, however, that the processes of isolation and environmental degradation have reduced the diversity of the mammalian fauna. In Chapter 4 it was proposed that isolation consequences appear to be more important for fauna than for flora.

Flora

The number of floral species recorded on Kenilworth Racecourse during this study is likely to be an underestimate of the number of species present (section 5.3.2). This diversity is unparalleled per unit area within other remnants on the Cape Flats. The number of Red Data species on Kenilworth Racecourse also far exceeds any other of the remnants on the Cape Flats, with 18 species having been recorded. Four of these species records remain unconfirmed, with four other previously recorded species having been confirmed as now locally extinct (McDowell *et al.*, 1990). The Red Data plant species present on Kenilworth Racecourse are listed in Table 11 (p. 63). Two of these species, *Erica turgida* and *Erica lasciva*, now extinct in the wild, were reintroduced on the Racecourse (McDowell *et al*, 1990). However, it would appear that a dry summer season caused the death of the reintroduced plants which were not adapted to such stresses in cultivation. *Erica margaritacea* and *Moraea elsiae* are two species known to be endemic to the area. *Erica margaritaceae* appears to be relatively secure in the area. *Moraea elsiae* is

[3] Rondevlei Bird Sanctuary, a reserve partially located on acid sand on the Cape Flats, has a low carrying capacity for this buck species due to the highly selective browsing habit it has evolved (Langley, pers. comm.).

clearly favoured by fire, as the only area in which it was sighted was burnt approximately
four years previously. Only five plants of the species were sighted. The species which are protected by statute and the level of protection they have been accorded by the Cape Provincial statutes are presented in Table 12 (p. 65). The species included in the statutes are obviously not representative of the species requiring protection by law.

The fynbos biome, and in particular, all lowland fynbos ecosystems on sandy substrates such as Sand Plain Fynbos, are inherently prone to invasion by alien plants (Macdonald & Jarman, 1984). Two other factors increase the susceptibility of Kenilworth Racecourse to invasion. Firstly, its locality in a residential environment makes it prone to invasion by 'garden escapees'. Secondly, areas with a history of anthropogenic disturbance are known to be prone to invasion (Macdonald & Jarman, 1984). Species posing the greatest threat to the fynbos in the study area due to their invasive nature or present high cover abundance on Kenilworth Racecourse are listed in Appendix 2. Invasive species requiring control measures (Appendix 1) were selected according to the findings of Macdonald & Jarman (1984).

5.3 SPECIES LOSS FROM KENILWORTH RACECOURSE

5.3.1 Approach and rationale

Conservation management rationale should, according to the current conservation literature, be based on autecological studies of keystone or critical species (Chapter 4). The usefulness of this approach in fynbos environments may be limited because of its typically high floral species diversity (Chapter 4). An approach which attempts to understand island effects at the community level was used by Bond *et al.* (1988) on fynbos fragments of varying size in the southern Cape. These islands have been isolated to differing degrees over an evolutionary time period. The approach

> "represents a simple empirical procedure which may be useful for determining the effects of insularistion on species numbers and the processes that have led to species loss in small isolated reserves" Bond *et al*.(1988), p 20.

Bond *et al* (1988) categorised species attributes on the fynbos 'mainland' versus fynbos 'islands' and were able to determine possible causes for lower species diversity on islands. Their approach is adapted here to examine possible causes of species loss from Kenilworth Racecourse during this century. Species loss is evaluated by comparing previous species records with the checklists compiled during the current study.

A limitation of this approach is acknowledged. Of the three major natural threats thought to influence population survival, namely genetic deterioration, demographic stochasticity and environmental uncertainty (Ewens *et al.*,1987), only environmental effects on species presence are investigated. Evidence for the first two threats has not yet been forthcoming for fynbos vegetation.

Flora and avifauna are the only groups for which sufficient data exist on previous occurrence and are therefore the only taxa which can be used to assess both species loss and species turnover. A checklist of snake species was collected by Attwell (1950), but difficulty in observing this group mitigated against undertaking an assessment of their present occurrence.

5.3.2 Plant Species Lost From Kenilworth Racecourse

The flora present on Kenilworth Racecourse was well-documented earlier this century, making this a useful and important case study for assessing the effects of insularisation on Sand Plain Fynbos. The data are probably more complete than for other surviving Sand Plain Fynbos remnants. Except for Rondebosch Common, no existing Sand Plain Fynbos remnants provide comparable information on species past and present. Extensive collections were also undertaken last century on 'Bergvliet Farm' located about seven kilometres south of Kenilworth Racecourse, but the area has since been completely covered by urban development (Rourke *et al.*, 1981) [Figure 2 (p. 3]; Figure 3 (p. 4)]. Checklists of past species occurrence do not exist for most other surviving remnants of Sand Plain Fynbos. This prevents objective assessment of the effects of insularisation for those areas (Chapter 3).

a) Methodology

The most accessible sources of information on past occurrence of species in the Kenilworth area were found to be the herbarium records, in combination with the work of Adamson & Salter (1950). Herbarium records for Kenilworth Racecourse date mainly from the 1930's and 1940's in the case of the Guthrie Herbarium, and from the 1960's and 1970's in the case of the Bolus Herbarium. The records for the Compton Herbarium cover a range of dates within this period.

A diagrammatic representation of the sampling method used to determine plant species disappearance from Kenilworth Racecourse is presented in Figure 5 (p. 70). In order to assess which species occurred on Kenilworth Racecourse in the past, a checklist of plant species was assembled for this study from Adamson & Salter (1950) [see the "probables" species list in Table 13 (p. 71)]. The "probables" fell into the following categories in Adamson & Salter (1950): 1) the species had actually been recorded from Kenilworth Racecourse, 2) the species was described as "common on the Cape Flats", or 3) the species occurred in "damp places on the Cape Flats".

Approximately 420 species were identified as "probables" by means of these criteria [Table 13 (p. 71)]. Although it was likely that these species had occurred in the Kenilworth vicinity, it could not be established from Adamson & Salter (1950) whether they had all occurred on the site of Kenilworth Racecourse. In order to establish their occurrence on Kenilworth Racecourse earlier this century, herbarium records of 100 randomly selected "probables" were consulted [Table 13 (p. 71)]. Only where herbarium sheets specifically stated Kenilworth Racecourse as a locality for species, were they categorised as "definites". The sample became necessary owing to the amount of time involved in searching through the herbarium records. A random number table was used in the species selection process.

Determination of the extent of disappearance of species from Kenilworth Racecourse from 1950 to present was then undertaken by comparing the "definites" with the current checklist of species observed in the field during this study [Table 9 (p. 59)]. A percentage number of species "lost" from Kenilworth Racecourse could therefore be derived.

In order to assess possible reasons for many of the "definites" no longer apparently occurring on Kenilworth Racecourse, "definites" were characterised according to the following attributes: "growth form" (shrub, forb, graminoid or geophyte), "plant height" (or "length" in the case of plants with a creeping habit), "fire survival strategy" (reseeder or resprouter) and "moisture regime preference" (whether or not requiring a moist habitat) [Table 14 (p. 79)]. Information on attributes was obtained from Adamson & Salter (1950), Bond & Goldblatt (1984)

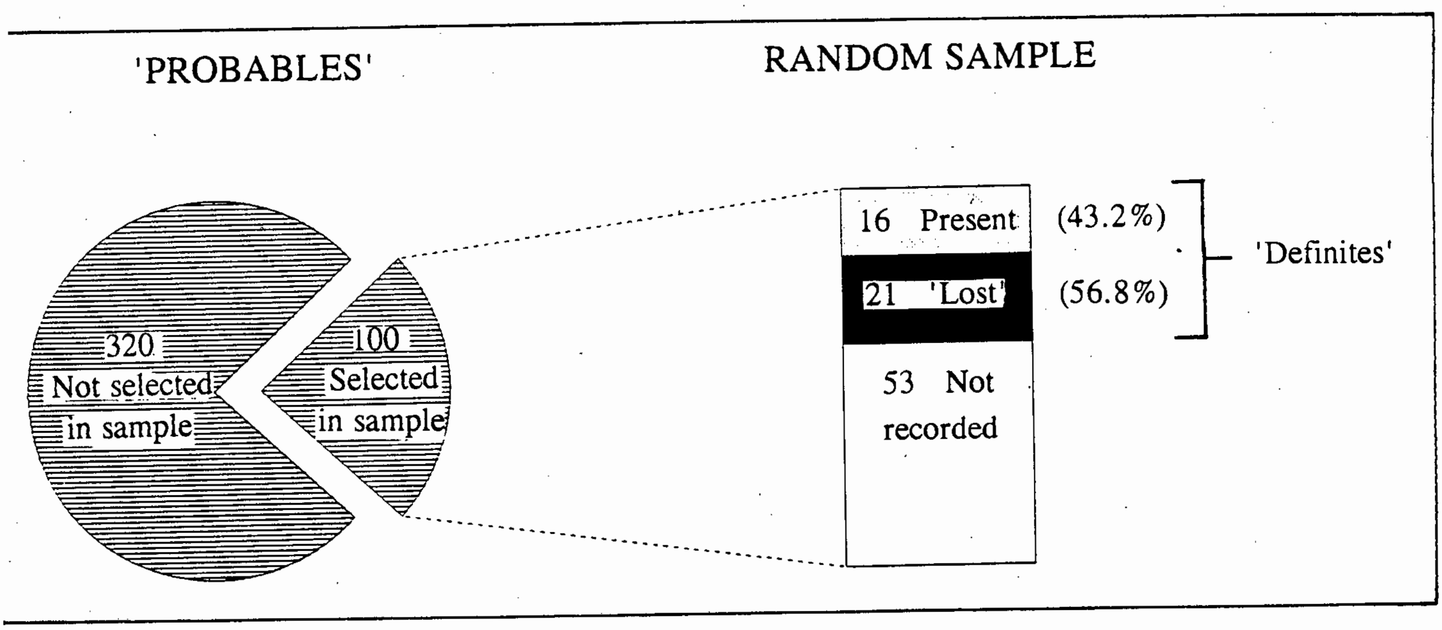

Figure 5: Diagrammatic representation of the sampling method used to determine plant species disappearance from Kenilworth Racecourse. A sample of plant species was randomly selected from the list of 'probable' species (species likely to occur on Kenilworth Racecourse). From herbarium records of these species, it was possible to ascertain which species 'definitely' occurred on Kenilworth Racecourse. By assessing the number of these species which no longer occur at Kenilworth Racecourse from the current species checklist, it was possible to calculate % species 'loss'.

Table 13: Plant species selected as "probables", owing to their likely occurrence at Kenilworth Racecourse, or in its nearby vicinity according to Adamson & Salter, 1950. Outdated names used by Adamson & Salter (1950) have been placed in brackets and updated according to Gibbs-Russell *et al* (1985; 1987).

FAMILY	SPECIES
* AIZOACEAE	*Pharnaceum incanum*
AMARYLLIDACEAE	*Boophane guttata*
* AMARYLLIDACEAE	*Gethyllis pusilla*
AMARYLLIDACEAE	*Hessea cinnamomea (Periphanes cinnamomea)*
ANACARDIACEAE	*Rhus angustifolius*
ANACARDIACEAE	*Rhus glauca*
ANACARDIACEAE	*Rhus laevigata (R. incana, R. mucronata)*
ANACARDIACEAE	*Rhus lucida*
ANACARDIACEAE	*Rhus tomentosa*
APIACEAE	*Arctopus echinatus*
APIACEAE	*Centella tridentata*
APONOGETONACEAE	*Aponogeton distachyos*
ARACEAE	*Zantedeschia aethiopica*
* ASTERACEAE	*Arctotis acaulis*
ASTERACEAE	*Arctotis angustifolia*
ASTERACEAE	*Arctotis leptorhiza (A. breviscapa)*
ASTERACEAE	*Athanasia dentata*
ASTERACEAE	*Berkheya rigida*
ASTERACEAE	*Castalis nudicaulis (Dimorphatheca nudicaulis)*
ASTERACEAE	*Cenia turbinata (Cotula turbinata)*
* ASTERACEAE	*Chrysanthemoides monilifera*
ASTERACEAE	*Chrysocoma coma-aurea*
ASTERACEAE	*Cineraria geifolia*
ASTERACEAE	*Conyza ambigua (C. ivaefolia)*
ASTERACEAE	*Corymbrium africanum*
ASTERACEAE	*Corymbrium glabrum*
* ASTERACEAE	*Cotula coronopifolia*
* ASTERACEAE	*Cotula filifolia*
* ASTERACEAE	*Cotula vulgaris*
ASTERACEAE	*Disparago anomala*
* ASTERACEAE	*Disparago lasiocarpa*
ASTERACEAE	*Edmondia sesamoides (Helichrysum sesamoides)*
ASTERACEAE	*Elytropappus scaber*
ASTERACEAE	*Felicia heterophylla (Charieis heterophylla)*
ASTERACEAE	*Felicia pappei*
ASTERACEAE	*Felicia tenella*
ASTERACEAE	*Gamolepis tagetes*
ASTERACEAE	*Gazania jurineifolia /leipoda /linearis /pectinata /serrata (G. pinnata)*
* ASTERACEAE	*Gerbera crocea*
ASTERACEAE	*Gerbera linnaei (G. asplenifolia)*
* ASTERACEAE	*Gymnodiscus capillaris*
ASTERACEAE	*Helichrysum apermum var.albidulum (H. ericaefolium)*
ASTERACEAE	*Helichrysum aspermum var.aspermum (H. ericaefolium)*
ASTERACEAE	*Helichrysum cymosum*

* Selected in random sample

FAMILY	SPECIES
ASTERACEAE	*Helichrysum indicum (H. expansum)*
ASTERACEAE	*Helichrysum niveum (metalasoides)*
ASTERACEAE	*Helichrysum retortum*
ASTERACEAE	*Helichrysum rutilans*
ASTERACEAE	*Helichrysum teretifolium*
ASTERACEAE	*Helipterum sp. (Helichrysum vestitum)*
ASTERACEAE	*Ifloga ambigua (laricifolia)*
ASTERACEAE	*Ifloga repens (I. reflexa)*
* ASTERACEAE	*Metalasia brevifolia*
ASTERACEAE	*Metalasia cephalotes (M. divergens)*
ASTERACEAE	*Metalasia muricata*
ASTERACEAE	*Othonna bulbosa*
ASTERACEAE	*Othonna coronopifolia*
* ASTERACEAE	*Othonna digitata*
ASTERACEAE	*Othonna filicaulis*
ASTERACEAE	*Senecio arenarius*
ASTERACEAE	*Senecio burchellii*
ASTERACEAE	*Senecio elegans*
ASTERACEAE	*Senecio hastatus*
ASTERACEAE	*Senecio littoreus*
* ASTERACEAE	*Senecio pubigerus*
ASTERACEAE	*Senecio rosmarenifolius*
ASTERACEAE	*Stoebe fusca*
ASTERACEAE	*Stoebe plumosa*
ASTERACEAE	*Ursinia anthemoides*
ASTERACEAE	*Ursinia nana subsp.nana (U. annua)*
* ASTERACEAE	*Ursinia tenuifolia*
ASTERACEAE	*Vellereophyton dealbatum (Gnaphalium canadidissimum)*
* BORAGINACEAE	*Lobostemon fruticosus*
* BORAGINACEAE	*Lobostemon glaucophyllus*
BORAGINACEAE	*Lobostemon montanus*
CRUCIFERAE	*Heliophila africana (Heliophyla integrifolia)*
CRUCIFERAE	*Heliophila refracta*
* BRUNIACEAE	*Berzelia abrotanoides*
CAMPANULACEAE	*Lightfootia tenella*
CAMPANULACEAE	*Microcodon glomeratus*
CAMPANULACEAE	*Roella ciliata*
CAMPANULACEAE	*Wahlenbergia androsaceae (W. arenaria)*
CAMPANULACEAE	*Wahlenbergia capensis*
CAMPANULACEAE	*Wahlenbergia exilis*
* CAMPANULACEAE	*Wahlenbergia procumbens*
CELASTRACEAE	*Maytenus heterophylla (Gymnosporia buxifolia)*
CELASTRACEAE	*Pterocelastrus tricuspidatus*
CHENOPODIACEAE	*Atriplex patula var.austroafricana (A. austroafricana)*
CONVOLVULACEAE	*Falkia repens*
* CRASSULACEAE	*Crassula decumbens var.brachyphylla*
* CRASSULACEAE	*Crassula flava*
* CRASSULACEAE	*Crassula glomerata*
CRASSULACEAE	*Crassula natans*
CYPERACEAE	*Cyperus congestus*
CYPERACEAE	*Cyperus lanceus*
CYPERACEAE	*Cyperus tenellus*
CYPERACEAE	*Ficinea nigrescens (F. bracteata)*
CYPERACEAE	*Ficinia bulbosa*
CYPERACEAE	*Ficinia capitella*

