SPATIAL UTILISATION, HABITAT SELECTION AND POPULATION STATUS OF THE WILD DOG (*Lycaon pictus*) POPULATION in HLUHLUWE UMFOLOZI PARK

by

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Supervisor : Prof. M. Perrin
Co-supervisor : Dr. A.H. Maddock

This thesis is dedicated to my parents, **Andy and Rina Andreka**, simply because they have always supported me in everything I do with interest, understanding and love which has no boundaries. This project was no exception.

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ABSTRACT

The African wild dog (*Lycaon pictus*) was reintroduced into Hluhluwe Umfolozi Park (HUP) in 1980/81 after an absence of over 50 years. A 'hands off' management approach was applied. Although the reintroduction is regarded as successful, the population has not increased significantly and still only consists of a single pack. Various aspects which may affect this population were investigated to compile an active management strategy. Home range analyses identified extensive use of a home range which covered only 22.7 % of HUP and was situated entirely in Hluhluwe Game Reserve. The extensive movements of the dogs within their home range were primarily dictated by the movements and distribution of their prey species, especially nyala (*Tragelaphus angasii*) and impala (*Aepyceros melampus*). Forest habitats were preferred, but all available habitat types were utilised extensively by the wild dogs. Space and habitat were both considered to have no limiting effect on this population and HUP has sufficient space and suitable habitat to support a larger population of *L. pictus.* A number of potentially pathogenic antigens were identified in the population, indicating that it had been exposed to these at some time. Domestic dogs in the areas surrounding HUP were identified as the most likely source of these diseases which pose a threat to the wild dogs. Some genetic considerations are discussed in terms of their effect on the population status and management of the wild dogs. A number of management proposals based on the results of the project were formulated. It is suggested that an active management approach be adopted for the population. This includes managing it as part of a metapopulation which primarily involves the exchange of genetic material among similar wild dog populations on a regular basis. The immediate supplementation of the population with new genetic material is proposed.

PREFACE

The experimental work carried out for this dissertation was conducted in the Department of Zoology and Entomology, University of Natal, Pietermaritzburg, from January 1993 to December 1994, under the supervision of Professor Mike Perrin. Fieldwork was carried out in Hluhluwe Umfolozi Park, Natal Parks Board, KwaZulu-Natal under the supervision of Dr Anthony H. Maddock.

These studies represent original work by the author and have not otherwise been submitted in any form for any degree or diploma to any University. Where use has been made of the work of others it is duly acknowledged in the text.

Gunther E. Andreka

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A zoology student in the field generally works alone. Behind the scenes, however, a small army of people and organisations provide the financial, technical, social and moral assistance and support required to produce this final product. I owe my gratitude to the following people and organisations :

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The Licaone Fund in Italy was founded for the sole purpose of providing funds for researchers who are committed to conserving the wild dog for future generations. The financial and moral support they provided was invaluable. Andrea Maggi and Oscar Mascagni are doing a great service to researchers via the fund.

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Kruger, who adopted a portion of my project and ably made it her own, often assisted me in many ways.

Thanks to the Natal Parks Board for the privilege to study such a fascinating animal in HUP and allowing me the freedom of HUP for my research. Financial assistance for the running costs of the project were also forthcoming from the Board.

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Dr Bret Louwrens and his staff at the State Veterinary Department in Hluhluwe were always friendly and willing to assist, specifically with the collection of samples from domestic dogs outside HUP. Rob and Fred and the rest of the staff at Bushlands are thanked for their interest and help with a job and accommodation for a while, and Brent Corcoran for doing my work for me while I was away for Christmas.

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I leave the most important people until last. My parents Andy and Rina Andreka and my sister, Liezel for their infinite patience, unending support, and incredible and loving interest in everything I do and have done, my eternal gratitude and thanks.

Like all normal people, of which I deem myself to be one, I have omitted to mention somebody who shouid have been thanked. To you, and others who deserved to be mentioned, please accept my humblest apology and sincerest thanks.

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND AND MOTIVATION

The African wild dog (*Lycaon pictus* Temminck 1820) is one of the most endangered canids in the world. Having once occurred in 34 sub-Saharan countries (Skinner & Smithers 1990) the species is now extirpated, or nearly so, in 19 of these. Fanshawe *et al.* (1991) estimated the remaining population of adult African wild dogs to be as low as 2000 individuals. Many of these individuals are members of widely scattered packs in unprotected, prey-depleted areas. Potentially viable populations persist in only six countries, and these populations are declining (Fanshawe *et al.* 1991). The distribution of wild dogs is illustrated in Figure 1 (from Frame & Fanshawe in prep., in Ginsberg & MacDonald 1990). Wild dogs are locally protected in many areas, but enforcement is uniformly poor (Ginsberg & MacDonald 1990).

A number of factors have contributed to the decline of wild dogs (Fanshawe *et al.* 1991). Increasing human populations and settlement have encroached on wild dog habitat with a number of adverse effects such as increased persecution by farmers to 'protect' domestic stock, increased contact with domestic dogs and their diseases and isolation of wild dog populations. Farmers and wildlife managers alike, both within and outside conservation areas (Davison 1930; Childes 1988a), treated wild dogs as vermin and carried out extermination programmes in the past. Although attitudes have changed, a negative public perception of wild dogs still persists. Other factors such as disease, low genetic heterozygosity, competition with other predators and road kills throughout their range (Fanshawe *et al.* 1991; Ginsberg & MacDonald 1990) also threaten the future of this species.

The wild dog is classified as ENDANGERED by the South African Red Data Book of Terrestrial Mammals (Smithers 1986) and has recently been classified as ENDANGERED by the International Union for the Conservation of Nature and Natural Resources (IUCN) (Ginsberg & MacDonald 1990). Researchers have realised that the reduced distribution and abundance of wild dogs must receive greater attention, study, finance (Fanshawe *et al.*

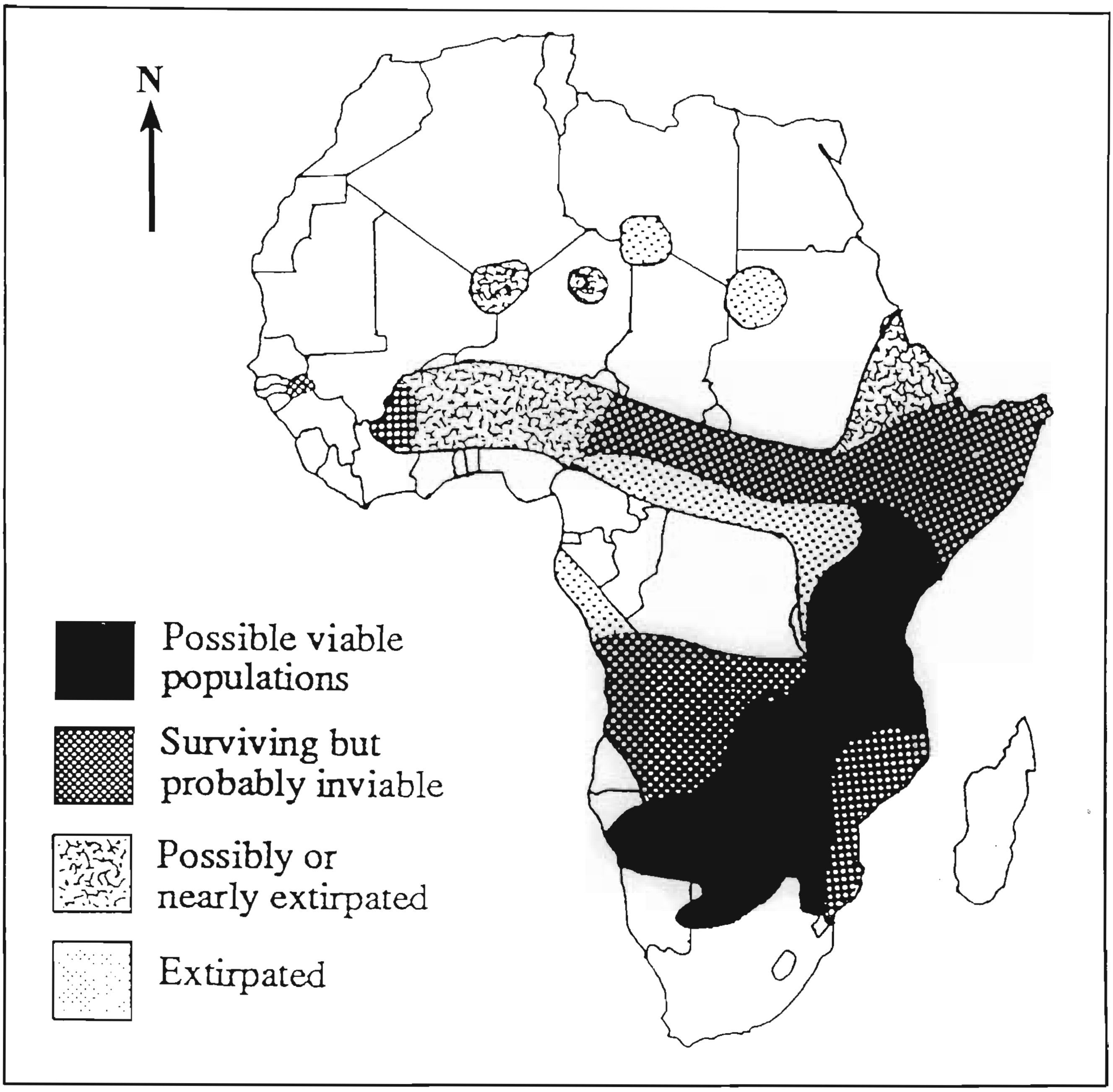


FIGURE 1 Distribution of the African wild dog

1991) and wider protection status (Fuller *et al.* 1992) if extinction of the species is to be prevented. All the remaining populations of wild dogs, regardless of size and whether they are wild- or captive-bred, must be managed as a unit towards the ultimate goal of conserving the species for future generations.