* Selected in random sample

FAMILY	SPECIES
CYPERACEAE	*Ficinia deusta*
CYPERACEAE	*Ficinia filiformis*
CYPERACEAE	*Ficinia indica*
CYPERACEAE	*Ficinia lucida*
CYPERACEAE	*Ficinia secunda*
CYPERACEAE	*Ficinia tristachya*
* CYPERACEAE	*Fuirena hirsuta (F. hottentota)*
CYPERACEAE	*Hellmunthia membranacea (Scirpus membranaceus)*
* CYPERACEAE	*Isolepis cernua (Scirpus cernuus)*
CYPERACEAE	*Isolepis hystrix (Scirpus hystrix)*
* CYPERACEAE	*Isolepis incomptula (Scirpus incomptulus)*
CYPERACEAE	*Isolepis ludwiggi (Scirpus ludwiggi)*
CYPERACEAE	*Isolepis marginata (Scirpus cartilagineus)*
* CYPERACEAE	*Isolepis prolifer (Scirpus prolifer)*
* CYPERACEAE	*Isolepis striata (Scirpus striatus)*
CYPERACEAE	*Isolepis verruculosa (Scirpus verruculosus)*
CYPERACEAE	*Macrochaetium hexandrum*
* CYPERACEAE	*Schoenus nigricans*
CYPERACEAE	*Scirpus maritimus*
CYPERACEAE	*Scirpus nodosus*
CYPERACEAE	*Scirpus trachyspermus*
CYPERACEAE	*Scirpus venusculus*
CYPERACEAE	*Tetraria compar*
CYPERACEAE	*Tetraria fasciata*
CYPERACEAE	*Tetraria flexuosa*
CYPERACEAE	*Tetraria microstachys*
CYPERACEAE	*Tetraria sylvatica*
CYPERACEAE	*Tetraria thermalis*
* DIPSACEAE	*Scabiosa columbaria*
ERICACEAE	*Blaeria ericoides*
ERICACEAE	*Erica capitata*
ERICACEAE	*Erica imbricata*
* ERICACEAE	*Erica lasciva*
ERICACEAE	*Erica mammosa*
* ERICACEAE	*Erica margaritaceae*
* ERICACEAE	*Erica multumbellifera*
ERICACEAE	*Erica pulchella*
ERICACEAE	*Erica subdivaricata*
* ERICACEAE	*Scyphogyne muscosa*
ERICACEAE	*Scyphogyne urceolata*
ERICACEAE	*Simocheilus depressus*
* ERICACEAE	*Syndesmanthus articulatus*
EUPHORBIACEAE	*Adenocline pauciflora (A. ovifolia)*
EUPHORBIACEAE	*Clutia alaternoides*
EUPHORBIACEAE	*Euphorbia tuberosa*
FABACEAE	*Amphithalea ericifolia*
FABACEAE	*Aspalathus angustifolia subsp. angustifolia (A. lanceolata)*
* FABACEAE	*Aspalathus callosa (A. callosus)*
FABACEAE	*Aspalathus contaminus*
* FABACEAE	*Aspalathus cordata (Borbonia cordata)*
FABACEAE	*Aspalathus ericifolia*
FABACEAE	*Aspalathus filicaulis*
FABACEAE	*Aspalathus heterophylla subsp. lotoides (A. lotoides)*
FABACEAE	*Aspalathus linifolius*
FABACEAE	*Aspalathus microphylla*

* Selected in random sample

FAMILY	SPECIES
	(A. divaricatus var. microphylla)
FABACEAE	*Aspalathus retroflexa var. bicolor*
FABACEAE	*Aspalathus retroflexus*
* FABACEAE	*Aspalathus spinosa*
FABACEAE	*Cotalaria excisa*
FABACEAE	*Lebeckia meyeriana*
FABACEAE	*Lessertia tomentosa*
FABACEAE	*Lotononis peduluncaris*
* FABACEAE	*Podalyria sericea*
FABACEAE	*Psoralea alata*
* FABACEAE	*Psoralea cordata*
FABACEAE	*Psoralea laxa*
FABACEAE	*Rafnia angulata*
FABACEAE	*Rafnia capensis*
FABACEAE	*Rhynchosia capensis*
FABACEAE	*Trifolium dubium (T. filiforme)*
GENTIANACEAE	*Chironia baccifera*
GENTIANACEAE	*Chironia decumbens*
GENTIANACEAE	*Chironia linoides subsp. emarginata (C. emarginata)*
* GENTIANACEAE	*Orphium frutescens*
GENTIANACEAE	*Sebaea ambigua*
* GENTIANACEAE	*Sebaea aurea*
GENTIANACEAE	*Sebaea exacoides*
GENTIANACEAE	*Villarsia ovata*
GERANIACEAE	*Geranium incanum*
GERANIACEAE	*Pelargonium myrrhifolium*
GERANIACEAE	*Pelargonium triste*
* GERANIACEAE	*Pelargonuim betulinum*
* POACEAE	*Aristida junciformis*
POACEAE	*Brachypodium distachyum*
POACEAE	*Cynodon dactylon*
POACEAE	*Diplachne fusca (D. malabarica)*
POACEAE	*Ehrharta calycina*
POACEAE	*Ehrharta calycina var.calycina (geniculata)*
POACEAE	*Ehrharta erecta*
POACEAE	*Ehrharta longifolia*
POACEAE	*Ehrharta villosa*
POACEAE	*Eragrostis brizoides*
POACEAE	*Eragrostis sarmentosa*
POACEAE	*Holcus setiger*
POACEAE	*Koeleria alopecuris*
POACEAE	*Lasiochloa longifolia*
POACEAE	*Lolium rigidicum*
POACEAE	*Paspalum vaginatum*
POACEAE	*Pennisetum macrourum*
* POACEAE	*Pentaschistus colorata*
POACEAE	*Pentaschistus subulifolia*
* POACEAE	*Pentaschistus thunbergii*
POACEAE	*Pentashistus curvifolia*
POACEAE	*Plagiochloa Uniolae*
POACEAE	*Polypogon tenuis*
POACEAE	*Sporobolus africanus (S. capensis)*
HAEMODORACEAE	*Wachendorfia brachyandra*
HAEMODORACEAE	*Wachendorfia paniculata*
* HYPOXIDACEAE	*Empodium plicatum*
HYPOXIDACEAE	*Pauridia minuta*
HYPOXIDACEAE	*Spiloxene alba*

* Selected in random sample

	FAMILY	SPECIES
*	HYPOXIDACEAE	*Spiloxene aquatica*
	HYPOXIDACEAE	*Spiloxene capensis*
	HYPOXIDACEAE	*Spiloxene schlechteri*
	HYPOXIDACEAE	*Spiloxene serrata*
	ILLECEBRACEAE	*Herniaria capensis (H. arenicola)*
	ILLECEBRACEAE	*Paronychia braziliana*
*	ILLECEBRACEAE	*Silene clandestina*
	IRIDACEAE	*Aristea africana*
	IRIDACEAE	*Aristea dichotoma*
	IRIDACEAE	*Aristea glauca*
	IRIDACEAE	*Babiana hiemalis*
*	IRIDACEAE	*Bobartia filiformis*
	IRIDACEAE	*Geissorrhiza aspera (G. secunda)*
	IRIDACEAE	*Geissorrhiza humilis*
	IRIDACEAE	*Geissorrhiza imbricata*
*	IRIDACEAE	*Geissorrhiza juncea*
	IRIDACEAE	*Geissorrhiza teretifolia*
	IRIDACEAE	*Gladiolus brevifolius*
	IRIDACEAE	*Gladiolus carinatus*
	IRIDACEAE	*Gladiolus gracilis*
	IRIDACEAE	*Gladiolus punctulatus var.punctulatus (G. villosus)*
	IRIDACEAE	*Hesperantha falcata*
	IRIDACEAE	*Hesperantha pilosa*
	IRIDACEAE	*Hexaglottis lewisiae (H. flexuosa)*
*	IRIDACEAE	*Homeria miniata*
	IRIDACEAE	*Ixia maculata*
	IRIDACEAE	*Ixia paniculata*
*	IRIDACEAE	*Lapeirousia fabricci*
	IRIDACEAE	*Micranthus alopecuroides (M. plantagineus)*
	IRIDACEAE	*Micranthus junceus*
	IRIDACEAE	*Moraea ciliata*
	IRIDACEAE	*Moraea decussata*
*	IRIDACEAE	*Moraea fugax (M. edulis)*
*	IRIDACEAE	*Moraea neglecta*
*	IRIDACEAE	*Moraea papilionacea*
	IRIDACEAE	*Moraea tripetala*
	IRIDACEAE	*Morea bituminosa*
	IRIDACEAE	*Romulea elegans*
	IRIDACEAE	*Romulea rosea*
	IRIDACEAE	*Romulea triflora*
*	IRIDACEAE	*Sparaxis grandiflora*
*	IRIDACEAE	*Watsonia meriana (W. humilis)*
	IRIDACEAE	*Watsonia tabularis var.concolor*
	JUNCACEAE	*Juncus cephalotes (J. inequalis, J. filifolius)*
	JUNCAGINACEAE	*Triglochin striata (T. striatum)*
	LABIATAE	*Leonotis Leonorus*
*	LABIATAE	*Salvia africana-lutea (S. aurea)*
	LEMNACEAE	*Lemna gibba*
	LENTIBULAREACEAE	*Utricularia bisquamata (capensis)*
*	HYACINTHACEAE	*Albuca canadensis*
*	HYACINTHACEAE	*Albuca cooperi*
	LILIACEAE	*Androcymbium capense*
	LILIACEAE	*Anthericum brachypodum*
	LILIACEAE	*Anthericum ciliatum*
	LILIACEAE	*Anthericum longepedunculatum ?*
	LILIACEAE	*Anthericum revolutum*
*	ASPHODELACEAE?	*Baeometra uniflora*

* Selected in random sample

	FAMILY	SPECIES
*	ASPHODELACEAE	*Bulbine asphodeloides*
	ASPHODELACEAE	*Bulbine favosa*
	ASPHODELACEAE	*Bulbinella triquetra*
	ASPHODELACEAE	*Caesia contorta*
	LILIACEAE	*Eriospermum lancifolium (E. lanceaefolium)*
	LILIACEAE	*Eriospermum pumilum*
	LILIACEAE	*Eriospermum spirale*
	LILIACEAE	*Lachenalia variegata*
	LILIACEAE	*Onixotis punctata*
	LILIACEAE	*Onixotis triquetra (Dipidax triquetra)*
*	HYACINTHACEAE	*Ornithogalum graminifolium*
	HYACINTHACEAE	*Ornithogalum hispidifolium*
	HYACINTHACEAE	*Ornithogalum thyrsoides*
	HYACINTHACEAE	*Ornithoglossum viride*
*	ASPARAGACEAE	*Protasparagus capensis (Asparagus capensis)*
	ASPARAGACEAE	*Protasparagus rubicundus*
	LILIACEAE	*Tenicroa filifolia (Urginea filifolia)*
*	LILIACEAE	*Tulbaghia alliacea*
	LILIACEAE	*Wurmbea spicata*
*	LOBELIACEAE	*Laurentia secunda*
	LOBELIACEAE	*Lobelia comosa*
	LOBELIACEAE	*Lobelia setacea*
	LOBELIACEAE	*Monopsis debilis*
	LOBELIACEAE	*Monopsis luteus (Parastranthus luteus)*
	MESEMBREANTHEMACEAE	*Carpanthea pomeridiana*
	MESEMBREANTHEMACEAE	*Carpobrotus edulis*
	MESEMBREANTHEMACEAE	*Jordaaniella dubia (Cephallophyllum procumbens)*
*	MESEMBREANTHEMACEAE	*Dorotheanthus bellidiformis*
	MESEMBREANTHEMACEAE	*Erepsia tuberculata*
	MESEMBREANTHEMACEAE	*Lampranthus bicolor*
	MESEMBREANTHEMACEAE	*Lampranthus explanatus*
	MESEMBREANTHEMACEAE	*Lampranthus filicaulis*
	MESEMBREANTHEMACEAE	*Lampranthus glaucus*
	MESEMBREANTHEMACEAE	*Lampranthus reptans*
*	MESEMBREANTHEMACEAE	*Lampranthus tenuifolius*
*	MESEMBREANTHEMACEAE	*Ruschia geminiflora*
	MYOPORCEAE	*Oftia africana*
	ORCHIDACEAE	*Corycium orobanchoides*
	ORCHIDACEAE	*Disa cornuta*
	ORCHIDACEAE	*Disa filicornis (Penthea filicornis)*
*	ORCHIDACEAE	*Disa tenella*
	ORCHIDACEAE	*Disa villosa*
	ORCHIDACEAE	*Herschelia barbata*
	ORCHIDACEAE	*Herschelia hians (H. lacera)*
*	ORCHIDACEAE	*Holothrix cernua*
	ORCHIDACEAE	*Holothrix villosa*
	ORCHIDACEAE	*Micrantha sabulosa*
	ORCHIDACEAE	*Monadenia bracteata (micrantha)*
	ORCHIDACEAE	*Pterygodium catholicum*
	ORCHIDACEAE	*Satyrium bicallosum*
*	ORCHIDACEAE	*Satyrium bicallosum var.ocellatum*
	ORCHIDACEAE	*Satyrium bicorne*
	ORCHIDACEAE	*Satyrium lupulinum*
	ORCHIDACEAE	*Satyrium stenopetalum subsp.brevicalcaratum (S. marginatum)*
	OROBANCHEACEAE	*Orobanche ramosa*
	OXALIDACEAE	*Oxalis commutata*

* Selected in random sample

	FAMILY	SPECIES
	OXALIDACEAE	*Oxalis corniculata*
	OXALIDACEAE	*Oxalis ecklonian*a
	OXALIDACEAE	*Oxalis glabra*
*	OXALIDACEAE	*Oxalis hirta*
	OXALIDACEAE	*Oxalis luteola*
	OXALIDACEAE	*Oxalis minuta*
	OXALIDACEAE	*Oxalis natans*
	OXALIDACEAE	*Oxalis obtusa*
	OXALIDACEAE	*Oxalis pes-caprae*
	OXALIDACEAE	*Oxalis punctata*
	OXALIDACEAE	*Oxalis versicolor*
*	PENAEACEAE	*Penaea mucronata*
*	PENAEACEAE	*Stylapteris fruticulosus (Penaea fruticulosa)*
*	PLUMBAGINACEAE	*Limonium equisetinum*
	POLYGALACEAE	*Muraltia filiformis*
*	POLYGALACEAE	*Muraltia heisteria*
	POLYGALACEAE	*Muraltia satureioides (M. salteri)*
	POLYGALACEAE	*Muraltia striata*
	POLYGALACEAE	*Muraltia thunbergii (M. phylicoides)*
	POLYGALACEAE	*Muraltia thymifolia*
	POLYGALACEAE	*Nylandtia spinosa (Mundia spinosa)*
	POLYGALACEAE	*Polygala bracteolata*
*	POLYGALACEAE	*Polygala garcini*
*	POLYGALACEAE	*Polygala recognita*
*	POLYGONACEAE	*Polygonum salicifolium*
	POLYGONACEAE	*Rumex sarcorrhizus*
	PONTEDERIACEAE	*Eichornia crassipes*
	PRIMULACEAE	*Angallis arvensis var.coerulea*
	PRIMULACEAE	*Samolus valerandi*
	PROTEACEAE	*Diastella serpyllifolia*
*	PROTEACEAE	*Leucadendron salignum (L. adscendens)*
	PROTEACEAE	*Protea acaulos*
	PROTEACEAE	*Protea cynaroides*
	PROTEACEAE	*Serruria burmanni*
	PROTEACEAE	*Serruria glomerata*
*	RESTIONACEAE	*Chondropetalum nudum*
	RESTIONACEAE	*Chondropetalum tectorum*
*	RESTIONACEAE	*Elegia asperiflora*
	RESTIONACEAE	*Elegia parviflora*
	RESTIONACEAE	*Elegia vaginulata*
	RESTIONACEAE	*Restio eliocharis*
	RESTIONACEAE	*Restio fruticosus*
	RESTIONACEAE	*Thamnochortus dichotomus*
	RESTIONACEAE	*Thamnochortus erectus*
	RESTIONACEAE	*Thamnochortus fruticosus*
*	RHAMNACEAE	*Phylica ericoides*
*	RHAMNACEAE	*Phylica imberbis*
	RHAMNACEAE	*Phylica parviflora*
	RHAMNACEAE	*Phylica plumosa var.squarrosa*
	RHAMNACEAE	*Phylica stipularis*
	ROSACEAE	*Cliffortia depranoides (C. depranoide*s)
	ROSACEAE	*Cliffortia ericifolia*
	ROSACEAE	*Cliffortia ferruginea*
*	ROSACEAE	*Cliffortia filifolia*
	ROSACEAE	*Cliffortia hirta*
	ROSACEAE	*Cliffortia obcordata*
*	ROSACEAE	*Cliffortia polygonifolia*
	ROSACEAE	*Cliffortia ruscifolia*

* Selected in random sample

	FAMILY	SPECIES
	ROSACEAE	*Cliffotia strobilifera*
	RUBIACEAE	*Anthospermum aethiopicum*
	RUTACEAE	*Agathosma imbricata*
	RUTACEAE	*Diosma hirsuta*
*	RUTACEAE	*Diosma oppositifolia*
	SANTALACEAE	*Osyris compressa*
	SANTALACEAE	*Thesidium fruticulosum*
	SANTALACEAE	*Thesium acuminatum*
*	SANTALACEAE	*Thesium aggregatum*
	SANTALACEAE	*Thesium capitatum*
	SANTALACEAE	*Thesium carinatum*
	SANTALACEAE	*Thesium frisea*
	SANTALACEAE	*Thesium funale*
*	SANTALACEAE	*Thesium spicatum*
	SANTALACEAE	*Thesium virgatum*
	SCROPHULARIACEAE	*Alectra sessiliflora var.sessiliflora (Melasma sessiliflorum)*
*	SCROPHULARIACEAE	*Bartsia trixago (Bellardio trixago)*
	SCROPHULARIACEAE	*Diascia elongata*
	SCROPHULARIACEAE	*Diascia nemophiloides*
*	SCROPHULARIACEAE	*Harveya tubulosa*
*	SCROPHULARIACEAE	*Hemimeris sabulosa*
	SCROPHULARIACEAE	*Manulea cheiranthus*
	SCROPHULARIACEAE	*Manulea tomentosa*
*	SCROPHULARIACEAE	*Nemesia bicornis*
	SCROPHULARIACEAE	*Nemesia versicolor*
	SCROPHULARIACEAE	*Phyllopodium heterophyllum (Polycarena heterophylla)*
	SCROPHULARIACEAE	*Sutera tristis*
	SCROPHULARIACEAE	*Zaluzianskya capensis*
	SCROPHULARIACEAE	*Zaluzianskya villosa*
	SELAGINACEAE	*Agathelpis dubia*
	SELAGINACEAE	*Dischisma ciliatum*
	SELAGINACEAE	*Hebenstreitia dentata*
	SELAGINACEAE	*Hebenstreitia ramosissma(Rondebosch)*
*	SELAGINACEAE	*Selago corymbosa*
*	SELAGINACEAE	*Selago dreigei*
	SELAGINACEAE	*Selago spuria(burnt)*
	STERCULIACEAE	*Hermannia cuneifolia*
	STILBEACEAE	*Stilbe ericoides*
*	TECOPHILAEACEAE	*Cyanella hyacinthoides (C. capensis)*
	THYMELEACEAE	*Cryptadenia grandiflora*
	THYMELEACEAE	*Gnidia imbricata*
	THYMELEACEAE	*Gnidia inconspicua*
*	THYMELEACEAE	*Gnidia laxa*
	THYMELEACEAE	*Gnidia oppositifolia*
	THYMELEACEAE	*Gnidia pinifolia*
	THYMELEACEAE	*Gnidia viridis*
*	THYMELEACEAE	*Passerina paleacea*
*	THYMELEACEAE	*Passerina vulgaris*
	THYMELEACEAE	*Struthiola ciliata*
*	THYMELEACEAE	*Struthiola dodecandra*
	TYPHACEAE	*Typha capensis*

* Selected in random sample

Table 14: Randomly selected species previously or still occurring on Kenilworth Racecourse after Adamson and Salter, 1950. Names have been updated according to Gibbs-Russell *et al* (1985; 1987). Names shown in brackets appeared in Adamson & Salter (1950). Attributes were obtained from Adamson & Salter (1950), Dyer (1975) and Bond & Goldblatt (1984).

	Family	Species	Growth form	Shrub height	Fire survival	Habitat preference
	Present					
B	ASTERACEAE	*Cotula coronopifolia*	3	1	2	1
G	BRUNIACEAE	*Berzelia abrotanoides*	1	3	2	1
G	CYPERACEAE	*Fuirena hirsuta (F. hottentota)*	2	1	1	1
G	ERICACEAE	*Erica lasciva*	1	2	2	2
B	ERICACEAE	*Erica margaritaceae*	1	2	1	2
G	GENTIANACEAE	*Orphium frutescens*	1	2	1	2
G	HYACINTHACEAE	*Albuca canadensis*	4	1	2	1
B	HYPOXIDACEAE	*Spiloxene aquatica*	4	2	2	1
B	IRIDACEAE	*Moraea papilionacea*	4	1	2	2
G	IRIDACEAE	*Watsonia meriana (W. humilis)*	4	3	2	1
B	POLYGALACEAE	*Muraltia heisteria*	1	2	1	2
B	PROTEACEAE	*Leucadendron salignum (L. adscendens)*	1	1	1	2
G	RESTIONACEAE	*Chondropetalum nudum*	2	2	1	2
B	ROSACEAE	*Cliffortia polygonifolia*	1	2	2	2
B	RUTACEAE	*Diosma oppositifolia*	1	2	2?	2
B	TECOPHILAEACEAE	*Cyanella hyacinthoides (C. capensis)*	3	1	1	2
	Lost					
B	ASTERACEAE	*Cotula vulgaris*	3	1	2	1
B	ASTERACEAE	*Othonna digitata*	3	1	2?	2
B	CAMPANULACEAE	*Wahlenbergia procumbens*	3	1	1	1
G	CRASSULACEAE	*Crassula decumbens* var. *brachyphylla*	3	1	2?	1
G	CYPERACEAE	*Isolepis cernua (Scirpus cernuus)*	2	1	1	1
G	CYPERACEAE	*Isolepis incomptula (Scirpus incomptulus)*	2	1	1	1
B	CYPERACEAE	*Isolepis prolifer (Scirpus prolifer)*	2	1	1	1
B	ERICACEAE	*Syndesmanthus articulatus*	1	1	2	2
G	FABACEAE	*Aspalathus callosa (A. callosus)*	1	1	2?	2
B	HYACINTHACEAE	*Ornithogalum gramiminifolium*	4	3	1	2
B	IRIDACEAE	*Bobartia filiformis*	4	1	1	2
B	IRIDACEAE	*Moraea neglecta*	4	1	1	2
G	LOBELIACEAE	*Laurentia secunda*	3	1	2?	1
B	ORCHIDACEAE	*Disa tenella*	4	1	1	1
B	ORCHIDACEAE	*Satyrium bicallosum* var. *ocellatum*	4	1	1	1
B	POACEAE	*Aristida junciformis*	2	1	2?	2
B	POACEAE	*Pentaschistus colorata*	2	1	2?	2
B	RESTIONACEAE	*Elegia asperiflora*	2	2	1	1
G	RHAMNACEAE	*Phylica imberbis*	1	1	2?	2
B	SANTALACEAE	*Thesium aggregatum*	1	1	1	2
B	??LILIACEAE	*Tulbaghia alliacea*	4	1	1	2

G: found in Guthrie Herbarium

B: found in Bolus Herbarium

Growth Form: 1=shrub; 2=graminoid; 3=forb; 4=geophyte
Plant height/length: 1= < 50cm; 2= < 1m; 3= > 1m.
Fire survival: 1=resprouter; 2=reseeder
Moisture regime preferred: 1=moist, 2=dry or not specified

and Dyer (1975). The first three attributes, also used by Bond *et al.*(1988), were selected for this study because they identify the effects of fire, an essential ecological factor, on the plant community structure. Bond *et al.*(1988) also included species traits relating to dispersal and breeding systems, as well as pollination syndromes. Exclusion of these latter attributes is justified in this report on the grounds that Bond *et al.*(1988) had found that isolation did not significantly affect the attributes of the community on islands versus the mainland. Preference for a moister or drier habitat was assessed in this study to determine the possible impact of wetland drainage on species diversity. Trends in, and possible causes of species loss from the area could thus be determined.

The species present on Kenilworth Racecourse vary markedly with regard to the ease with which they are sighted in the field. To test the importance of the 'ease of observation' of species to their inclusion in checklists, three 'conspicuous' families which are generally well-represented in the herbaria, and which are unlikely to have been overlooked during field surveys, were selected, namely Ericaceae, Iridaceae and Proteaceae [Table 15 (p. 81)]. Herbarium sheets for all "probables" [Table 13 p. 71)] in these families were consulted to ascertain if the species occurred on Kenilworth Racecourse in the past. Extent of "loss" of these species from Kenilworth Racecourse was ascertained by comparison with the current species checklist [Table 9 (p. 59)]. The following possible conclusions could be drawn from the assessment: 1) If there was a marked "loss" of these highly visible species, it would indicate that ecological factors had, indeed, resulted in species 'extinction'. 2) If, on the other hand, it was found that the majority of these prominent species were still present on Kenilworth Racecourse, it would indicate that plant species "loss", as ascertained from the random sample of "probables", could be accounted for by omission of inconspicuous species from the current species checklist [Table 9 (p. 59)]. Attributes relating to the influence of fire on species presence were also determined for this sample of 'conspicuous' families.

b) Results

Table 14 (p. 79) indicates the 37 species in the random sample previously occurring on Kenilworth Racecourse ("definites"). Only 16 of these still exist on Kenilworth Racecourse, according to the current species checklist. This represents a 43.2% 'loss' of species. Trends in species 'loss' found for the random sample were as follows:

Table 15: Traits in species loss on Kenilworth Racecourse in three well-collected and easily observed plant families. Names have been updated Gibbs-Russell et al.(1985; 1987). Species names appearing in Adamson & Salter (1950) are shown in brackets. Attributes were obtained from from Adamson & Salter (1950), Dyer (1975) and Bond & Goldblatt (1984).

Family	Species	Growth form	Shrub height	Fire survival	Habitat preference
Present					
B ERICACEAE	*Erica imbricata*	1	2	2	2
B ERICACEAE	*Erica lasciva*	1	2	2	2
B ERICACEAE	*Erica mammosa*	1	1	2	2
G ERICACEAE	*Erica margaritaceae*	1	1	2	2
B ERICACEAE	*Erica subdivaricata*	1	1	2	2
C IRIDACEAE	*Ixia paniculata*	4	1	1	2
C IRIDACEAE	*Moraea papilionacea*	4	1	1	2
C IRIDACEAE	*Geissorrhiza aspera* *(Geisorrhiza secunda)*	4	1	1	2
C IRIDACEAE	*Hexaglottis lewisiae* *(Hexaglottis flexuosa)*	4	1	1	1
C IRIDACEAE	*Babiana villosula* *(Babiana hiemalis)*	4	1	1	1
G PROTEACEAE	*Leucadendron salignum*	1	1	1	2
G PROTEACEAE	*Serruria glomerata*	1	3	2	2
Lost					
G ERICACEAE	*Syndesmanthus articulatus*	1	1	2	2
C IRIDACEAE	*Moraea fugax* *(Moraea edulis)*	4	1	1	2
C IRIDACEAE	*Moraea neglecta*	4	1	1	1
C IRIDACEAE	*Geissorrhiza humilis*	4	1	1	2
C IRIDACEAE	*Geissorrhiza juncea*	4	2	1	1
C IRIDACEAE	*Moraea tripetala*	4	2	1	2
C IRIDACEAE	*Bobartia filiformis*	4	1	1	2
C IRIDACEAE	*Hesperantha pilosa*	4	1	1	2
C IRIDACEAE	*Geissorrhiza imbricata*	4	1	1	2
C IRIDACEAE	*Moraea gawleri* *(Morarea decussata)*	4	1	1	2
B PROTEACEAE	*Protea cynaroides*	1	1	1	2

B: found in Bolus Herbarium

C: found in Compton Herbaruim

G: found in Guthrie Herbarium

Growth Form: 1=shrub; 2=graminoid; 3=forb; 4=geophyte
Plant height/length: 1= < 50cm; 2= < 1m; 3= > 1m.
Fire survival: 1=resprouter; 2=reseeder
Moisture regime preferred: 1=moist, 2=dry or not specified

1) Species in the smallest size class were found to be conspicuously absent (19 out of the 21 'lost' species were smaller than 50 cm).

2) No clear pattern relating growth form, fire survival strategy or preference for a wetter or drier moisture regime emerged [Table 14 (p. 79)]. This may be accounted for, in part, by the small sample of the "probables" species for which herbarium records exist which cite Kenilworth Rcecourse as a specific location..

In the assessment of presence or absence of the conspicuous families, Ericaceae were found to be well-represented, with five of the six species still present. However, nine of the fourteen species of Iridaceae of established previous occurrence were absent. Only three species of Proteaceae appearing on the "probables" list had been collected on Kenilworth Racecourse [Table 15 (p. 81)].

c) Discussion

I: *"Probables" with no records of past occurrence at Kenilworth Racecourse*

The randomly selected species on the "probables" list for which specimens were not found in the herbaria for Kenilworth Racecourse could have fallen into two categories of: 1) they never actually occurred on Kenilworth Racecourse itself, but only in its vicinity, or 2) they were overlooked through being either too common or too inconspicuous.