In South Africa, the Kruger National Park (KNP), including adjacent private nature reserves in the Mpumalanga (Eastern Transvaal) Lowveld, is the only area where a viable population of African wild dogs exist (Maddock & Mills 1994). A small population of dogs was reintroduced into Hluhluwe Umfolozi Park (HUP) in 1980/81. It is currently one of only two established populations of wild dogs in game reserves in South Africa outside KNP. The second population has recently been reintroduced into Madikwe Game Reserve in North West Province. Although the population in HUP has survived (Table 1), indicating a successful reintroduction, there is concern that because of the small size of this population and its isolation, it is not contributing maximally to the conservation of the species on a continental basis as is required (A. Maddock 1995, pers. comm.).

At the time of the reintroduction to HUP, no monitoring programme was instituted and records kept on the progress and success of the reintroduction were poor. In 1991 a demographic project was initiated (Maddock, in prep.). The estimated annual population numbers recorded are listed in Table 1. These records show a large fluctuation in population size of between approximately three and 30 individuals. These large fluctuations in and failure to produce a litter in certain years are caused by the presence of only one pack in HUP and is consistent with trends in other wild dog packs. Although the packs in KNP fluctuate in size, the population as a whole has remained reasonably stable over the last 25 years (Maddock & Mills 1994). The fact that only one pack persisted in HUP since the reintroduction led to the concern that the natural behaviour and demographic patterns of wild dogs was not occurring. Possible problems with the population's genetic status due to likely parent - offspring breeding and isolation were also a cause for concern. These factors prompted the initiation of a research project in HUP to investigate this population of dogs and factors influencing its survival.

The study was initiated as part of a research programme by Dr Anthony Maddock of the Natal Parks Board. The project was divided into three parts. First, to collect information on the

TABLE 1 Pack and litter sizes of wild dogs in HUP. These values represent average figures (from Maddock in prep.)

YEAR	PACK SIZE	LITTER SIZE
1981	22	
1982	22	
1983	15	7
1984	23	6
1985	20	11
1986	28	5
1987	14-30	
1988	16	
1989	14-30	
1990	16	13
1991	26	11
1992	28	8
1993	22	4
1994	13+7 *	-
1995	13+7 *	-

* one pack and one group of dispersing individuals

current status of the population and the factors affecting it, and the movements, spatial utilisation and habitat selection of the wild dogs (the subject of this thesis). Second, to investigate the feeding ecology of the wild dogs (Krüger, MSc study in prep.). The third component consisted of collecting a photographic record of the dogs since the reintroduction to investigate population dynamics and pack composition (Maddock, in prep.). Resulting data will be used to draw up an improved management plan for wild dogs in HUP and to try to increase the contribution of wild dogs in HUP to the continental conservation effort.

1.2 CONFLICT WITH MAN

Conflict with man is cited by many researchers and conservationists as being one of the main causes for the decline in wild dog numbers in recent years (Malcolm 1979; Childes 1988a; Fanshawe *et al.* 1991). Encroachment and settlement is constantly reducing the amount of land and habitat available for wild dogs, leading to more contact between wild dogs and man and his domestic animals. Although wild dogs are protected in many areas, enforcement is uniformly poor and local resentment of wild dogs is strong (Ginsberg & MacDonald 1990).

Predator control programmes have been largely responsible for drastic reductions in wild dog numbers. As recently as the late 1960's, managers both within and outside protected areas treated them as vermin (Davison 1930; Childes 1988a). A good example is the minimum number of 3404 wild dogs which were shot in Zimbabwe between 1956 and 1975, including those shot in Hwange National Park, effectively reducing the Zimbabwian population to about 500 individuals in 1975 (Childes 1988a).

Wild dogs disappeared from the northern Natal - Zululand area as recently as the late 1920's. Their disappearance is largely attributed to local farmers and conservationists who regarded them as vermin and destroyed them on sight. This misconceived public perception of wild dogs has been one of the primary causes for their decline over the past few decades in southern Africa. Generally old ideas are still evident today and dogs are still killed by some farmers (Childes 1988a; Ginsberg & MacDonald 1990).

The primary cause of conflict with private land owners is predation on domestic stock and wild ungulates by wild dogs. All evidence however points to only occasional predation by wild dogs on domestic stock (Childes 1988a; Njungiri 1990) and exaggerated losses reported by farmers (Ginsberg & MacDonald 1990; Mills 1991). Game ranching is emerging as a very lucrative business in South Africa as domestic stock farmers are realising the value of game on their land for the hunting and eco-tourism market. Wildlife ranchers complain that wild dogs are a source of financial loss to them through predation on game, i.e. trophies, by making game wild and thus making hunting difficult, or by preying on rare species which are extremely valuable (Fanshawe *et al.* 1991). Wild dogs have never been popular as sport hunting trophies and thus have little value to game ranchers.

HUP is surrounded by extensive rural farming communities which practice mainly subsistence agriculture. Beyond these rural farming areas are essentially large stock and game farming areas. Wild dogs escaping from HUP, together with a single case of predation on livestock by the dogs, have been reported. The potential for conflict with these communities as a result of wild dogs leaving HUP is thus a reality which needs to be considered in a management strategy.

1.3 WILD DOG : DESCRIPTION AND TAXONOMIC STATUS

The Latin name for the African wild dog, *Lycaon pictus*, is translated as 'painted or ornate wolf' which refers to their varicoloured coat which is blotched with patches of black, white and yellow (Plate 1). Each dog has its' own unique coat pattern which can assist researchers in identifying them individually (Maddock & Mills 1994). Wild dogs are medium-sized carnivores (18 to 28 kgs) with characteristic large rounded ears, long legs and bushy, broadly white-tipped tails (Skinner & Smithers 1990). They have a shaggy coat, even though they appear short-coated at a distance.

The African wild dog represents a taxonomically distinct genus related to the wolf-like canids, a group which includes the grey wolf (*Lupes lupes*), the coyote (*Canis latrans*), and the African jackals (*C. mesomelas, C. adjustus* and *C. aureus*)(Clutton-Brock *et al.* 1976; Van Gelder 1978; Wayne & O'Brien 1987; Wayne *et al.* 1989; Girman *et al.* 1993). The species was

PLATE 1 An African wild dog in HUP, showing the varicoloured coat which has earned them the name of 'Painted wolf '(Photo by Vio Cavrini)

originally described from a specimen from coastal Mozambique, under the name *Hyaena picta*, by Temminck in 1820. The dogs found in East Africa tend to have less white in their coats than those in southern Africa. East African dogs are also smaller, weighing about 18 kilograms in comparison to the 26 to 28 kilograms of the southern African dogs (Skinner & Smithers 1990). Girman *et al.* (1993) suggest that the southern African populations should be considered a separate sub-species based on morphological analyses.

1.4 DISTRIBUTION

The status of the wild dog appears to be changing rapidly (Ginsberg & MacDonald 1990). Until very recently the range of the wild dog included much of Africa (Figure 1). Although formerly widely distributed in South Africa, by 1983 the wild dog was found only in KNP and HUP. They were sometimes recorded in the Kalahari Gemsbok Park and on private land in northern Natal north of HUP. The distribution of the wild dog today is very patchy and they are very scarce with only 2000 to 5000 individuals still surviving (Ginsberg & MacDonald 1990), mostly in protected areas and game reserves (Figure 2).

Several captive populations of wild dogs exist in South Africa; at De Wildt Breeding Centre near Brits in Gauteng, one near Oudtshoorn in the Western Cape, and a small group at the Cheetah Breeding Centre on Kapama Game Reserve in Mpumalanga. Some reintroductions to private nature reserves have been attempted. A pack was relocated from Kangwane to De Beers Venetia-Limpopo Game Reserve in the Northern Province (Mills & Nel 1993). This pack has since disappeared (J. Van Heerden 1994, pers. comm. [1]). The most recent attempt was a mixed group of captive- and wild-bred dogs released in Madikwe Game Reserve in the North Western Province in 1995. Madikwe is a recently established reserve which covers 70 000 ha of Kalahari sandveld.