II: *Why the decrease in observed species: 1950 to present?*

1. The current species checklist [Table 9 (p. 59)] may be incomplete and the continued existence of species absent from the list cannot be ruled out. The following possibilities may explain an inadequate listing of species in the recent study: Firstly, some of the species absent from the list are inconspicuous. Table 14 (p. 79) shows the high incidence of previously recorded plants below 50 cm in size which were not found in the recent study, such as the Orchidaceae (*Satyrium bicallosum* var. *ocella* and *Disa tenella*). *Herschelia barbata* (Orchidaceae) is a further 'inconspicuous' species not found during the recent study but which occurred on Kenilworth Racecourse in the past (Adamson & Salter, 1950). In some parts, the vegetation has become dense and overgrown, making assessment of species present difficult. However, the analysis of trends of species loss in three

conspicuous' families showed that even within these taxa, some species were not found in the recent survey [Table 15 (p. 81)]. Thus factors apart from merely 'ease of observation' are influencing species represented in the recent checklist.

Secondly, within taxa such as the graminoids (Cyperaceae, Poaceae and Restionaceae), identification of species, particularly when not in flower, is difficult. For example, no *Isolepis* spp. were observed during this study, although at least three species used to occur [Table 14 (p. 79)]. These may have been mistaken for other taxa within the Cyperaceae during compilation of the current species checklist.

Finally, incorrect identification of species and inability to identify the specimens to species level in some cases during this survey may account for 'loss' of some species. For example the *Bobartia* sp. listed in Table 9 (p. 59) could only be identified to genus level; this may have represented *B. filiformis*, which, according to the distribution range described by Adamson & Salter (1950), may have occurred on Kenilworth Racecourse.

2. Species may now be absent (at least above ground) from the area. This can be fairly conclusively stated for the species with prominent growth forms, such as *Protea cynaroides*, *Oxalis natans* and *Erica turgida*, all of which previously occurred on Kenilworth Racecourse. Possible reasons for species absence are as follows:

Firstly, since 1950, 31 hectares of fynbos have been destroyed by development (see Chapter 3) which is likely to have caused species loss. For example, construction of a new track caused the elimination of *P. cynaroides* (E. Luff, pers. comm.). However, the herbarium data do not include precise species localities within the Racecourse; thus the proportion lost due to habitat destruction cannot be assessed.

Secondly, a change in moisture levels in the soils may account for species loss. Species composition, based on 'moisture regime' of preferred habitat, does not appear to have been extensively altered, implying that surface hydrology may not have been extensively altered by the installation of drainage ditches. On the other hand, many of the drainage ditches were probably *in situ* early on in the century and their impact might already have caused species loss.

Thirdly, the process of 'relaxation' could be used to account for species loss from the area (see Chapter 4). However, it would be difficult to prove that this has occurred at Kenilworth Racecourse; furthermore, doubt has been expressed in the literature about the existence of this phenomenon (Burgman *et al, 1988)*.

Finally, absence of fire from the area (see Chapter 3) may be the most significant cause for species 'loss'. Gill & Groves (1981) observe that in fynbos, post-fire succession involves the gradual loss of species, rather than the replacement of species over time, implying that absence of fire for extended periods in fynbos results in species loss. The phenomenon is rooted in the evolution of fire-dependence in the fynbos. This is reflected in the literature of the fynbos biome, which emphasises the essential role of fire both in the evolution of high species diversity characteristic of the biome (Kruger, 1979) and structure of plant communities (Cowling, 1987).

Optimum fire frequency has been the source of debate in the fynbos biome. Generally it is considered that shorter (< 4 years) fire cycles cause loss of species due to mortality prior to seed production, whilst fire intervals that are too long (> 30 years) result in senescence (Kruger, 1984). For example, Bond (1980) was able to show a decrease in regeneration after fire of certain taxa, including Proteaceae, in communities greater than 40 years of age. Absence of fire has frequently been cited as a cause for reduced recruitment, as noted by Manders & Cunliffe (1987). Litter build-up also occurs, preventing seed germination. Manders & Cunliffe (1987) also observe that in certain species, fire may be a prerequisite for the production of flowers and seed. Furthermore, small plant species would tend to be overshadowed and perhaps eliminated in a long fire cycle (Bond *et al*, 1988). This provides a further reason why there has been a high incidence of small plant species elimination on Kenilworth Racecourse in the current species list [Table 14 (p. 79)].

In fynbos species, two basic post-fire survival strategies are adopted: seeding and resprouting (Kruger, 1983). Over-frequent fire tends to stimulate resprouting species and eliminate reseeding species (cited in Kruger, 1983).

Conversely, absence of fire results in reseeding species being favoured (Kruger, 1983; Bond *et al*, 1988). Coexistence of reseeders and resprouters requires a variable fire frequency which includes fire-free periods (Kruger, 1983). The absence of fire from Kenilworth Racecourse for an extended period is clearly seen in the dominance of reseeding species. Table 15 (p. 81) indicates the absence of nine of the fourteen species of Iridaceae from the area at present. These genera normally have the strategy of resprouting after fire. The plants may, however, presently be in a phase of dormancy, surviving as below-ground corms and a fire may encourage them to resprout. A case in point is the area where a fire occurred approximately four years ago [Figure 4 (p. 14)]. This is now the only apparent area in which *Moraea elsiae* (with this area being its only locality) and *Moraea papilionacea* occur on Kenilworth Racecourse.

The Ericaceae, on the other hand, are now apparently well-represented, with five of the previously six species present. This family generally reseeds after fire, thereby accounting for its apparently high representation. Other species which have been particularly 'successful' are also reseeders, namely *Leucadendron levisanus* (a threatened member of the family Proteaceae), *Berzelia abrotanoides* (Bruniaceae, a family endemic to the south western Cape), *Cliffortia* spp. (Rosaceae) and *Passerina vulgaris* (Thymelleaceae).

However, even the reseeding species might eventually start decreasing in abundance with increasing time after fire, as it has been demonstrated that seed viability decreases with length of time after fire in the Proteaceae (Van Staden, 1978). Thus fire has been shown to be an essential process in the maintenance of species diversity and turnover and its absence for species loss with time after fire. It also represents an important process for recycling nutrients in fynbos communities (Groves, 1984), essential due to the oligotrophic soils which have severe deficiencies in certain nutrients.

5.4.3 Avifaunal Species Turnover on Kenilworth Racecourse

a) Methodology

The number of species which have apparently disappeared or arrived since 1950 was assessed by comparing checklists from Grindley (1950) and the present study. The data of Grindley (1950)were collected on a monthly basis, by one or two observers.

Data for the present study were gathered less frequently, although in a more intensive manner with greater numbers of observers involved. Habitat preferences of species were obtained from Maclean (1984). Species were also categorised according to whether they would still be likely to be resident if the area had become purely urban, based on the habitat preferences given in Maclean (1984).

b) Results

According to the results of this study, a 51% loss and a 67% gain in bird species composition has occurred on Kenilworth Racecourse. During the 1988/1989 survey, 33 species not recorded by Grindley (1950) were sighted [Table 7a (p. 55)]. However, 19 of the previously observed species were not seen during the recent survey [Table 7b (p. 56)]. Table 16 (p. 87) summarises the changes in species numbers associated with particular habitat preferences. In the survey of habitat preferences (according to the descriptions by Maclean, 1984), it was found that 23 out of the 49 species that now occur on Kenilworth Racecourse are not generally associated with urban environments.

c) Discussion

There are definite limitations to the method adopted here, in that an individual species can fall into more than one category of habitat preference. Furthermore, "losses" in species may be accounted for by a greater number of site visits being undertaken by Grindley (1950) than occurred for the recent Bird Atlas Data. Whilst this is acknowledged, clear trends were observed in species turnover. A large turnover, as well as an increase, in species occurred from 1950 to present [Tables 7a and 7b (pp. 55, 56)]. The arrival of species associated with the 'aquatic' elements [reed, marsh and dam in Table 16 (p. 87)] on Kenilworth Racecourse since 1950 can account for most of this increase. This can most likely be explained by the construction of three dams during the late 1960's and mid-1970's. The small increase in species numbers preferring urban or garden environments was skewed by the inclusion of species which are 'generalist'. If the latter species are excluded from that category, an overall increase of 6 species associated with urban (including garden) environments has occurred. This result is to be expected, considering the transformation of the surrounding landscape into urban (largely residential) land use (Chapter 2).

Table 16: Numbers of bird species with particular habitat preferences departing from and arriving at Kenilworth Racecourse between 1950 and 1988/1989 as an indicator of habitat change (adapted from Maclean, 1984).

HABITAT PREFERRED#	SPECIES LOSS	SPECIES ARRIVAL	EFFECTIVE CHANGE
Fynbos/grassland	4	3	-1
Reeds/marsh/dam	4	16	+12
Garden/urban/ generalist	8	10	+2
Non-resident*	3	3	None

Categories allocated according to Maclean (1984).

* Birds of prey, swifts and swallows generally resident on the cliffs of Table Mountain and using the area for foraging.

The mobility of avifauna allows them the choice of opportunistically responding to habitat alteration, thus escaping detrimental changes and exploiting advantageous ones. Whilst some of the original suite of species may no longer be present at Kenilworth Racecourse, opportunities for other species have arisen. Avifauna are thus a useful indicator of habitat alteration on Kenilworth Racecourse. On the other hand, factors other than habitat changes occurring on Kenilworth Racecourse could alter species composition (see Section 5.4 (5)).

An assessment of habitat preferences (*sensu* Maclean, 1984) indicates that 23 out of the total of 49 species now on Kenilworth Racecourse are not normally associated with urban environments. If this observation is correct, the importance of the area as a natural refuge for bird species in the altered urban landscape is self-evident.

Frequency of species, not only their presence, may be important as an indicator of environmental change. Grindley (1950) included species abundance in his monthly survey of avifauna on Kenilworth Racecourse conducted over a year. It was not considered feasible to collect comparable data for the present study, a possible limitation in the present survey.

5.4 LIMITATIONS OF CHECKLISTS AS INDICATORS OF ENVIRONMENTAL CHANGE

Although the checklist is obviously of use in assessing species lost from an area over time and for providing guidelines to reserve managers, certain limitations need to be recognised:

1) Information on genetic and demographic requirements of species acquired by autecological studies is also necessary if the evolutionary implications of management decisions is to be assessed (see Chapter 4).

2) Unless highly area-specific, checklists will not identify localised habitat destruction.

3) Careful selection and justification of species attributes that are investigated as indicators of habitat change are necessary. Important trends in habitat degradation might otherwise be overlooked.

4) The possibility that species may become extinct from a locality for reasons other than change in habitat, including factors such as disease, competition and predation (Cairns, 1980) needs to be considered.

5) Checklists probably have reduced significance for highly mobile species such as avifauna. It is possible that regional fluctuations in bird species composition may account for the trends on Kenilworth Racecourse between 1950 and the present, and not necessarily just habitat change on Kenilworth Racecourse. This possibility was not explored here.

5.5 CONCLUSIONS

The natural habitat of Kenilworth Racecourse has remained unexpectedly intact considering its small size, isolation and setting in the urban environment. Although the area has suffered a certain degree of disturbance, it acts as the refuge for at least 200 indigenous plant species, 48 bird species and 11 amphibians, as well as several small mammal and reptilian species. The invertebrate fauna, not assessed in this study, is also likely to be species rich. Several of these species have been accorded Red Data Status.

A random sample of plant species previously occurring indicates that a maximum of 43.2% have become locally extinct from Kenilworth Racecourse in recent decades. Whilst this may be an overestimate for several reasons presented in this chapter, it can be concluded that absence of fire has been a major cause of species loss. Attributes of species lost indicated that they were species disadvantaged by a longer fire cycle. Habitat destruction is also likely to have been an important cause of species extinction, but this cannot be conclusively shown in this study. The analysis of bird species turnover indicates that the habitat is serving an important function as a 'refuge' for many species not apparently adapted to the urban environment *per se*. The area has increased in importance for species preferring an 'aquatic' habitat due to dam construction. However, this needs to be seen as being of secondary importance to the habitat provided by the fynbos and natural wetlands because water bodies are relatively plentiful within urban Cape Town.

A fire management programme of variable frequency that emulates the natural fire regime as closely as possible is required to reverse plant species loss and to maintain the conservation importance of the area. This should be combined with a strategy to halt the prevailing environmental degradation both inside and outside the system. The following chapter presents such recommendations. Although autecological investigations were not undertaken in this study, ways of achieving greater population size and improved gene-flow patterns are explored at the community level in Chapter 6.

CHAPTER SIX

DISCUSSION

6.1 INTRODUCTION

The processes contributing to the present status of Sand Plain Fynbos in the southern suburbs are summarised and justification for concentrating conservation initiative on Kenilworth Racecourse is given. After the need for conservation management is established, the approach required for successfully involving the landowner in the conservation process is established. Background to the recommendations provided in the Management Plan is given and requirements for long term conservation of Kenilworth Racecourse are then investigated. Finally, the importance of conservation on private land in the broader South African context is discussed.

6.2 THE STUDY SITE AND ITS CONTEXT IN THE SOUTHERN SUBURBS

Kenilworth Racecourse, Rondebosch Common, Youngsfield and Meadowridge are amongst the last remaining islands of Sand Plain Fynbos in the southern suburbs [Figure 2 (p. 3)]. Their isolation from neighbouring natural habitat was largely complete by the first half of this century. The isolation process comprised a gradual transition from rough grazing during the 19th century followed by a period of patch cultivation, until peri-urban development occurred in the early part of the 20th century (Chapter 3). Urbanisation was initiated on the western extremity of the Cape Flats and extended eastwards on to the Cape Flats. An additional factor causing Sand Plain Fynbos destruction during this phase was the spread of woody alien species (Shaughnessy, 1980b). These processes effectively eliminated all but a few remnants of the veld type. Various islands which had escaped destruction were eliminated more recently (Chapter 3). Of the remaining islands in the Southern Suburbs, Kenilworth Racecourse and Youngsfield are in close proximity, separated by approximately 100 metres of field and road [Figure 2 (p. 3)]. Rondebosch Common is situated approximately five kilometres to the north of Kenilworth Racecourse [Figure 2 (p. 3)].

6.3 JUSTIFYING THE CONSERVATION INITIATIVE AT KENILWORTH RACECOURSE

6.3.1 Rarity Factor

Concerning the concept of species and habitat rarity, Margules (1986) is of the opinion that incidence of rare species adds conservation value to a site because of their intrinsic value. From this point of view, denying the importance of rarity ignores the human value that is attached to conservation, namely the 'caretaker attitude' (Margules, 1986).

On the basis of rarity of habitat and species, the selection of Kenilworth Racecourse as a conservation area of primary importance within Sand Plain Fynbos and the Fynbos Biome is entirely justified. This is based on:

1) the extent to which the Sand Plain Fynbos has dwindled and become degraded on the Cape Flats (McDowell *et al.*, 1990) (Chapter 2). Only 0.05% of its original extent survives as reasonably high conservation quality habitat. Of this already small figure, a mere 3.5% is currently conserved in proclaimed nature reserves. This clearly identifies Sand Plain Fynbos as an extremely poorly conserved veld type (McDowell *et al.*, 1990). By contrast, Strandveld on the Cape Flats is relatively well conserved, with approximately 2000 hectares falling into proclaimed reserves. The importance of the three racecourses on the Cape Flats to conservation of Sand Plain Fynbos is emphasised in Chapter 2, where it is observed that they comprise the largest proportion (28%) of the Sand Plain Fynbos not currently falling in proclaimed reserves (McDowell *et al.*, 1990).

   The poor conservation status of wetlands on the Cape Flats has also been highlighted (Day & King, 1980; Hall & Manchip, 1981; McDowell *et al.*, 1990) (Chapter 2). Existing wetlands have suffered the side-effects of urban expansion, including pollution, canalisation and other forms of degradation. The seasonal wetland habitat has consequently become the scarcest habitat type on the Cape Flats (McDowell *et al.*, 1990). In contrast to the generally low quality of other seasonal wetlands of the Cape Flats, Silberbauer & King (1990) find that Kenilworth Racecourse has exceptionally high water quality, ranking with just one other wetland in the south western Cape as the most pristine included in their extensive study.

2) the concentration of threatened flora in Sand Plain Fynbos (McDowell *et al*, 1990) (Chapter 5). In a recent study of remnants on the Cape Flats, Kenilworth Racecourse was found to support 18 floral and three resident faunal Red Data species [Table 11 (p. 63)], providing further justification for its selection as an area of the highest conservation priority. Scott *et al* (1987) advocate focusing conservation attention on species-rich areas so as to offer:

> "the most efficient and cost-effective way to retain maximal biological diversity in minimal area ... Given the inevitability of further habitat loss, this strategy may be the only way to resolve conflicts between development and the preservation of genetic and species diversity" (cited in Siegfried, 1989, p 200).

Kenilworth Racecourse undoubtedly fulfills the role of an area extremely rich in species.

6.3.2. Historical Value

Sand Plain Fynbos represents the natural habitat present prior to agricultural and urban development in the Southern Suburbs and elsewhere on the Cape Flats. The extent to which Sand Plain Fynbos has been destroyed and hence the rarity of surviving habitat emphasises the value of Kenilworth Racecourse in this regard.

6.3.3 Scientific Value

Of necessity, conservation is becoming oriented toward the conservation of island remnants due to extensive destruction of habitat (see Saunders *et al.*, 1987 for the Australian experience of remnant conservation in the wheatbelt of Western Australia). Kenilworth Racecourse provides a useful case study for assessment of the effects of insularisation on species diversity, because of the relatively complete records for past species incidence in the area (Adamson & Salter, 1950). Such records are rare in the Fynbos Biome (Chapter 5).

6.3.4 Recreational and Aesthetic Value

Since Kenilworth Racecourse is privately owned, the onus is on the SATC to admit visitors to the area. The SATC have opposed visits to the area by individuals undertaking activities such as jogging and walking because damage to the turf is an ongoing source of concern. They do not, however, oppose activities that involve the natural area on the Racecourse in-field. No official policy which defines types of activity allowed has been stated except that prior permission from the Grounds Manager needs to be obtained for entering. A number of recreational activities have been allowed which are to some extent enhanced by the natural quality of the area. Cross-country horse-eventing takes place in the natural remnants on several occasions each year. An area which is suitably 'wild' and which includes the presence of waterbodies enhances this type of activity. The local organisations which are involved with such eventing have experienced difficulty in finding other venues for the activity. A further indication of importance attached to the area comes from the frequent requests that are received by the SATC for people to use the area for purposes specifically relating to the natural quality of the area, for example bird watching (V. Norton, pers. comm).

Negative public response to a proposal to develop a manicured park on Rondebosch Common was published in the form of a letter to a local newspaper (*Cape Times*, 31 May, 1990). Numerous letters received in reply indicated strong objection to the proposal; the response indicated that members of the public attach high value to open space carrying natural vegetation in the urban environment.

6.3.5 Educational Value

McDowell & Low (1990) highlight the educational importance of conserved areas on the Cape Flats. Monospecific stands of Port Jackson which cover most undeveloped areas of the Cape Flats do not have the same educational potential (McDowell & Low, 1986). The value of Kenilworth Racecourse as a natural resource is much enhanced by its convenient locality in close proximity to schools. The SATC are not averse to scholars visiting the area, provided that adequate notice is given and that the scholars are under supervision. Several visits have already been arranged for scholars as well as university students.

6.3.6 Multiple Land Use

A justifiable argument against 'greening' efforts in Greater Cape Town, notably the Greening the City Project, has been that financial resources expended on the project "could be better spent on housing than trees" (cited in Low, 1987). The Racecourse clearly cannot be developed for purposes such as housing, as this would conflict with the present land use. Furthermore, the costs of undertaking conservation management of the area are envisaged as minimal. It can thus be argued that conservation of the area is an acceptable alternative to development.

6.3.7 Future Security of the Area

Kenilworth Racecourse is *de facto* fortuitously conserved because of the compatibility of its land use with conservation (Chapter 3). Its conservation is, furthermore, assured in the future, the main proviso being that the management retain their positive attitude towards conserving the area. The following factors lend the area a certain degree of immunity from destruction:

1) There are some economic advantages to conserving the in-field in its present state. The fynbos is low-growing and requires little maintenance, apart from the organisation of localised burns over varied time intervals approximately ranging from fifteen to forty years (Appendix 1). Although ongoing removal of alien vegetation is required, periodic removal avoids the buildup of dense stands. The alternative of having manicured gardens and lawns in the centre of the Racecourse would require constant maintenance. Poynton & Roberts (1985) indicate the combined value of relatively low-cost maintenance of natural vegetation with high inherent aesthetic value. They cite Kelcey (1978) who proposed a 'quasi-natural environment' in place of 'costly, highly artificial, formal and over-managed landscapes'. Poynton & Roberts (1985) endorse this view for Cape Town in particular because of its value as a "uniquely important natural region" (p 20).

2) Kenilworth Racecourse is zoned as private open space. As such, no buildings may be erected except for the purposes of providing benefits to the predominant land use of the site (Zoning Scheme for the Municipality of Cape Town, 1990), that is, for horse-racing. The SATC does not envisage the building of any structures on the centre of the Racecourse, as this will obstruct the field of view. Furthermore, any change in land use, including, for example, the creation of other types of sporting facilities, requires an application for rezoning to the Cape Town City Council (CCC). The area is thus, to a large extent, conserved at the discretion of the CCC, albeit as an informal, unproclaimed natural refuge.

3) The land may not be alienated because it has been granted in perpetuity to the SATC (1882 Title Deed). Furthermore, a precedent may have been set disallowing the leasing of SATC land at Kenilworth Racecourse, when a court ruling prevented the lease of land to a retail company for the purposes of parking (V. Norton, pers. comm.).

4) The land use of the area may not change from horse-racing, according to the Title Deed, and to date this activity has proven compatible with conservation.

5) It is unlikely that insufficient finance will cause the closure of Kenilworth Racecourse. According to the Milnerton Racecourse Manager, only two racecourses, situated in Bloemfontein and Windhoek respectively, closed down in recent years because they had become financially non-viable. This can be accounted for by the fact that they were situated in small centres (R. Louw, pers. comm.). The importance of the particular circumstances that have prevailed at Kenilworth Racecourse are highlighted by reference to other racecourses in South Africa. The other racecourses in Greater Cape Town, namely Durbanville and Milnerton, still support high quality natural vegetation on the largest proportion of their in-field land. Both of these racecourses have converted a portion of their area into sportsfields. A telephonic survey of the land use of in-fields at other Racecourses in South Africa was undertaken. All the other racecourses in the country have had their in-fields completely cleared of natural vegetation. Land uses now include carparks, manicured gardens, sand training tracks, irrigation dams and stabling.

Although it has been shown that the land use is relatively secure at Kenilworth Racecourse, important threats to ongoing conservation of the area exist. These include refuse dumping, dam-construction, drainage and the extension of parking in the racecourse in-field as well as species loss due to disruption of natural patch dynamics normally maintained by fire (Section 7.4). Conservation management of the area is, therefore, still required.

6.4 THE NEED FOR CONSERVATION MANAGEMENT AT KENILWORTH RACECOURSE

6.4.1 Conservation Management Defined

Conservation management consists of those activities undertaken in the belief that they will contribute to the retention of whole or designated biota in a remnant (Main, 1987). This implies that an integral knowledge of the ecology of the species being managed is required for effective conservation management (Saunders & Hopkins, 1987).

6.4.2 The Ecological Consequences of Neglecting Conservation Management at Kenilworth Racecourse

The opportunity for selection of reserves is now limited, particularly in the case of Sand Plain Fynbos, where the remaining areas of conservation value are small. Main (1987) indicates that without conservation management , it is unlikely that nature reserves will survive in the long term. This is particularly important for small reserves: Saunders & Hopkins (1987) hold that more rapid species loss from small reserves than large reserves must be matched by a greater amount of conservation effort.

This has not, however, been the case on Kenilworth Racecourse. The only activity of the SATC which has also incidentally constituted a conservation management practice has been the removal of tall woody alien vegetation, to maintain a field of view for the punters. This is a critically important management activity, as shown by the dense infestation of Port Jackson that has completely eliminated Sand Plain Fynbos in areas where control has not been maintained because field of view is not required. Further than this, essential ecological processes which require conservation management have not been maintained. The lack of adequate conservation management may have been instrumental in the loss of plant species from the area in the past century (Chapter 5). Main (1987) proposes that changed status of species is a good indicator that some of the interactions within the ecosystem have changed and that management action is required.

6.4.3 Identifying Processes Causing Species Loss

There is little doubt that isolation and fragmentation of natural habitat causes extinction of species (Soule, 1987b), but the precise mechanisms whereby this occurs have been the source of debate (Chapter 4). Until these mechanisms are understood, little can be done to counteract the extinction process.

Equilibrium Island Biogeography proposes that a possible cause of observed species loss after fragmentation is reduction in area *per se*. The state of dynamic equilibrium that exists between species number and area is disrupted and the extinction of species continues until a new equilibrium is reached (relaxation). The more isolated the island, the lower will be the new equilibrium number of species (Diamond, 1975). The theory purports to be able to overcome extinction by adequate planning of reserve arrangement and area.

Empirical evidence showing that area is the primary cause of species loss has not been forthcoming and the usefulness of Equilibrium Island Biogeography in explaining species extinction has been called into question (Burgman et *al.*, 1988). The MVP concept has proved to be more useful in explaining extinction processes. It proposes that species loss after fragmentation and isolation is not caused by area reduction, *per se*, but by shrinkage of population sizes to levels below their minimum viable size. Populations need to be sufficiently large to overcome the following threats: deleterious genetic changes caused by processes such as inbreeding, crashes in the population size due to demographic stochasticity and environmental uncertainty. These threats have been discussed in some depth in Chapter 4.

It needs to be asked whether any of the above-mentioned processes can account for species loss on Kenilworth Racecourse (Chapter 5). It is possible that loss in genetic fitness of individuals has occurred in the period since fragmentation and isolation, but no attempt has been made to determine whether this is the case. Loss in genetic fitness due to inbreeding may pose a threat to population survival in the longer term. Despite the high degree of narrow endemism in fynbos plant species, indicating that the species have evolved in small populations, it can be assumed that populations on the Sand Plain Fynbos remnants are far smaller than occurred previously. This assumption is based on the original distribution ranges of the species (see for example descriptions of plant species distribution ranges in Adamson & Salter, 1950).

Demographic stochasticity may have caused species extinctions on Kenilworth Racecourse. Indication of the occurrence of such a process is difficult to ascertain, as it cannot be linked to observable species attributes. Whether or not species extinctions have occurred since isolation due to demographic stochasticity, it is likely that this will occur in the long term. As was recognised by Ewens *et al.* (1987), small populations are particularly susceptible to this threat.

Absence of fire for an extended period, as has occurred on Kenilworth Racecourse, is an important environmental threat in fynbos environments (Bond *et al.*,1988). Considerable attention was paid to this, one of the most plausible explanations for observed species loss from the study area (Chapter 5). It was indicated that species which are fire-dependent, including resprouting species, geophytes and species which are small in size are conspicuously absent from the area, in comparison to their presence earlier this century. Similarly, Bond *et al.* (1988) found that in islands of fynbos surrounded by fire-resistant Afromontane Forest in the southern Cape, absence of fire is the main cause of absence of certain suites of species from islands. In the longer term, ongoing threats are posed by events such as storms sufficiently large to destroy entire populations.

Boundary size is a further threat to the viability of small reserves in that their proportionately longer boundary length results in increased vulnerability to alien invasion (Chapter 4), disease and other forms of deleterious disturbance. The fragmented nature of the Racecourse due to the presence of race tracks [Figure 4 (p. 14)] has rendered the area particularly vulnerable to alien invasion, the threat being heightened by its urban setting.

Direct impacts caused by the requirements of the SATC have resulted in degradation of the natural remnants on Kenilworth Racecourse. These processes include topsoil removal for upgrading of the track, dumping of refuse and the removal of indigenous vegetation which is obstructing the field of view, the creation of in-field parking and the construction of dams (Chapter 3). Species extinction from Kenilworth Racecourse has undoubtedly been increased by these processes. Exactly which species have been lost from the area as a result of these impacts cannot be ascertained because records of past species occurrence in precise localities within the Racecourse do not exist (Chapter 5).

6.5 A CONSERVATION MANAGEMENT PLAN AS A MEANS TO COUNTERACTING DEGRADATION

The trends and threats outlined above imply that there is a need for comprehensive management of remnants on Kenilworth Racecourse. A Conservation Management Plan was commissioned by the Cape Town City Council (CCC). The Plan also fell under the auspices of the Conservation Priority Survey of the Cape Flats (McDowell & Low, 1990). The draft of the Management Plan, drawn up the author of this research report, is presented in Appendix 1. A previous city-wide move to promote the creation of 'green lung' spaces in urban Cape Town (the 'Greening the City' campaign, Anon., 1982), had failed to achieve the conservation of the Sand Plain Fynbos and wetlands at Kenilworth Racecourse. The Campaign had partly aimed to link areas of ecological importance such as vleis and wetlands with green belts. Within this concept, the Kenilworth Racecourse natural remnant was linked with undeveloped potential corridors located to the south. Although there appeared to be initial enthusiasm for the scheme in Metropolitan Cape Town, follow-up was daunted largely because of what was perceived to be exorbitant cost of the project (McDowell *et al.*, 1990). Failure to consult with members of the public (Low, 1987) and to conduct ongoing consultation with landowners (as found during this study) also detracted from the success of the scheme. The Management Plan produced during this study aimed to overcome these problems.

6.5.1 Management Objectives for Kenilworth Racecourse

The brief provided by the CCC formed the basis for the Conservation Management Plan Objectives. These were the following:

a) Maintenance of species diversity

In the statement of objectives of the Management Plan provided to the SATC Management, the first objective was to "ensure the long term conservation of the unique fynbos of Kenilworth Racecourse" (Appendix 1). For the purposes of the document provided to the 'lay conservationist' Management, this level of explanation was sufficient, but more specifically, the Management Plan centred on the ideal of conserving species diversity as a whole.

The ideal conservation goal for a reserve is to contain representative populations of faunal and floral species originally occurring in the region. In reality, many conservation areas are too small, fragmented and dispersed to achieve this ideal (Hopkins & Saunders, 1987). The severely fragmented nature of the remnants of Sand Plain Fynbos presents a similar situation. The inability to be representative of species previously occurring in the vicinity is heightened by the high spatial turnover of plant species. What can be hoped for is the conservation of the species and propagules of species already present in the reserve. For the majority of reserves, the objective is to "conserve as far as possible the complete array of organisms present in the reserve" (Hopkins & Saunders, 1987). This is especially important for small reserves experiencing perturbation, because diversity is an important component of resilience (Main, 1987). This is the major goal of the Management Plan produced for Kenilworth Racecourse. An additional goal is to reintroduce species extinct from the area.