The distribution of wild dogs in KwaZulu-Natal is restricted to northern KwaZulu-Natal (Figure 3). The HUP population consists of < 20 individuals. Regular reports are received of

---

[1] Dr. Joe van Heerden, Kimberley Vet Clinic, 16 Dalham Road, Kimberley, 8300

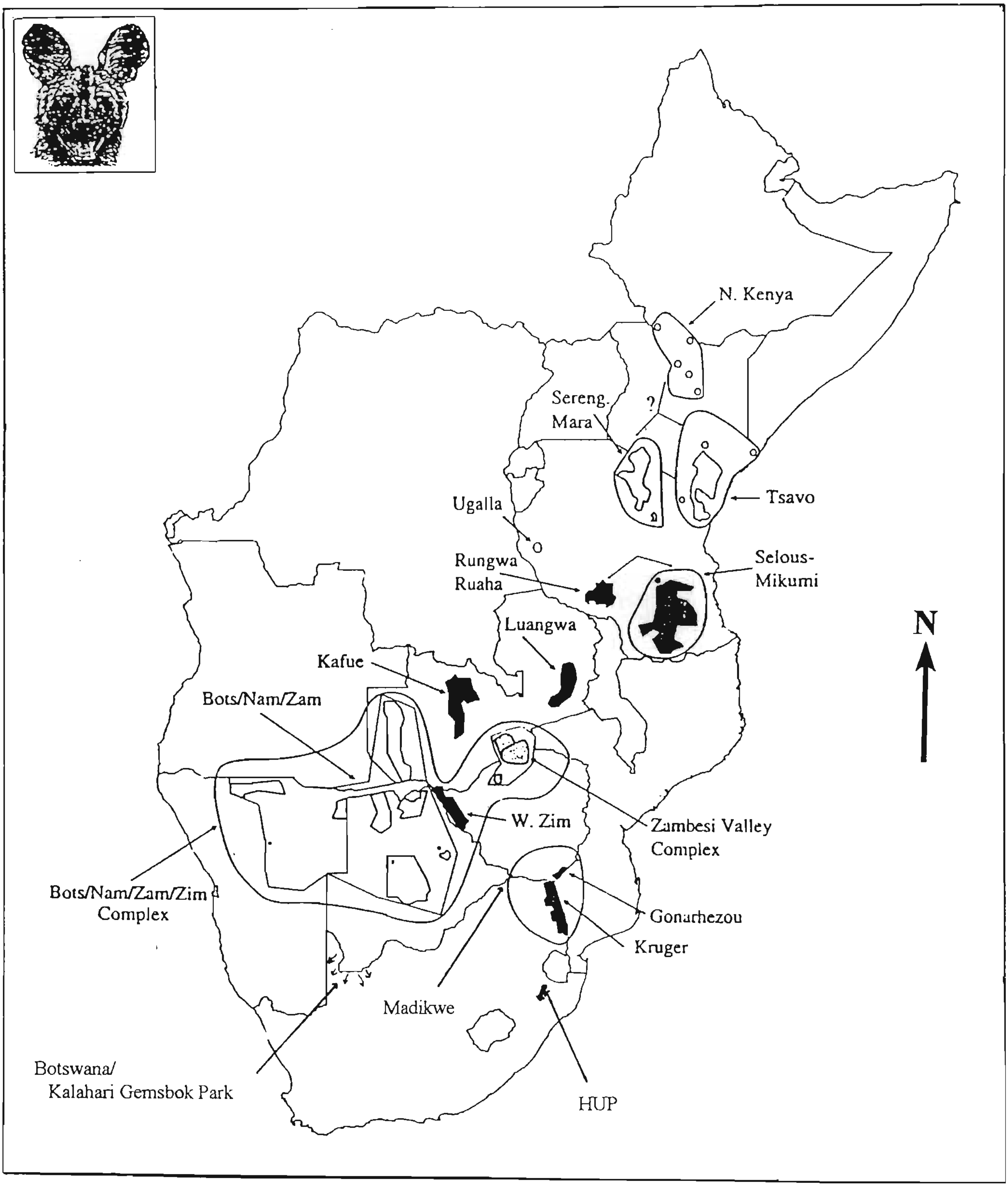


FIGURE 2 The specific distribution of wild dog populations in game reserves throughout Africa (Ginsberg 1993)

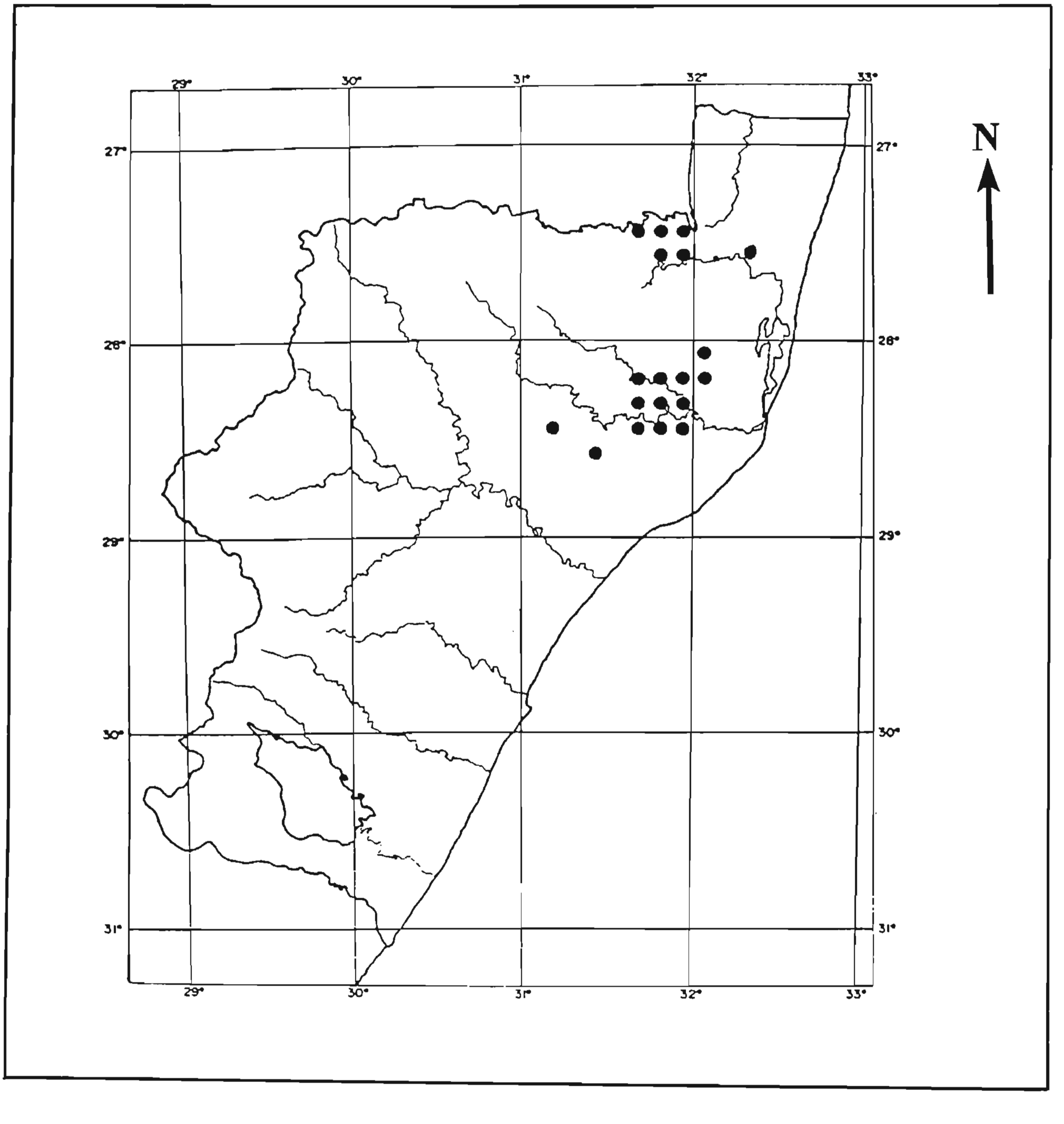


FIGURE 3 The distribution of wild dogs in KwaZulu-Natal, RSA (Rowe-Rowe 1992)

one or more packs of dogs living on a group of private game ranches in the Magudu area (approximately 27° 20' S and 31° 45' E)(K. Landman 1993, pers. comm. [2]). Two dogs were seen on Tennis Ranch in this area in June 1994 (approximately 27° 20' S and 31° 45' E)(A. DuBoisson 1994, pers. comm. [3]). One of these dogs died from a snare around its neck the following day. A dog from HUP was also photographed in Itala Game Reserve (A. Maddock 1995, pers. comm. [4]).

1.5 HISTORY OF WILD DOGS IN HLUHLUWE UMFOLOZI PARK

The species was originally widely distributed in Natal (Pringle 1977), but the major populations occurred in Zululand (Rowe-Rowe 1992). They were last recorded in the Drakensberg area between 1918 and 1924, but were still present around Lake St Lucia and in Umfolozi Game Reserve (UGR) in 1924. Pringle (1977) gives the probable date of extirpation as 1930 after which some unknown epidemic disease was believed responsible for eliminating the remaining dogs, after a campaign was waged against them as vermin (Bourquin *et al.* 1971).

Wild dogs were thus present in HUP prior to 1930, but then became extinct from the area until 1980. One unsubstantiated record exists of a pack having been seen by game guards in the Corridor between HGR and UGR in 1953 (Bourquin *et al.* 1971). After an absence of 50 years, reintroduction of wild dogs into HGR was approved by the Natal Parks Board on 29 January 1971. Over the period December 1980 to September 1981, a total of 22 wild dogs (12 males and 10 females) were released into HGR. A further four animals were released into UGR in 1986. Table 2 lists details of release dates and locations, and numbers, sex ratios and origins

---

[2] Mr Karel Landman, Leeukop Game Ranch, P.O. Box 767, Pongola, 3170

[3] Mr André DuBoisson, Manager, Tennis Ranch, Magudu

[4] Dr. A.H. Maddock, Research Scientist, Natal Parks Board, P.O. Box 662, Pietermaritzburg, 3200

TABLE 2 Details of the dates and locations of release, number, sex ratios and origin of wild dogs released in HUP

DATE OF RELEASE	RELEASE SITE	NUMBER OF DOGS	SEX RATIO	ORIGIN
April 12 1980	Gontshi	9	4M+5F	Captive bred at De Wildt (2M+1F; Born June 9, 1979) Wild born at Gravelotte, NTVL and raised by NPB from 2 months of age (2M+4F)
June 14 1981	Mgovuzo	4	2M+2F	Wild caught at Mtswari, Eastern TVL (1M of ±3 years of age) Captive bred at De Wildt (1 male; born June 9, 1979) Wild caught in Kruger National Park (1M+1F)
September 15 1981	Hilltop	2	1M+1F	Captive bred at De Wildt (1M; born May 19, 1980) Captive bred at Hluhluwe Game Reserve (1F; born April 29, 1980)
September 21 1981	Mgovuzo	9	6M+3F	Captive bred at De Wildt (2M+2F; born April 29, 1980) Captive bred at HGR (3M; born April 29, 1980) Mtswari and KNP (1M+1F were recaptured on July 20, 1981 as they had returned to the pens and were in poor condition)

M = male

F = female

of wild dogs released in HUP (M. Brooks, 1993, pers. comm. [5]). No records of the 4 dogs released in UGR are available.

At the time of the reintroduction into HUP very little information was available on reintroduction methods for wild dogs. A number of small groups of dogs from different origins were released at various times (Table 2). The first group were kept in a boma in HUP where they produced a litter before being released. This group could thus be considered to have been socially stable and that the wild-bred dogs were able to hunt. The second group was a similar combination of dogs, but were released in a different location to the first group.

The final group released included three males from the litter born in the boma in HUP, and a male and female which had been recaptured after they had returned to the boma continuously. Attempts were made to combine dogs from different origins, probably for genetic reasons, and to encourage the formation of a number of packs by releasing at different times and in different areas. The dogs which returned to the boma were in a poor condition as a result of their reliance on man for food developed during captivity and their resulting inability to provide for themselves. These past attempts at reintroducing wild dogs into HUP must be noted when further introductions are planned.

1.6 STUDY AREA

The Hluhluwe and Umfolozi Game Reserves were proclaimed in 1895 (Brooks & MacDonald 1983) with a corridor of land separating the two reserves. Today both reserves and the corridor area are enclosed by a single game proof fence. Originally referred to as the Central Hluhluwe-Corridor-Umfolozi Complex, the unit is now termed the Hluhluwe Umfolozi Park (HUP). The entire park is surrounded by rural areas where human population densities are high and agriculture is extensive (Whateley & Porter 1983). Today both the human density and agricultural areas are increasing.

---

[5] Dr. Martin Brooks, Head of Ecosystems Research, Natal Parks Board, P.O. Box 662, Pietermaritzburg, 3200

HUP lies between 28° 00' and 28° 26' S and 31° 43' and 32° 09' E in central Zululand (northern Kwazulu-Natal), Republic of South Africa, and covers an area of approximately 96 000 ha (960 km^2)(Figure 4). It occupies the foothills of the first escarpment on the western side of the Zululand coastal plain. The terrain is broken by numerous hills and valleys with altitudes ranging from 60 m to 750 m above sea level (Plate 2). Flat areas are usually confined to the floodplains of the four larger rivers which flow through the Park : the Hluhluwe River with its three major tributaries, the Manzibomvu, Mansiya and Nzimani Rivers in the north; the Nyalazi to the south and further south, the Black and White Umfolozi Rivers.

HUP is underlain by a variety of geological formations representing most of the major rock series of Natal, with Karoo sediments most widespread (King 1970). The topographic, geological and climatic heterogeneity of the area has led to the formation of a large variety of soils and a great diversity of plant life.

The rainfall pattern is unimodal (Brooks & MacDonald 1983), peaking in summer (November to February). The June to August period is generally dry. Rainfall is highest in the hills of north-western Hluhluwe with an annual mean of 980,3 mm (n = 60; at eGodeni), decreasing through the Corridor to Umfolozi with an average of 733,6 mm (n = 33; at Mpila)(Maddock & Coulon 1994). Temperatures are warm to hot, particularly in the summer months. Very occasional frosts have been recorded in some river valleys.

HUP lies within two veld types as described by Acocks (1988). These are the Lowveld subcategory of the Tropical Bush and Savanna Types and Zululand Thornveld, a subcategory of the Coastal Tropical Forest Types. These areas correspond with bioclimatic types 9 and 10 as described by Phillips (1973). Undifferentiated coastal forest communities are restricted to the high rainfall hillsides or the riverine belts, especially in Hluhluwe. Broad-leaf open to closed woodland communities dominated by *Euclea divinorum* (Magic guarri) or *Spirostachys africana* (Tamboti) are found in certain bottomland situations while those on rocky or sandy hillslopes are dominated by *Combretum* woodlands. A large part of the area is dominated by acacias, particularly *Acacia karroo (*Sweet thorn*), A. nilotica (*Scented thorn*), A. burkei (*Black monkey-thorn*), A. gerrardii (*Red thorn*), A. nigrescens (*Knob-thorn*), A. tortilis (*Umbrella thorn*)* and *A. caffra (*Common hook-thorn*)*. These generally have a grass cover of tall-tufted