It is difficult to assess the time scale over which management will successfully maintain the viability of the reserve. Conservation in perpetuity is possibly an unrealistic expectation for a reserve of small size. Without management, Kenilworth Racecourse would undoubtedly experience increasing species loss, such that the majority of the species would become extinct. The large percentage loss of floral species from the Racecourse during the past 50 years, a period over which little conservation management was applied to the area, has been documented in Chapter 5.

b) Co-operation with the landowner

The second objective of the Management Plan was to "ensure that the activities and requirements of the South African Turf Club (SATC) are complemented by conservation efforts" (Appendix 1). The SATC are under no legal obligation to conserve the Sand Plain Fynbos fragments at Kenilworth Racecourse and as such, conservation of the area is dependent on their goodwill. The conservation management practices cannot interfere (or need to do so as little as possible) with the operations of the SATC and where possible, should "benefit the operation of the SATC" [third objective stated in the Conservation Management Plan (Appendix 1)].

A prior initiative to implement conservation management for the area (the "Greening the City", Anon., 1982 campaign cited above), failed partially as a result of inadequate co-operation with the Management of the SATC. In addition, a botanical survey undertaken several years ago aimed to provide conservation management guidelines for Kenilworth Racecourse (Boshoff, 1985). Although the comments and proposals presented in the survey report appeared reasonable, no evidence of practical implementation nor interaction with the Racecourse management has been apparent.

In consideration of the hopelessly inadequate sample of Sand Plain Fynbos in public conservation lands, sole reliance must be placed on the conservation of privately owned areas of Sand Plain Fynbos, notably the three racecourses occurring in the area (Chapter 2). This serves to emphasise the importance of consultation with the landowner if conservation aims are to be achieved on privately owned land.

c) Conservation of the surrounding areas

The fourth objective of the Management Plan was to "ensure that adjacent areas (belonging the CCC) with conservation potential are conserved". A survey of the immediately adjacent area did not reveal remnants of immediate conservation importance. Nevertheless, recommendations were provided to the CCC to ensure that activities carried out on the surrounding land do not interfere with the conservation quality of the natural remnants within the grounds of the SATC.

6.5.2 Development of the Management Plan in this Study

The three decision-makers in the SATC who control activities within the area of interest in the SATC grounds were identified at the outset of the study and three combined as well as two individual interviews were arranged. The interviews were designed to meet the following objectives:

a) to assess attitudes of the Management towards, and reservations about, conserving the remnants;
b) to identify purposes for which the SATC requires the areas carrying natural vegetation, and
c) to identify those activities carried out which are detrimental to the conservation value of the area.

6.5.3 Attitudes Towards Conserving the Area

Reservations were expressed by the Management about possible negative publicity that could result if the needs of the SATC were to conflict with conservation aims.

Negative experience with over-zealous conservationists had caused some caution about allowing the production of a Conservation Management Plan, but initial reservations gave way to a positive response when the objectives of this study were clarified. One prominent member of the SATC commented that "we are happy to say that we have got it [the natural remnants on the Kenilworth Racecourse], we want to keep it and do our bit for it". It was added that "The centre of the Racecourse has been preserved by the goodwill of the Turf Club [SATC]" (Minutes of meeting held on 7.9.88).

6.5.4 Management Plan Development

Repeated meetings were held between the SATC, the CCC and conservationists, including the author. Issues addressed in the draft of the Plan were discussed, and participants were invited to provide comments. At the request of the SATC, the report was written in layperson's language. Furthermore, the SATC and the CCC stipulated that the report be short. It was indicated that a longer report would not be consulted by the SATC Management.

6.5.5 Recommendations for Counteracting Ecological Processes Causing Species Loss

The present plant community structure of Kenilworth Racecourse indicates that a fire management strategy is required. As proposed by Kruger (1983), an organised burning programme is an integral part of conservation management in fynbos ecosystems. A fire management strategy to counteract the process of loss of plant species favoured by a shorter fire interval was included in the Conservation Management Plan (Appendix 1). It was proposed that an initial test area of about 0.5 hectares should be burnt. In order to minimise the risk of invasion by weeds, it was proposed that the burn should take place in a high conservation quality area. The recommendation is that pre- and post-fire regeneration monitoring be carried out for several years before a large-scale burning programme is implemented. This would preempt possible negative effects on species abundance and composition due to an absence of propagules. This possibility needs to be borne in mind considering the long period that the area has been fire-free. It is also advisable that relatively small areas be burnt, firstly, so as to ensure ease of control of the fire, secondly, to enhance the positive benefits of patchiness on vegetation community structure and thirdly to favour the survival of faunal species. Season of burn is important because it significantly affects fire intensity. Late summer or autumn burns have generally been found to be the most favourable, since plants are then in a period of dormancy (Kruger, 1984). Furthermore, avifaunal breeding season tends to be predominantly during spring, thus obviously being favoured by summer or autumn burns (Maclean, 1984).

The importance of ongoing woody alien vegetation removal was emphasised in the Management Plan (Appendix 1). The preferred method of removal is by mechanical means, but for many of the species this is not possible. The alternative method of removal proposed, is that of careful application of herbicides as recommended by a leading horticultural firm for the removal of the alien species (Appendices 2 and 3). The herbicides recommended have proven low soil residue and mammalian toxicity (Hendry, pers. comm.). Difficulties may be encountered in the near future when legislation is promulgated requiring that users of herbicides should undergo a stringent learning programme at a Pretoria institute. This may prove to be impractical for the SATC Management.

Reintroductions of species might form a further means of offsetting threats associated with small population size as well as replacing species which have become extinct. Two plant species, namely *Erica turgida* and *E. verticillata*, are locally extinct from Kenilworth Racecourse and throughout their previous distribution range. Reintroduction of cultivated adult plants of these species was undertaken at Kenilworth Racecourse during this study. Success in the venture was thwarted by a particularly dry summer which killed the plants. Repeated efforts to reintroduce plants are to be carried out.

6.5.5 Counteracting Area and Species Loss due to Requirements of the SATC

It is essential that a field of view be maintained across the in-field for the race-goers . A suggestion was put forward by the SATC that, in order to control natural vegetation which was obstructing the 'field of view' for the punters, brushcutting to about 30cm in height should be carried out. However, as was pointed out to them, brushcutting has been shown to detrimentally affect species diversity in both fynbos (Parisi, 1985) and 'kwongan', an analogue of fynbos occurring in western Australia (Griffin & Hopkins, 1981). In each of the above studies, it was found that woody obligate reseeders were particularly detrimentally affected in the post-harvest period. Mortality directly due to harvesting is a further important negative impact resulting from brushcutting (Griffin & Hopkins, 1981).

In a trigonometric survey conducted during this study, it was found that taaibos (*Rhus laevigata*) is an indigenous species which obstructs the field of view in certain areas. It is recommended in the Management Plan (Chapter 6) that this species can be periodically cut to a height of approximately 30 cm without damage to the plant, since it is a resprouting species. The Management of the Racecourse had planned to brushcut vegetation on the eastern wall of the in-field dam. The trigonometrical survey revealed that the height of the wall itself was, in fact, the cause of the obstruction in view, indicating that brushcutting in this area would be superfluous.

Surplus clay material derived from the granites underlying the Kenilworth Racecourse, excavated during dam construction in the 1960's and 1970's, was dispersed on the ground surface to a depth of a 0.5m in places. Since the granitic sub-soil characteristics differ markedly from the aeolian acidic sandy soil, the natural surface material on Kenilworth Racecourse, the suite of species differs markedly in this area. In the Management Plan it is proposed that this surface material should be removed to expose the natural acidic sandy soil surface and Sand Plain Fynbos should be reintroduced. Extensive areas of topsoil and sandy subsoil have also been mined in recent years by the SATC for use as topdressing on the racing tracks. Unfortunately, this has irreparably altered the soil structure for the growth of Sand Plain Fynbos. The CCC have undertaken to provide suitable soil material, should the need arise, to upgrade the tracks in the future.

The creation of in-field parking has resulted in the destruction of 3.4 hectares of fynbos within the past decade [Figure 4 (p. 14)]. Prior to this, no parking was provided in the in-field. The parking is comprised of grass (primarily kikuyu (*Pennisetum clandestinum*) and kweek (*Cynodon dactylon*) which naturally forms a ground cover once the indigenous vegetation is mowed. Since no planting or fertilising has been undertaken, it was proposed to the SATC that these areas be reclaimed as natural vegetation if land could be obtained elsewhere. This proposal was not agreed to by the SATC and the in-field parking is to remain ***in situ***. Nevertheless. the SATC did agree that the infield parking would extend no further than is shown in Figure 4 (p. 14). Various alternatives for future increased parking requirements were explored. The expropriation of abandoned cemeteries located adjacent to the SATC grounds in Wetton Road [Figure 4 (p. 14)] was investigated, but the cost of the land is prohibitive and furthermore, great difficulties would be experienced in gaining the necessary permission to exhume the graves. A more workable solution could involve a land exchange between the CCC and the SATC.

Periodic flooding of the SATC grounds during winter months represents an indirect threat to the future survival of the natural wetland system. The loss in revenue through cancellation of races caused by flooding may provide an important incentive for the Management to further drain the in-field system. However, the Management have given their verbal assurance that such further drainage will not be contemplated.

By contrast, the summer months, are frequently associated with periods of drought. Irrigation dams were constructed to redress the problem of water shortage for track irrigation. This has caused considerable reduction in the area of the natural system. The SATC have undertaken to build any further dams that may be required for irrigation in the disturbed area at the eastern extremity of the Racecourse, outside of the main tracks [Figure 4 (p. 14)].

The destruction of the natural habitat due to the creation of in-field grassed-over parking, topsoil removal and dam construction (Chapter 3) probably all have contributed directly, or at least indirectly, to observed reduction in biotic diversity (Chapter 5). Management cannot rectify the impact that much of these areas have suffered, either because the SATC Management wishes to retain the land use (as in the case of the in-field parking) or else the veld has been virtually irreparably damaged (for example, areas where topsoil has been removed). Certain parts have been highlighted where reclamation is feasible and where this has been agreed to by the SATC Management [Figure 4 (p. 14)]. Surrounding the two dams outside the main track on the eastern extremity of the grounds, Port Jackson has formed dense monospecific and uncontrolled thickets. It is considered that this portion of the Racecourse is beyond the stage where it can be restored to a state of conservation value and a recommendation is therefore included in the Management Plan to the effect that it would be appropriate to use as a dumping area.

6.5.6 The Success of the Management Plan

An attempt has been made to develop a successful Conservation Management Plan by incorporating the needs and interests of the SATC (the landowner). It is as yet too soon to judge the chances of the long term implementation of the Plan. Destruction of an area of fynbos (for the underlying topsoil) by the Management took place when discussions concerning the conservation of the area were already well advanced. These circumstances brought into question the commitment of the

Management to conserving the natural remnants. The CCC was in a position to provide the material required (J. Thornton, pers. comm.). However, it was decided that a breakdown in communication had caused the incident. In order to overcome further such problems, names and addresses of relevant experts were included in the Plan, to be consulted should action need to be taken by the SATC in the areas of conservation value.

Initial positive outcome from the process of developing the Plan can be noted:

1) It has been an informative process for the SATC management.
2) By having requirements of the Management incorporated into the Plan, it has hopefully been a positive conservation experience for them.
3) Public awareness of and interest in the area has been heightened by the publication of popular articles (McDowell, 1989a; McDowell, 1989b) and the press (*Cape Argus* 7/9/88; 9/9/88).

6.6 CONSERVATION IN THE LONG TERM

The long term conservation of Kenilworth Racecourse is dependent primarily on the goodwill of the SATC. It will also require ongoing input from conservationists who would be prepared and able to monitor the need for management practices. The most important of these practices is to monitor the implementation of a burn programme designed to maintain maximum species diversity. The proposal that a 'Friends of the Kenilworth Racecourse' group be established (under the auspices of a programme run by the Wildlife Society of Southern Africa, termed the 'Friends of the Nature Reserves') was found to be unacceptable by the SATC. Although the group would act largely in an advisory capacity to the SATC as well as being able to provide personnel where required, it was felt by the SATC that such a structured advisory body might restrict their freedom of action. At the same time, fear of possible negative publicity has become apparent. An acceptable compromise has yet to be achieved at the time of writing.

Overcoming deleterious genetic change, as well as demographic and environmental uncertainty is also of crucial significance to the long term conservation of Kenilworth Racecourse. Knowledge of minimum viable population sizes in order to overcome these threats is rudimentary within the fynbos biome. For example, little is understood of the distance over which gene transfer occurs. In this sense, it is unknown how genetically isolated the plant populations on Kenilworth Racecourse are from their neighbouring remnants. Youngsfield, situated in close proximity to the Racecourse, is likely to present some opportunities for gene transfer. However, the species still surviving tend to be persisters and only 23 of the 30 species now known to be present co-occur on Kenilworth Racecourse [Table 3 (p. 30)]. Rondebosch Common would be a more important source of gene transfer, but unfortunately is probably too far from the Racecourse. Furthermore, the possibility of a natural corridor linkage with the Racecourse does not appear to be feasible because no suitable habitat is available for such a feature [Figure 3 (p. 4)].

The Cape Peninsula Mountain Chain is relatively closely situated to the west of Kenilworth Racecourse, but its value as a source of gene interchange for plant species is reduced as the suite of species is fundamentally different (Adamson & Salter, 1950). This difference stems from the difference in substrate, Sand Plain Fynbos occurring on aeolian acid sands, whereas Mountain Fynbos exists on acid sands derived from Table Mountain Sandstone, weathered *in situ*.

McDowell *et al.* (1990) present a system of restored corridor networks aimed at facilitating the ongoing conservation of natural remnants on the Cape Flats. A finding of their study was that extensive strips of land remain undeveloped, these having potential to be developed into corridors. The possibility might exist for a corridor system linking Kenilworth Racecourse with Youngsfield and other Sand Plain Fynbose remnants to the south of Kenilworth Racecourse. The wide verges alongside the Kromboom Freeway were included identified as potential corridors, as proposed in the 'Greening the City' report (Anon., 1982).

On theoretical grounds, the creation of corridor networks has been strongly promoted (Main, 1987; Saunders et al., 1987). However, the value of corridors to increasing conservation potential has not been empirically established. Although it has been proposed that they form conduits for faunal migration in the short term, and migratory paths of floral species in the long term (McDowell *et al.*, 1990), more empirical data are required to verify that corridors might serve the role they have been purported to perform.

6.7 CONSERVATION ON PRIVATE LAND - ITS BROADER IMPLICATIONS

As with Kenilworth Racecourse, the long term prospect of conservation on all privately owned natural remnants in South Africa rests with the goodwill of the landowner. This is partially a consequence of the dearth of legislation in South Africa protecting natural habitat. Certain species do enjoy a level of statutory protection by the Nature and Environmental Ordinance No. 19 of 1974, Cape Province [see for example, the status accorded to several of the species on Kenilworth Racecourse (Table 12 p. 65)]. Notwithstanding the statutory protection provided by the conservation Ordinance (*ibid*), private landowners have a high degree of indemnity from restrictions with respect to species occurring on their own property. For example, it is permissible for the landowner to harvest flora deemed endangered by the Ordinance, even though this is the highest conservation status that is awarded. Endangered fauna may be destroyed by a landowner in the course of normal duties.