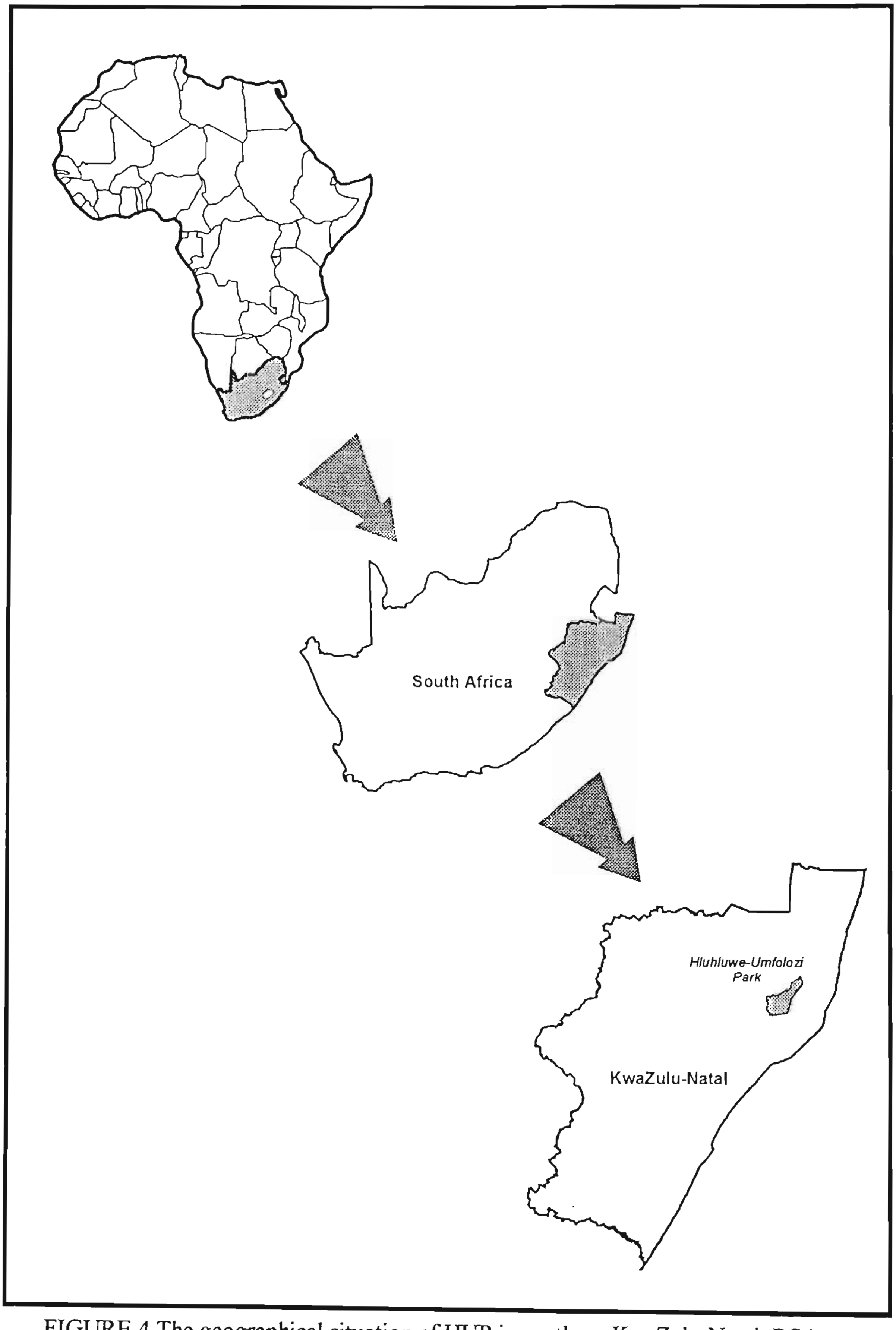


FIGURE 4 The geographical situation of HUP in northern KwaZulu-Natal, RSA

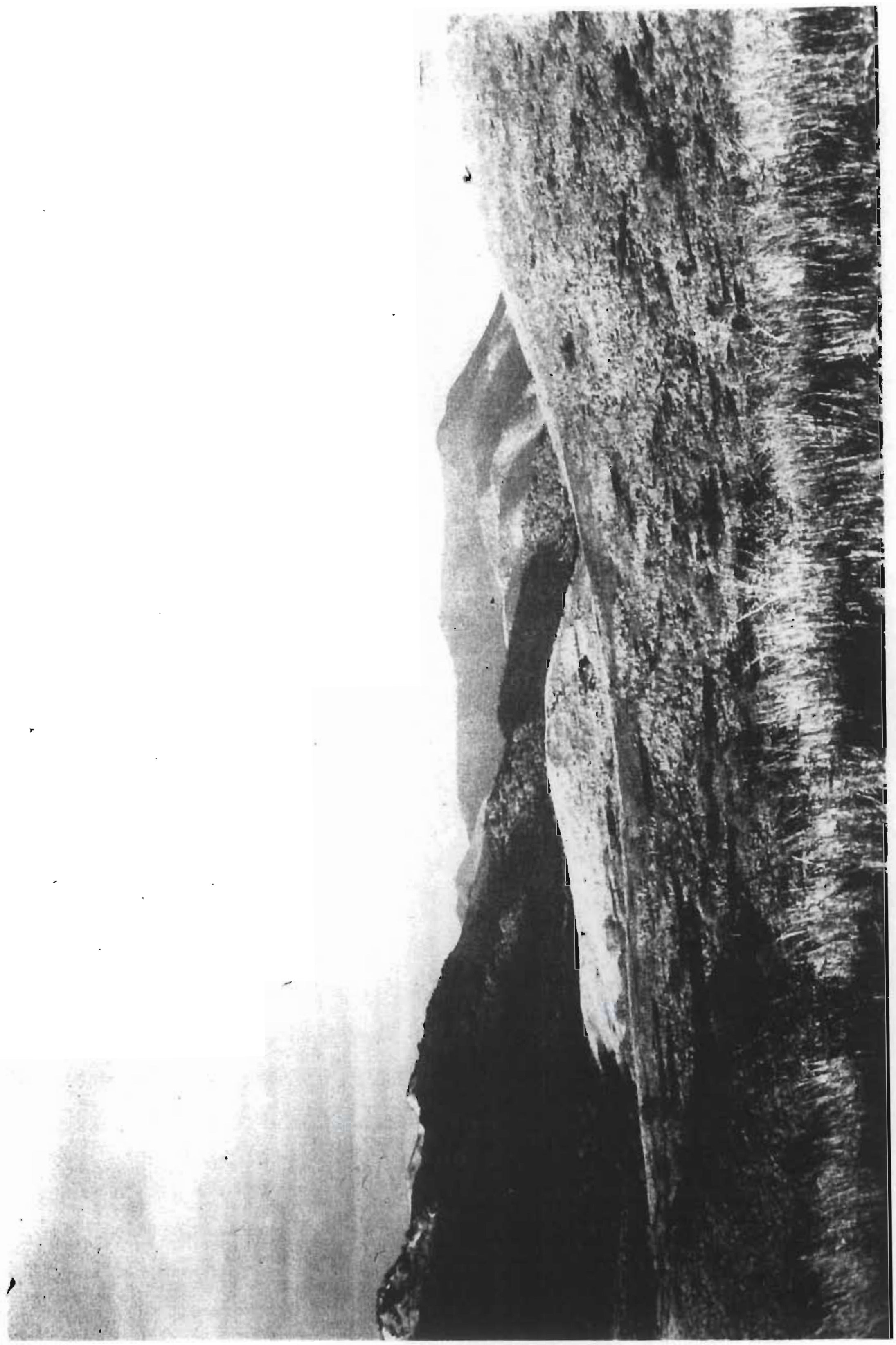


PLATE 2 Typical undulating terrain made up of numerous hills and valleys in the Hluhluwe section of HUP

perrenials including *Themeda triandra (*Rooigras*)* and *Cymbopogon* species. True grassland communities are poorly represented.

The physiognomy of the vegetation types in HUP was classified by Whateley (1975) who identified two forest, two riverine forest, five woodland, four thicket, one induced thicket and two grassland categories (Figure 5). In 1983 Whateley & Porter (1983) updated this vegetation map with changes to the woodland and thicket categories. Their classification was based on the classification of Phillips (1973), and included the following categories : forest, riverine forest, woodland, open woodland, thicket and grassland. An induced thicket category was also added as described by Pratt *et al.* (1966).

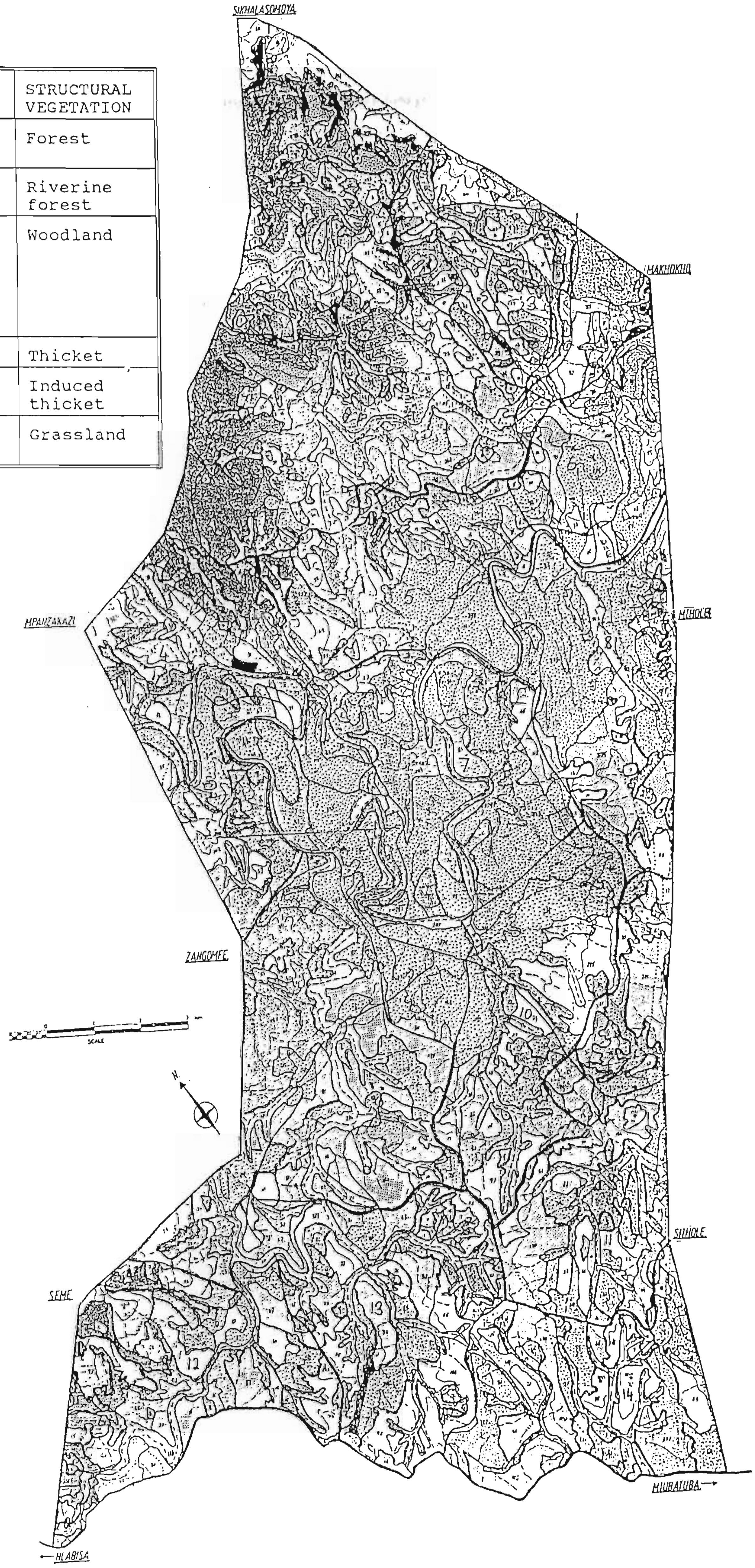
An extensive network of tourist and management roads within HUP allow access to most areas (Figure 6). Hluhluwe has one tourist camp, Hilltop Camp, and two bush camps while Umfolozi has two tourist camps, Mpila and Masinda. A number of ranger outposts are scattered throughout HUP.

1.7 OBJECTIVES

The HUP wild dog population is unique in that it represents the only reintroduction of wild dogs into their former habitat which has been successful l. The lack of follow up scientific study and observation of this population's progress has however led to the lack of knowledge of the status of these dogs in HUP. The endangered status of the wild dog has been highlighted as has the need for each remaining population of dogs to make a positive contribution to the conservation of the species. The contribution which the HUP wild dog population should be making must be identified and implemented as it is one of the key populations in Southern African conservation efforts for this species. This project was thus initiated with the following objectives :

1) To investigate the movements of the wild dogs in HUP and correlate these with the area needed by the pack (i.e. home range area) and the relative utilisation of the available area,

FLORISTIC VEGETATION	STRUCTURAL VEGETATION
Celtis africana - Harpephylum - caffrum *Celtis africana - Euclea schimperi*	Forest
Spirostachys africana - Euclea schimperi *Acacia robusta - Ficus sycamorus*	Riverine forest
Euclea divinorum *Spirostachys africana* *Combretum molle* *Acacia nilotica* *Acacia karroo* *Acacia burkei*	Woodland
Acacia caffra	Thicket
Dichrostachys cinerea - Acacia karroo	Induced thicket
Themeda triandra *Panicum maximum - Cyperus textilis*	Grassland



KEY

267,6m	Spot heights
▲	Trig beacons
	Rivers
	Roads
	Tracks
	Boundary
	Contours
■	Buildings

FIGURE 5 Vegetation map of the Hluhluwe Game Reserve and northern Corridor (Compiled by Whateley 1975)

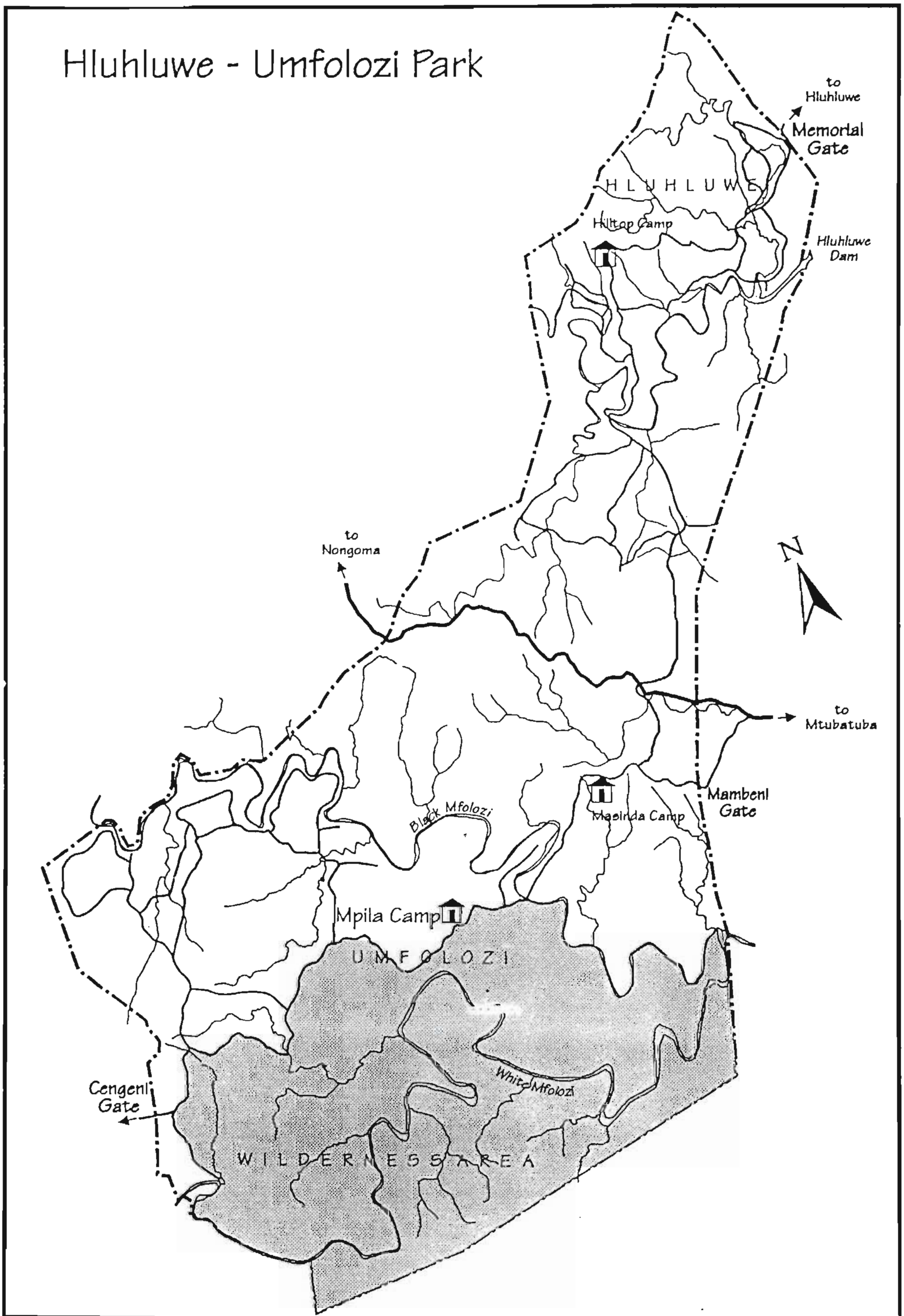


FIGURE 6 General features of HUP showing rivers, tourist roads, major management tracks and tourist camps

2) to investigate habitat selection and compare habitat utilisation with habitat availability, for information on decisions about further possible reintroductions.

3) To consider the threats to the population by investigating some factors known to affect wild dogs and believed to be present in HUP, namely disease, genetic status and viable population size.

4) To contribute information that is needed to formulate a management strategy over the short (next 5 years) and long (thereafter) term for the HUP wild dog population.

Use of space and time by wild dogs in HUP and the implications thereof for future population management is discussed in Chapter 2. Habitat type utilisation by wild dogs and the availability of these habitat types within HUP for wild dogs is compared in Chapter 3. Chapter 4 deals with the influence of disease and genetics on the population status of these dogs. Management proposals, including those for further supplementation of the existing population with additional dogs, based on the results in Chapters 2 through 4 are set out in the fifth and final chapter of this thesis.

CHAPTER 2

USE OF SPACE AND TIME

2.1 INTRODUCTION

The HUP wild dog population is confined to the area within the game proof fence surrounding the park. The amount of space available to them is thus limited. The continued existence of a single pack in HUP could be attributed to these space limitations. An investigation of the use of space and time by the wild dogs was required to answer these questions and to make objective management decisions.

2.1.1 Concepts of home range

No wild animal roams at random over the country; each has a home region, even if it is not an actual home (Seton 1909). The concept of home range has been investigated by many researchers and given many definitions. Burt (1943) defined home range as that area which an animal occupies during its normal daily activities of food gathering, mating and caring for young. Jewell (1966) described home range as an area with a certain productivity that meets the energy requirements of the individual or group that occupies it. Jewell (1966) also used the phrase 'routine activities' to describe the behaviour of a mammal within its home range. Anderson (1982) uses a more precise definition based on the bivariate probability density function that gives the probability of finding an animal at a particular location on a plane.

Many smaller mammals, particularly rodents, expend time and energy in monitoring an intensively used central part of the home range, but retain an interest in a peripheral region to detect exploitable changes in the vicinity (I. Linn 1995, pers. comm. [6]). Reasons for such excursions out of normal home range may include juvenile dispersal, migration or exploration (Jewell 1966; Shillito 1963). Large mammals may pursue a similar strategy. Breitenmoser *et al.* (1993) found that the European lynx (*Lynx lynx*) make extensive excursions outside their

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[6]Ian Linn, Department of Biological Sciences, University of Exeter, Exeter

normal home range. Burt (1943) was of the opinion that since these 'occasional sallies' were made outside the normal home range, they should be excluded from consideration when an animal's home range was being defined. The inclusion of locations of such sallies (commonly called outliers) in range calculations, generate range estimates of large size and bizarre shape, which includes a considerable area which appears not to be visited by the animal (Burt 1943; Wolton 1982; Samuel *et al.* 1985). Not all mammals utilise this strategy, however, and despite less intensive use, the peripheral zone should not be logically excluded from the home range (I. Linn 1995, pers. comm [7]).

Animals generally use space disproportionately within the boundaries of their home range (Samuel *et al.* 1985). The existence of a high intensity use or core area within an animal's home range was proposed by Kaufmann (1962). Core areas are those used more frequently than other areas and probably contain home-sites, refugia, and the most dependable food sources (Burt 1943; Kaufmann 1962; Ewer 1968). If the home range of an animal is defended by an animal or group of animals, it is defined as a territory. The relationship of a defended area or territory to the total home range differs among species. The distinction is linked to the intensity to which territories are marked and defended, and whether the areas are exclusive of each other. Often the territory does not have the same delineation as the total home range.