It is likely that in most cases where natural habitat has been retained on private land, this has been as an incidental consequence of a relatively low-impact land use practice. As shown in the present study, this is the case with the three racecourses which still support Sand Plain Fynbos on the Cape Flats. However, a special set of circumstances surrounds the latter cases, firstly, in that it is advantageous for the landowners to retain Sand Plain Fynbos because of its low-growing habit and secondly, such ground cover is relatively low maintenance in comparison to a manicured park. It is probable that the present land use of these areas will be retained, given the present success of the horse-racing industry. This fortuitous factor lends a certain degree of long term security to the natural remnants they support.

The majority of privately owned natural remnants are unlikely to be assured the same level of *de facto* conservation security. Such remnants are more likely to suffer impact in the long term as a result of change to a higher impact land use following change of landowner or the decision by the existing landowner to alter land use. This serves to emphasise the importance of developing positive relationships between the private landowner and conservationists. This should involve an intensified educational effort aimed at the general public and the owner of natural habitat in particular. However, in order to achieve success in influencing the private landowner, an approach needs to be adopted where compromise can be reached between the requirements of the conservationist and the landowner, without jeopardising the position of either party. From this point of view, the conservation approach adopted in this report has wider applications than merely for the racecourses supporting natural remnants on the Cape Flats. By means of positive interaction with the landowner, a rapport can be built up, through which the landowner may develop a degree of moral obligation to conserve the natural habitat on the property.

As indicated by a review of the literature (Chapter 4) and the Kenilworth Racecourse case study (Chapter 5), monitoring, combined with active conservation management, are crucial to the long term survival of small and isolated remnants. The establishment of 'Friends' groups through the Wildlife Society of Southern Africa, to date only existing for proclaimed nature reserves, has important potential as a cost-effective means of achieving conservation management.

CHAPTER 7

CONCLUSIONS

There is clearly a need to intensify conservation efforts in the face of the rapidity with which natural habitats are being diminished. This is particularly true for Sand Plain Fynbos, a veld type that has become severely depleted throughout its distribution on the west coast lowlands of the south western Cape. Kenilworth Racecourse has been shown to be an important refuge for Sand Plain Fynbos.

The following conclusions to the objectives as enumerated within Chapter 1 (Introduction) can be drawn:

1) Agriculture during the 19th century and urban development during the 20th century have been highlighted as the major factors instrumental in the destruction of Sand Plain Fynbos (Chapter 3), destroying more than 99% of the previous extent of this veld type on the Cape Flats.

2) These destructive influences were avoided, albeit incidentally, by certain low-impact land uses, for example racecourses and certain public open spaces, established before the destruction of the natural habitat. The three racecourses of the Cape Flats, all within the Sand Plain Fynbos, have demonstrated some compatibility with *de facto* conservation, in that they all support a significant proportion of natural vegetation. The requirement by race punters for a clear field of view is catered for by the low-growing tendency of Sand Plain Fynbos. This factor, in combination with the relative security offered by the horse-racing land use and the restrictive conditions under which the land was granted, imply a strengthened prospect for conservation of Kenilworth Racecourse in comparison to other land uses carrying natural habitats. Public open space, for example, may be rezoned for residential development. The conservation of the area is dependent on the continued existence of the Racecourse. If the current land use of Kenilworth Racecourse should change, it is unlikely that the conservation merit of the area would save it from high impact land development. Given the present economic success of horse racing at the present site, such a change in land use is fortunately improbable.

3) A review of the literature concerning the survival of insularised natural systems indicates that severe threats are posed to the long term survival of remnants such as the study site. Major threats to remnants habitat include demographic stochasticity, environmental uncertainty and genetic deterioration. For the most part, understanding of these factors within the fynbos biome is still rudimentary.

4) Even if Kenilworth Racecourse remains in the hands of the present landowner, active conservation initiative is necessary to pre-empt present and future threats to conservation. Apart from factors mentioned above, the following have been highlighted as major threats: edge effects, absence of fire from the area for an over-long period and the destruction of habitat due to actions taken by the landowner in the line of duty, have been highlighted as major threats.

5) The need for conservation management is substantiated by the apparent loss of plant species within the past 40 years. This has been addressed by the compilation of a conservation management plan. This plan has attempted to cater for the known ecological requirements of key species in order to at least retain the current diversity. Proposed management strategies include veld burns at appropriate time intervals and season, and alien vegetation control. The establishment of corridors and species reintroduction may offset some of the problems associated with small population size, although to date, a dearth of empirical research exists establishing the values of such measures in the fynbos (McDowell *et al.*, 1990). A further purpose of the Management Plan is to ensure that the activities on the Cape Town City Council-owned land surrounding the study area will not have impact on the natural system at Kenilworth Racecourse. All management proposals encompass the obvious and traditional role of a Conservation Management Plan, namely, to counteract ecological threats to long term survival of natural systems.

Apart from this goal, a more novel approach has been adopted which aims to incorporate the needs and requirements of the landowner. This has been viewed as an essential component for the conservation initiative at Kenilworth Racecourse. This is considered to be the case because long term conservation of the area is totally dependant on the goodwill of the landowners. It was ascertained that the majority of the needs of the South African Turf Club can be addressed in ways favouring the conservation of the in-field.

6) The research findings and approach of this study have direct application to the other Cape Flats racecourses, namely those at Durbanville and Milnerton.

Although these areas are smaller in extent than Kenilworth Racecourse, they also carry good quality Sand Plain Fynbos vegetation, comprising 27% of the veld type not occurring in reserves. These remnants are at present receiving little or no conservation management and are likely to have suffered species and area loss in a manner similar to Kenilworth Racecourse. As with the latter racecourse, they represent potentially secure conservation areas, but require management to halt species loss. The approach adopted in the production of the Management Plan has wider application to the conservation of privately conserved remnants. Positive interaction with the landowner may be the only means available for achieving the conservation of such areas.

Several positive outcomes of the approach adopted for Kenilworth Racecourse are highlighted in the report. It would appear that while still under the same management, the conservation of the area has been assured. This is partly ascribed to positive interaction between the landowner and conservationists. Certain issues, however, remain unresolved. Although positive towards the ongoing input of conservation advice, the Management is hesitant about allowing direct participation by volunteer groups who can undertake monitoring and practical implementation of conservation measures.

The Racecourse has value, not only as a refuge for a threatened habitat type and the Red Data species it supports, but it also has an important educational and social role to play as near-natural open space in urban Cape Town.

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Appendix 1: A draft of the Conservation Management Plan that was produced for the Kenilworth Racecourse Management.

CONSERVATION MANAGEMENT PLAN FOR KENILWORTH RACECOURSE FYNBOS AND SURROUNDING AREA

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Joint funders: Cape Town City Council
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<u>ACKNOWLEDGEMENTS</u>

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Objectives of the Conservation Management Plan

1. To ensure the long term conservation of the unique fynbos of Kenilworth Racecourse.
2. To ensure that the activities and requirements of the South African Turf Club (SATC) are complemented by conservation efforts.
3. To benefit the operation of the SATC.
4. To ensure that adjacent areas with conservation potential are conserved.

THE SITE

The study area is situated in Kenilworth, bounded by Doncaster, Wetton and Chichester Roads, as well as the M5 highway (refer to MAP 1 [Figure 4 (p. 14) in this report]). SECTION 1 concerns Kenilworth Racecourse, owned by the South African Turf Club (SATC). SECTION 2 covers the area which is presently owned by the Cape Town City Council (CCC).

SECTION 1

KENILWORTH RACECOURSE

1. CONSERVATION VALUE

The high concentration of rare and endangered species and the rarity of the habitat type gives the area its high conservation value. The natural remnants on Kenilworth Racecourse comprise the best example of the vegetation type, Sand Plain Fynbos, which once covered the acid sands area of the Cape Flats. This vegetation type has largely been eliminated by urban and agricultural development, as well as invasive alien vegetation (McDowell, 1989a; 1989b). As the largest stretch of natural vegetation remaining in Cape Town's Southern Suburbs, the Kenilworth Racecourse fynbos remnants have great historic and cultural significance. Apart from conservation *per se*, a further value of such natural habitat is its educational potential, especially due to its setting within a densely populated urban environment (McDowell *et al*, 1990).

A recent water quality study of vleis throughout the south western Cape ranked the largest vlei of Kenilworth Racecourse with another wetland in the south western Cape as being the most pristine of the 27 wetlands surveyed (Silberbauer & King (in prep.) (refer to MAP 1 [Figure 4 (p. 14) in this report]). The main reason for this phenomenon is probably linked to the low level of disturbance and lack of inflow of water-borne pollution into the Kenilworth Racecourse vleis. The water originates largely from natural seepage points on the centre of the Racecourse. These seepage points represent the source of the Kromboom River (now largely canalized).

APPENDICES 1 and 2 [Tables 4 to 9 (pp. 52-59)] list indigenous plant and animal species recorded on Kenilworth Racecourse (see also McDowell *et al*, 1990).

1.1 Categories of Conservation Value Derived from the Survey (refer to MAP 1 [Figure 4 (p. 14) in this report]).

A. **<u>Areas of high conservation priority</u>**

A.1 Areas that are currently in good condition - red.

These areas appear to have suffered relatively minimal anthropogenic impact.

A.2 Areas that require upgrading - pink.

These areas have suffered impacts such as dumping of waste materials and mowing of the vegetation to create parking areas. However, with conservation management, these areas can be restored.

<u>Great caution must be exercised in these highly sensitive zones</u>. PART 3 in SECTION 1 outlines the precautions and procedures that need to be exercised.

B. **Areas of low conservation priority** - green.

These areas have been altered so such an extent that caonservation potential is low.

Except where activities or conditions may affect adjoining high conservation priority areas, **no special precautions need to be exercised in these zones**.

2. CONSERVATION STATUS

Although the SATC has never followed an official conservation policy, it has inadvertently protected much of the natural veld from degradation (McDowell, 1989a; 1989b). The current land use has proven amenable to the conservation of this irreplaceable natural asset ever since the area was proclaimed a racecourse in 1882. The future security of Kenilworth Racecourse as a conservation area depends on the property remaining unaltered by high impact developments.

Several of the plant and animal species present are protected officially by law. APPENDIX 3 [Table 12 (p. 65) in this report] lists these species and the level of protection they have been accorded (Nature and Environmental Conservation Ordinance No. 19 of 1974 - Cape Province).

3. CONSERVATION MANAGEMENT PROPOSALS

3.1 Alien Vegetation

Eradication of alien vegetation within the fynbos of Kenilworth Racecourse is essential. Firstly, this will prevent woody alien species from obscuring the field of view and secondly, the desirable low-growing natural fynbos vegetation will be encouraged. However, **removal of plants by bulldozing or grading is to be avoided** because such action has devastating consequences for the topsoil. It is also ineffective in destroying alien vegetation because these more often than not can resprout (e.g. poplars and gums). In fact, by minimising disturbance of the soil, the area will become far less prone to invasion of woody aliens in the future.

Ideally, the stand of Port Jackson (*Acacia saligna*) and other aliens on the east side of the track bordering on the M5, should also be removed in the longer term.

APPENDIX 4 [Table 10 (p. 62) in this report] lists the alien plant species present on Kenilworth Racecourse.

APPENDIX 5 [Appendix 2 in this report] contains a table of the species (both indigenous and exotic) that represent present or potential problem plants for the Racecourse Management. The recommended methods of control are also presented in this appendix.

APPENDIX 6 [Appendix 3 in this report] gives details of how to make up the solutions of herbicides recommended in APPENDIX 5 [Appendix 2 in this report].

3.2 Management of Natural Vegetation that is either too High or too Old

Taaibos (*Rhus lucida*) plants that have become too tall, thereby blocking the field of view, may be controlled by being cut manually to 30cm (or higher) from ground level.. This is not to be repeated more than once every two years (see APPENDIX 5 [Appendix 2 in this report]). **Bushcutters, bulldozers or graders should not be allowed within any red high priority areas shown in MAP 1 [Figure 4 (p. 14) in this report]. Apart from the use of bulldozers, which should be used only for the special purpose defined under "3.4. Dumping" (paragraph 4), exactly the same precaution applies to the pink high priority areas. In the case of an area of old vegetation (more than 15 years of age) being too high, a controlled fire should be arranged with the co-operation of relevant authorities (see below).**

3.2.1 Burning of the veld

In general, burns during summer at intervals of not less than 15 years are useful for the conservation management of fynbos vegetation. Besides enhancing the quality of the vegetation, this practice will ensure a clearer field of view for the spectators.

However, fynbos on Kenilworth Racecourse has not been burnt for at least 100 years in places. The impact of fire on such old vegetation may be negative. It is therefore suggested that a test burn should be organised in the area marked on the MAP 1 [Figure 4 (p. 14) in this report] which will be followed up with a monitoring programme to last for several years to assess the effects of the fire on the species composition of the area. An ecologist with the CCC may be able to undertake the monitoring.

Veld burns should be undertaken in consultation with the Cape Town City Council and the Chief of Conservation and Forestry (APPENDIX 7 [not included here]). Written permission for managed burns needs to be obtained by the SATC from the Chief of Conservation and Forestry (refer to APPENDIX 7 for contact address [not included in this report]).

The Department of Forestry has the expertise and the personnel to carry out a burning programme. They will levy a fee covering the basic costs of fire management. The final planning of the burning programme should only proceed once the test-burn area has been monitored for period of a couple of years. It is recommended that relatively small units (as demarcated on MAP 1 [Figure 4 (p. 14) in this report]) are burnt at appropriate times, viz. on calm days during autumn, so that fires can be readily controlled. Where absent, fire breaks should be prepared around vital installations, such as the electronic betting board, outbuildings, electric cables on the surface etc. These should be prepared according to guidelines available from the relevant authority (below).

<u>Any queries concerning the necessary permission may be addressed to Mr T. Newby of the Cape Department of Conservation and Forestry</u> (refer to APPENDIX 7 [not included in this report]).

Application has to be made in writing to the Chief of Conservation and Forestry, who will forward the application to the Air Pollution Control Officer at the CCC (Mr Linder).

3.3 Removal of the Natural Sandy Topsoil

Removal or disturbance of the natural topsoil in the pink and red areas should not occur because this prevents re-establishment of good quality natural vegetation. **The CCC has undertaken to provide suitable soil for racetrack dressing etc. whenever the need arises**. Any queries in this regard should be addressed to the Head, Environmental Planning, CCC (refer to APPENDIX 7 [not included in this report]). Appropriate sand is also available within the green area to the east of the tracks (see MAP 1 [Figure 4 (p. 14) in this report]).

In Part 3.4. there is a note on the suggested removal of sub-soil and soil that has been imported into the red and pink areas in the vicinity of the in-field dam.

3.4 Dumping

It is vital that **all non-biodegradable material such as refuse and dumped construction material be removed from the areas marked in red and pink on MAP 1** [Figure 4 (p. 14) in this report].

Whereas it is commendable that the Management have been clearing alien plants in the high priority natural areas (marked red or pink), it has been observed that chopped/ uprooted plants frequently remain lying in the fynbos. It would be advantageous for the Management to discontinue this practice when plants are carrying seed because re-infestation by aliens may result from seeds dropped from the drying branches. It is recommended that **the red and pink areas on MAP 1** [Figure 4 (p. 14) in this report] **be kept free of grass-cuttings and all other organic refuse - including dead alien plants carrying seed.** This refuse should also be dumped in the green areas marked on MAP 1 [Figure 4 (p. 14) in this report].

In order to enhance the aesthetic appeal of the area and to reduce the risk of fire, it is advised that this and other previously **dumped material should be taken to**

allocated dump sites in the green areas on MAP 1 [Figure 4 (p. 14) in this report].