2.1.2 Wild dogs and home range

Wild dogs have been shown to use a very large home range (Kruuk 1972; Schaller 1972; Reich 1981) and to roam over considerable distances within these ranges. During the denning period the packs generally remain and hunt in areas of between 100-200 km^2 in the Serengeti (Kuhme 1965a,b; Schaller 1972) and 50-170 km^2 in KNP (Reich 1981). However, for the rest of the year wild dog packs are nomadic, moving to new rest sites each day, and range over areas of 260-3800 km^2 (Fuller *et al.* 1992). The variations in home range size of wild dogs recorded by various researchers is listed in Table 3 (Fuller *et al.* 1992).

Some variations in estimates of home range area are attributable to the method of calculation or to the timing of samples (Fuller *et al.* 1992). It is, however, apparent that range area is

[7] Ian Linn, Department of Biological Sciences, University of Exeter, Exeter

TABLE 3 Estimated home range area (km^2) and density (number/1000 km^2) of African wild dogs (adapted from Fuller *et al.* 1992)

LOCATION	YEARS	RANGE SIZE			DENSITY
		$\bar{x}$	Range	n	
Botswana	1988-89				4-15
Botswana, Moremi	1990	617	375-1050	9	17
Kenya, Masai Mara	1988-89	660		1	22-35
South Africa, Kruger NP	1913	3800		1	
South Africa, Kruger NP	1964				12-34
South Africa, Kruger NP	1975-78	555	150-1110	16	15-20
South Africa, Kruger NP	1988-89				17
South Africa, Kruger NP	1990	545	341-885	4	
Tanzania, Serengeti NP	1964-68				<10
Tanzania, Serengeti NP	1966-69	665	620-710	2	10-12
Tanzania, Serengeti NP	1967-72	1300		1	
Tanzania, Serengeti NP	1973-78		1500-2000	4	5-29
Tanzania, Serengeti NP	1985	2460		1	
Tanzania, Serengeti NP	1989-90	1500		1	2
Zimbabwe	1989-90	1500		1	14-15
Zimbabwe, Hwange NP	1989-90	423	260-663	4	18

correlated with prey density and availability (Fuller *et al.* 1992) as it is with wolves (*Canis lupis*)(Fuller 1989). Wild dogs may range widely to ensure a constant food supply with minimal effort (Schaller 1972), and may range less where prey are less aware of their presence, such as in dense vegetation. Reich (1981) believed that ranges were smaller in KNP because of the presence of permanent water and the resultant higher year-round density of prey, especially impala (*Aepyceros melampus*). Fuller *et al.* (1992) concluded that wild dog ranges are likely to be smallest in areas of high prey density and dense habitat.

These immense home range areas, together with low population densities and the extreme mobility engender grave conservation problems for *L. pictus* (Fanshawe *et al.* 1991) as few protected areas are large enough to support viable populations. The future conservation of the species will depend largely on the availability of space for the establishment of sustainable viable populations. HUP is one of the larger conservation areas in South Africa which emphasises the importance of this wild dog population.

Wild dogs are not considered territorial (Kruuk 1972; Schaller 1972). The den site, which is utilised for about 2-3 months of the year, seems to be defended from conspecifics, which may be considered temporally dynamic 'territorial behaviour' (Wilson 1975). But exclusive year-round territories are rare for many mammals, especially those ranging over large areas, because of the high energy expenditure (Brown & Orians 1970) required to maintain them. Where more than one pack exists in an area, the annual ranges overlap by 30-50 % in KNP (Reich 1981) and 10-50 %, but up to 80% in the Serengeti (Schaller 1972; Frame & Frame 1976a; Frame *et al.* 1979).

2.2 METHODS AND MATERIALS

2.2.1 Data collection

Data were primarily collected using radio telemetry assisted by direct observation of the wild dogs in HUP (Plate 3). Locations were also obtained from telemetry bearings derived by triangulation and from verified reports by tourists and rangers. Reports where verified by identifying spoor or scats as direct evidence of the dogs having been in that area, or if two or more separate reports where received. Data collection was done from a four wheel drive vehicle making use of the road network in HUP (Figure 6). Tracking was carried out on a daily basis. Some attempts were made to track the dogs on foot. This was however an impossible task due the difficult terrain and the vast movements of the dogs.

Wild dogs were immobilised with a ketamine (Ketamine, Kyron Laboratories)(100-150 mg) - zylazine (Rhompun, Bayer)(40 mg) or a fentanyl (Fentanyl, Janssen)(1.5-2.5 mg) - zylazine (Rhompun, Bayer)(20 mg) combination. Darts were delivered with a Telinject system. Dogs were fitted with 148 MHz radiotelemetry collars (Model 400, Telonics, Arizona). Radio signals were received with a portable receiver (Model TR-2 series, Telonics, Arizona) connected to a 2-element hand-held yagi antenna.

Monitoring through observation was designed around the bimodal pattern of activity of wild dogs (Fuller & Kat 1990) with intense monitoring in the early morning and late afternoons when the dogs were generally active (see Chapter 3) and monitoring at fixed intervals during the midday hours. Whenever possible, the movements, positions and activities of the pack were recorded throughout daylight hours. Physical constraints prevented night monitoring. The time intervals at which observed locations were recorded depended on the general activity of the wild dogs. The categories chosen to facilitate data recording and analysis are listed in Table 4.

Triangulation was used when direct observation was not possible and telemetry bearings were taken at hourly intervals. Compass bearings for triangulation were taken from a vehicle at a fixed point and then as quickly as possible from another similar point(s) for a second, third and/or fourth bearings. All telemetry bearings were analysed with the program Locate II (Nams V.O. 1990, Pacer Computer Software) which was used to plot the bearings and estimate locations. Only verified reports of observations of the dogs by tourists and rangers were recorded (see above).

2.2.2 Home range calculations

The three data sets obtained, namely observation, telemetry and ranger - tourist locations, were analysed separately. All locations were plotted on a 1:50 000 topographical map and allocated corresponding latitude and longitude coordinates. These locations were analysed with the program Home Range (Ackerman *et al.* 1990, University of Idaho) which calculates home

TABLE 4 The time intervals for activities of wild dogs in HUP at which observed locations were recorded

ACTIVITY	DEFINITION OF ACTIVITY	TIME INTERVALS BETWEEN RECORDED LOCATIONS (MINUTES)
Feeding	At least one dog eating at a kill	10
Hunting	At least two dogs actively searching for or pursuing prey	15
Moving	At least two dogs walking or running	15
Resting	All dogs lying down	60

range estimates based on an extension of the harmonic mean utilisation distribution (Dixon & Chapman 1980). All analyses with the Home Range program were conducted by Ian Linn at the University of Exeter.

Independence between successive observations is an implicit assumption of most statistical analyses of animal movements (Hayne 1949; Calhoun & Casby 1958; Jennrich & Turner 1969; Metzgar 1972; Koepl *et al.* 1975,1977; Wierzbowska 1975). Autocorrelation occurs when locations are obtained which are too close together in time and space and will likely make home range estimates inaccurate (too small) in comparison with a home range estimated only from independent data (Ackerman *et al.* 1990). Severe autocorrelation may be held to invalidate any attempt to estimate harmonic mean contours, but autocorrelation bias is negligible in large data sets, and is of less importance where the behaviour of the animals involves strongly positive movements of ecological importance (I. Linn 1995, pers, comm. [8]). Shorter 'times of independence' of data may be more appropriate when animals occasionally choose not to move (Lair 1987)(which is certainly the case with wild dogs).The data sets were tested for serial autocorrelation using the method of Swihart & Slade (1985a,b; 1986).

All locations were tested for bivariate normality and bivariate uniformity using the Cramer-von-Mises goodness-of-fit test (Ackerman *et al.* 1990). Critical values for the bivariate normal and uniform tests were calculated using finite sample, empirical distribution-free (EDF) procedures (Stephens 1974). The bivariate normal test is made by comparing the squared Mahalanobis distances to an expected exponential distribution (Ackerman *et al.* 1990). The bivariate uniform test follows the methods of nearest neighbour analysis and spatial patterns (reviewed by Diggle 1979). Nearest distances from random points sweep areas that are expected to follow an exponential distribution when the points are uniformly distributed (Ackerman *et al.* 1990).

The total range of the wild dogs was defined as the minimum convex polygon (MCP) of all the locations (Mohr 1947). This is the simplest method for calculating home range size and configuration, and is the only method which is strictly comparable among studies (Harris *et al.* 1990). Peripheral fixes or outliers resulting from excursions outside the typical range can

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strongly influence the home range area estimation (Ackerman *et al.* 1990) and particularly the MCP method (Harris *et al.* 1990). Therefore the criteria used to define and exclude outliers are crucial (Breitenmoser *et al.* 1993). The Home Range program identified potential outliers through three different procedures : 1) a binomial test of observation density; 2) a weighted bivariate normal technique; and 3) a list of points with large harmonic values. These outliers were then further examined with the stem-and-leaf analysis method of Breitenmoser *et al.* (1993) which utilises an outside value of each location. The outside value is the geometric mean of two values (a) the distance of the fix from the arithmetic centre of all fixes (DCent), and (b) the mean distance of the fix from all the other fixes (its' 'isolation value', DLocs). Thus for any fix,

$$\text{Outside value} = \sqrt{(\text{DCent} \times \text{DLocs})}$$

An observation is then classified as an outlier if its

$$\text{Outside value} > \text{H75} + 1{\cdot}5 * \text{HS}'$$

where H75 is the upper hinge (the third quartile = 75% of the ranked observations : Zar 1984) and HS is the hinge spread (median ± 25% of the observations)(Breitenmoser *et al.* 1993).