White clay-soil was, unfortunately, spread on the soil surface to a depth greater than 1m in places during the excavation of the in-field dam (refer to MAP 1 [Figure 4 (p. 14) in this report]). It is recommended that such **undesireable surface material should be removed to expose the original sandy topsoil. Fynbos could then be encouraged to recolonize this area.** This would be of benefit to the SATC because the field of view is at present not as clear as it would be at the back section of the track due to the presence of this excavated material. Also demarcated on MAP 1 [Figure 4 (p. 14) in this report] is the area also within the vicinity of the in-field dam where sandy soil not indigenous to the area was spread to a depth of about 0.5m. It is **recommended that this imported sand be removed to expose the original topsoil**.

3.5 Alteration of Drainage

Poor drainage on the Racecourse is an ongoing problem for the SATC, particularly in the winter months. However, **drainage of the naturally boggy conditions should be avoided because it will harm the fynbos irreparably**. Should increased drainage ever become essential, it is advised that the Head of the Environmental Planning Section at the CCC, be consulted in this regard (refer to APPENDIX 7 [not included in this report]).

3.6 Application of Fertilizer to the System

Because fynbos can be seriously harmed by fertilizer, special caution needs to be exercised in order to **prevent any fertilizer used on the track from polluting the natural areas shown in red and pink on MAP 1** [Figure 4 (p. 14) in this report]. Fertilizing of the natural vegetation would encourage the growth of weedy species which would add to the management problem. Spread of fertilizer beyond the tracks would also degrade the high conservation quality of the natural seasonal vleis. For these reasons, it is suggested that **fertilizing of the tracks should be carried out on windless days and be confined strictly to the tracks themselves**.

3.7 Equestrian Eventing off the Main Tracks of the Racecourse

The Western Province Horse Society and the Cape Hunt and Polo Club have increasing difficulty in finding venues of a suitably 'wild' quality for their events. No major damage is expected if the current event schedule continues in the natural areas of Kenilworth Racecourse. Nevertheless, care must be taken in the design and laying out of the horse tracks to retain the desired natural quality of the area. Clearance of natural vegetation should be kept to the minimum in future. Rather than causing disturbance of new areas, the events should be kept, when possible, to the existing paths (see MAP 1 [Figure 4 (p. 14) in this report]). Planting of alien vegetation for jump construction, for example myrtle (*Leptospermum laevigatum*), has been observed. It is suggested that taaibos (*Rhus lucida*), which occurs naturally in the area, be planted instead. Precautions also need to be taken to ensure that the branches of alien plants, used for the construction of jumps, do not carry seeds which may spread the alien infestations. Furthermore, instead of dumping materials used for jump construction in the fynbos, certain areas should be set aside specifically for this purpose in the green areas of MAP 1 [Figure 4 (p. 14) in this report].

3.8 Provision of Parking

Increased parking need for the SATC has resulted in some fynbos within the Racecourse tracks being replaced with cropped grass (see MAP 1 [Figure 4 (p. 14) in this report]). Fortunately, **the SATC Management does not foresee any future extension to the in-field parking**. Parking that has been provided by the CCC alongside Lansdowne Road will offset any future need to extend formal or informal parking within the central "islands" of high quality natural vegetation marked in red or pink inside the Racecourse tracks. The parking that is to be created for the Kenilworth Park development is also to be made available to the SATC for race days requiring extra parking, such as the Metropolitan. It is suggested that additional parking be created on the sand training track alongside Lansdowne Road because this is no longer being used for its original purpose. If necessary, this parking should also be extended as far as possible beyond the south boundary towards the vicinity of the graveyard (Refer to MAP 1 [Figure 4 (p. 14) in this report]).

4. IMPROVEMENT OF CONSERVATION VALUE

4.1 Reintroduction of Key Species

It is recommended that indigenous species, that used to occur in the area and have been eliminated, be reintroduced to the red and pink areas on MAP 1 [Figure 4 (p. 14) in this report]. Species worth consideration include species that are now completely extinct in the wild and other species that were once common within the area but have since disappeared. Appropriate flora for reintroduction, together with a suitable action plan for their reintroduction, could be decided in consultation with experts - such as the 'Friends' group (described below). The possibility of reintroducing indigenous hares to improve the quality of the fynbos should be investigated further by the same group.

4.2 Improvement of Conservation Status

It is **proposed that a voluntary conservation group be established - namely the 'Friends of Kenilworth Racecourse Nature Sanctuary'**. Ideally, this would comprise interested conservationists as well as SATC representatives. The 'Friends of the Nature Reserves' programme is run under the auspices of the Wildlife Society of Southern Africa. The 'Friends' group can take on a coordinating, and if required, an active role in implementing guidelines laid down in this document. This role implies ongoing involvement in the conservation of the area. Such a group would also be available for advice if needed by the Racecourse Management.

Mrs A. Bean may be contacted for further information about the 'Friends of the Nature Reserves' programme (refer to APPENDIX 7 for contact address [not included in this report]). In the interim period before a formal 'Friends' group is established, the **people who can be contacted in connection with queries arising** directly or indirectly affecting conservation management of the area include: **Ms L.B. Brown, Dr C.R. McDowell and** the Head of Environmental Planning at the CCC (Refer to APPENDIX 7 for addresses [not included in this report]).

A successful conservation strategy devised for conservation-worthy private land in South Africa is the **Natural Heritage Site Programme** run by the Southern African Nature Foundation under the auspices of the Department of Environment Affairs (Chief Director, Environmental Conservation) (refer to APPENDIX 7 for address [not included in this report]). The proclamation of the fynbos of Kenilworth Racecourse as a Natural Heritage Site would result in positive publicity for the SATC. Such a gesture would not prevent the SATC from using the land for another purpose at some future time if it had to do so, because a Natural Heritage Site **may be deproclaimed 60 days from prior notice**.

SECTION 2

SURROUNDING AREA OWNED BY THE CAPE TOWN CITY COUNCIL

1. CONSERVATION VALUE

The land owned by the CCC in the study area has been severely disturbed (at best) or degraded (at worst). It is therefore considered to have only limited conservation value in its present state.

Ideally, the creation of a natural 'corridor' should be considered. A corridor consists of a strip of natural vegetation along which fauna and flora may readily migrate. One proposed corridor is to run along the verges of the M5 Freeway to link with areas of conservation potential which include Kenilworth Racecourse, the Royal Cape Golf Course and the Rondevlei Bird Sanctuary (see McDowell *et al.*, 1990). Because re-establishment of fynbos in disturbed areas is poorly researched, it is not considered likely that sufficient expertise exists whereby a roadside reserve could be created within the short- to medium- term. It is felt, therefore that **the area may be developed, with the exception of the pink areas for possible future corridors (MAP 1** [Figure 4 (p. 14) in this report]).

2. PRECAUTIONARY MEASURES

Precautions to be exercised when developing this zone to prevent the fynbos on Kenilworth Racecourse from suffering further impact include the following:

2.1 Alien Vegetation

Where possible, removal of alien vegetation and replacement with plant species indigenous to the area is advised (refer to SECTION 1 "4.1. Reintroduction of Key Species"). It is **recommended that the silver poplars (*Populus canescens*) growing along the M5 be eradicated, particularly along the south-eastern border with the Racecourse** (refer to APPENDICES 5 and 6 [Appendices 2 and 3 in this report] for control measures. This plant is highly invasive - suckering may spread into the indigenous vegetation within the Racecourse grounds.

2.2 Alteration of the Water Table at Kenilworth Racecourse

Caution needs to be exercised to ensure that the water table of the Racecourse is not lowered as this will harm the natural vegetation which is adapted to the boggy conditions. Where possible, drainage of the wetland areas surrounding Kenilworth Racecourse should be avoided.

2.3 Types of Developments

Developments that impinge on the aesthetic quality and outlook from Kenilworth Racecourse should be avoided. This is to maintain as much of its value as an open space as possible. Developments such as playing fields and carparks are felt to be appropriate for the area marked in green (MAP 1 [Figure 4 (p. 14) in this report]).

2.4 Noise Pollution

At present the area experiences a relatively low level of noise pollution. It is desirable that this situation be maintained as far as possible.

3. PARKING

The allocation of land alongside Wetton Road for parking for the SATC by the CCC has contributed to the conservation effort by reducing the need for parking within red and pink high conservation priority areas on MAP 1 [Figure 4 (p. 14) in this report].

ACKNOWLEDGEMENTS

The South African Turf Club has been co-operative in the production of this document and have pledged support for the Conservation Management Plan. The Cape Town City Council and the Southern African Nature Foundation provided joint financial support for the project and have also pledged support for its implementation. The Botanical Society of South Africa and the University of the Western Cape funded a study that resulted in Kenilworth Racecourse becoming a prime focus for conservation on the Cape Flats.

Appendix 2: Problem plant species that pose a threat to other vegetation or to the field of view at Kenilworth Racecourse.

SPECIES	COMMON NAME	THREAT OF SPREADING	SUGGESTED CONTROL MEASURES See Appendix 6 for herbicide recipes	SPECIAL PRECAUTIONS Spraying should not be done on windy days.
GRASSES				
Cortideria selloana	Pampass Grass	Very high	Spray plant with 2% Frenock or with 2% Roundup.	-
Pennisetum clandestinum	Kikuyu	Very high	Spray plant with 2% Roundup.	-
Pennisetum purpureum	Napier Fodder	Very high	Spray plant with 2% Frenock.	-
Sporobolus capensis	-	Spreading on turf	Spray plant with 2% Roundup.	-

SPECIES	COMMON NAME	THREAT OF SPREADING	SUGGESTED CONTROL MEASURES See Appendix 6 for herbicide recipes	SPECIAL PRECAUTIONS Spraying should not be done on windy days.
TREES AND SHRUBS				
Acacia longifolia	Long-leaved Wattle	High	Pull out seedlings by hand. Spray young plants with 0.5% Garlon. Paint 2% Garlon and diesel mix in 1/2m wide band (10 cm above ground) around stem of older plants.	Repeated applications may be necessary. Avoid contact with eyes.
Acacia saligna	Port Jackson	Very high	Pull out seedlings by hand. Spray young plants with 0.5% Garlon. Paint 2% Garlon and diesel mix in 1/2m wide band (10 cm above ground) around stem of older plants.	Avoid contact with eyes.
Eucalyptus grandis	Saligna gum	High	Pull out seedlings by hand. Spray young plants with 0.5% Garlon. Paint 2% Garlon and diesel mix in 1/2m wide band (10 cm above ground) around stem of older plants.	Avoid contact with eyes.
Eucalyptus lehmannii	Spider Gum	High	Pull out seedlings by hand. Spray young plants with 0.5% Garlon. Paint 2% Garlon and diesel mix in 1/2m wide band (10 cm above ground) around stem of older plants.	Avoid contact with eyes.
Leptospermum laevigatum	Australian Myrtle	Very high	Pull out seedlings by hand. Spray young plants with 0.5% Garlon. Paint 2% Garlon and diesel mix in 1/2m wide band (10 cm above ground) around stem of older plants.	Do not chop as it will coppice. Avoid contact with eyes.

SPECIES	COMMON NAME	THREAT OF SPREADING	SUGGESTED CONTROL MEASURES See Appendix 6 for herbicide recipes	SPECIAL PRECAUTIONS Spraying should not be done on windy days.
TREES AND SHRUBS CONT.				
Paraserianthes lophantha	Albizia/Stinkbean	Very high	Pull out seedlings by hand. Spray young plants with 0.5% Garlon. Paint 2% Garlon and diesel mix in 1/2m wide band (10 cm above	
Pinus pinaster	Cluster Pine	Very high	Pull out seedlings by hand. Cut down larger plants at ground level.	-
Pinus pinea	Stone Pine	Medium	Pull out seedlings by hand. Cut down larger plants at ground level.	-
Populus canescens	Silver/Grey Poplar	Very high	Spray young plants with 0,5% Garlon. Paint 2% Garlon and diesel mix in 1/2m wide band (10 cm above ground) around stem of older plants.	It is illegal to have this plant on any property. Avoid contact with eyes. Do not spray with Garlon on a hot day.
Quercus ilex	Oak	Medium	Pull out seedlings by hand. For older plants spray with 0,5% Garlon or chop out with hoes below ground level.	Must be chopped below ground level. Avoid contact with eyes.
Rhus lucida	Taaibos	Low	Hand cut plants that are too tall to a height of 30cm or more.	This is an important indigenous fynbos plant and should not be destroyed.

SPECIES	COMMON NAME	THREAT OF SPREADING	SUGGESTED CONTROL MEASURES See Appendix 6 for herbicide recipes	SPECIAL PRECAUTIONS Spraying should not be done on windy days.
TREES AND SHRUBS CONT.				
Sesbania punicea	Coffee Weed	Very high	Pull out seedlings by hand. Spray young plants with 0,5% Garlon. Paint 2% Garlon and diesel mix in 1/2m wide band (10 cm above ground) around stem of older plants.	Avoid contact with eyes. Do not spray with Garlon on a hot day.
OTHER				
Canna indica	Canna	High	Spot spray with 2% Roundup.	-
Phoenix canariensis	Canary palm	Low	?	
Yucca sp.1	Yucca	High	Chop out by hand or spray with 2% Frenock.	-

Appendix 3: Preparation and application of herbicides recommended in the Conservation Management Plan.

COMMERCIAL NAME	Garlon	Roundup/Ridder	Frenock
ACTIVE INGREDIENT	triclopyr	glyphosate	tetrapion
PRECAUTIONS	- causes eye irritation. - damages contact lenses. - do not use as spray on hot days as it will evaporate. - prevent from drifting into neighbouring vegetation. - avoid spraying when day is windy. - do not spray when rain is expected in next two days. - to prevent pollution, plants in water must not be sprayed; wait until water evaporated.	- do not use as spray on hot days as it will evaporate. - prevent from drifting into neighbouring vegetation. - avoid spraying when day is windy. - do not spray when rain is expected in next two days. - to prevent pollution, plants in water must not be sprayed; wait until water evaporated.	- do not use as spray on hot days as it will evaporate. - prevent from drifting into neighbouring vegetation. - avoid spraying when day is windy. - do not spray when rain is expected in next two days. - to prevent pollution, plants in water must not be sprayed; wait until water evaporated.
PREPARATION	- mix 0.5% spray using 100ml to 20 litres of water (i.e. 1 part per 200 parts) - make Garlon/diesel mix using 20ml pure Garlon in a litre of diesel.	- mix 20ml Roundup with a litre of water to make 2% spray solution.	- mix 20ml Frenock with a litre of water to make 2% spray solution.
APPLICATION	- 0.5% Garlon spray is applied using a backpack sprayer. - use a paintbrush to apply the Garlon/diesel mixture. This mixture can be used on a hot day. NOTE: - most effective when used during the growing season. - Garlon has no effect on monocot plants such as grasses, yukkas and restios.	- 2% Roundup is applied using a backpack sprayer. NOTE: - most effective when used during the growing season. - has most effect aplied in hot, dry weather.	- 2% Frenock is applied using a backpack sprayer. NOTE: - most effective when used during the growing season.
WHERE OBTAINABLE	- can be ordered wholesale from Efekto: ph 51-17324. - small quantities available from retail outlets such as Pick 'n Pay Hypermarkets.	- can be ordered wholesale from Efekto: ph 51-17324. - small quantities available from retail outlets such as Pick 'n Pay Hypermarkets	- can be ordered wholesale from Agricura: ph Paarl (02200) 21751.
COST (at May 1990, excl. G.S.T).	6x50ml (Efekto)..........R77 50ml (Pick 'n Pay).......R17	6x500ml (Efekto)..... 100ml (Pick 'n Pay)......R12	5 litres...............R370