Finally, cumulative graphs of isolation values were examined visually before deciding to include or exclude the values (fixes). In such graphs fixes closest to the centre form a relatively densely packed slope, and the more widely spaced points most distant from the centre form a vertical tail; inspection may assist in identifying the discontinuity between the main body of fix points, and scattered outliers. Fixes separate from the main body of fixes are usually indicative of outliers. The true home range was then defined as the minimum convex polygon of all locations excluding the outliers.

Space use was further analysed by the Harmonic Mean method developed by Dixon & Chapman (1980) which calculates a harmonic mean centre of activity based on areal moments which are calculated from a grid square superimposed on the distribution of fixes. It provides a technique for accurate calculation of centres of activity, representation of home range use and, by calculating isopleths within which a proportion of all fixes lie, a method of estimating home range areas. The method produces a range of configurations that relate well to the actual distribution of fixes (Harris *et al.* 1990). Spencer & Barrett (1984) found that the predicted centre of activity for 45 home ranges of five California carnivore species calculated by the harmonic mean method, was always in the most used portion of the home range, and was often associated with a den site.

2.2.3 Daily activity patterns

Daily activity patterns were investigated by plotting the observed activities at the recorded locations over 55 full-day observation periods on a graph against the time period. A full-day observation period was defined as the entire period of daylight between approximately 30 minutes before sunrise and 30 minutes after sunset.

General movement patterns and space use can be illustrated by drawing sequential plots of activity in which fix points of activity are joined by straight lines in a time sequence. Tourist - ranger data were not utilised for sequential activity plots as they did not represent actual movements.

2.3 RESULTS

2.3.1 Data collection

Data were collected over the period September 1993 to October 1994, but some data were also recorded in April - May 1993. Radio collars were fitted to five dogs during the study period, of which at least two were operational at any one time. All dogs collared were members of the same and only pack in the study area (Plate 4).

2.3.2 Home range calculations

Location fixes by direct observation (n=2005) totalled 184 days. All duplicate fixes resulting from where dogs had remained in the same position for a period of time (Table 4) were removed from this data set, leaving 1013 locations (full data set). Limitations of the Home Range program allowed for only 1000 locations to be analysed at a time. However, analyses of the first 1000 and last 1000 locations produced identical results. All the duplicate or rest locations were included in a data set consisting of 1251 fixes at 253 locations (rest locations). A total of 141 location fixes from the telemetry data were obtained (telemetry data). Confirmed reports of sightings from tourists and rangers (n=83) were received for a further 44 days during the study period (tourist - ranger data).

PLATE 4 Only one pack of wild dogs is presently found in HUP

There was severe autocorrelation in the observation and telemetry data, but this was weak to absent in the tourist - ranger data (Table 5). This could be expected as the observations and telemetry locations were recorded sequentially while the tourist - ranger locations were at random.

Minimum convex polygons (MCPs') were drawn for each of the data sets (Figures 7 to 10). The area estimates for the MCPs' are listed in Table 6. Figures 11 and 12 plot all fix locations and join them in sequence with straight lines for the full data and telemetry data sets respectively. Figures 7 to 9 together with the sequential movement plots (Figures 11 and 12), all show similar areas of high use and low use. The areas of most intense use were on the east and west sides of the plot at about 15 km north (y-axis) which correspond to the Mapumulo - Manzibomvu and Hilltop - Mansiya Valley areas in HUP respectively. Other areas of less intense use are also visible. A crescentic blank area along the southeastern edge and a large blank along the southwestern edge of the plots (Figures 7 to 9) indicate that these MCP's may be providing an overestimate of the home range area by including areas which were not utilised by the wild dogs.

Identification and elimination of outliers was necessary before the area of the true home range was estimated. The Home Range program identified 91 outliers in the full data set. However, examination of the MCP (Figure 7) and movement plots (Figure 11) identified two fixes at the extreme southwest tip and three fixes along the southeast border of the fix distribution which were outliers. The stem-and-leaf analysis of Breitenmoser *et al.* (1993) generated only a single probable outlier (Figure 13). However, on a cumulative graph of the isolation values (Figure 14) two outlying points are clearly seen in the top right-hand of the scatter plot. Only these two extreme points were treated as outliers.

Removal of these outliers from the full data set had a dramatic effect on the analyses. The number of outliers identified by the Home Range software package decreased from 91 to zero. The reason for this was the shift in the location of the harmonic mean centre of activity from the main area of density usage on the east side of the plot (Figure 15), to a more central location within the fix distribution (Figure 16). The area of the MCP produced from the data set generated by the removal of these two outliers (Figure 16) was reduced to 218.37 km^2

TABLE 5 Serial autocorrelation of locational data of wild dogs in HUP

CALCULATED VALUE	STATISTIC		
	Psi	Gamma	$t^2:r^2$
Full data set	3.09	0.91	0.18
Telemetry data	3.09	0.88	0.23
Tourist - ranger	0.55	0.17	1.6
Expected value if observation independent	0.0	0.0	2.0
Significance level	>0.6	>0.3	<1.6 or >2.4

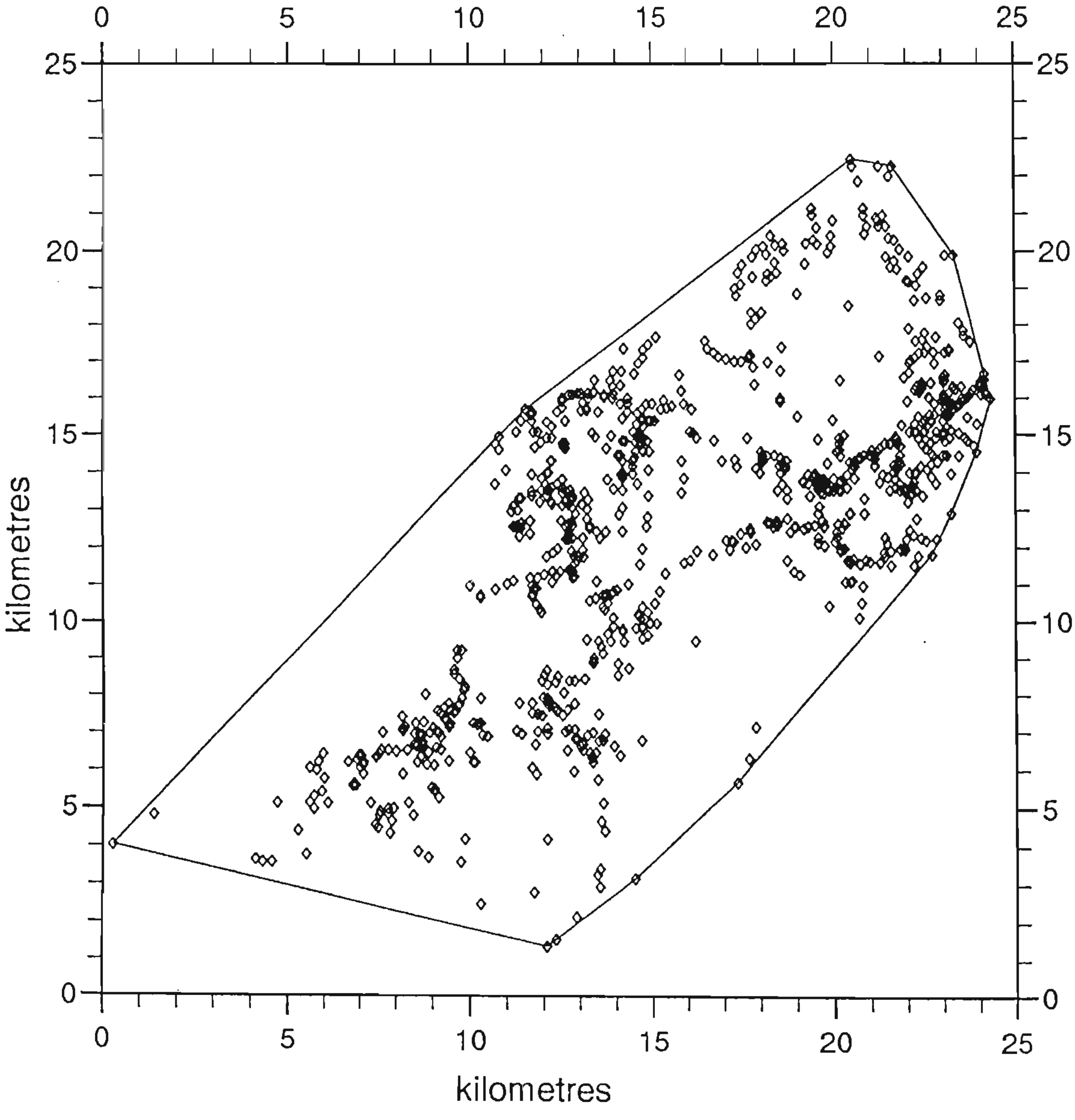

FIGURE 7 Minimum convex polygon drawn from the full data set with all points plotted (n=1000)

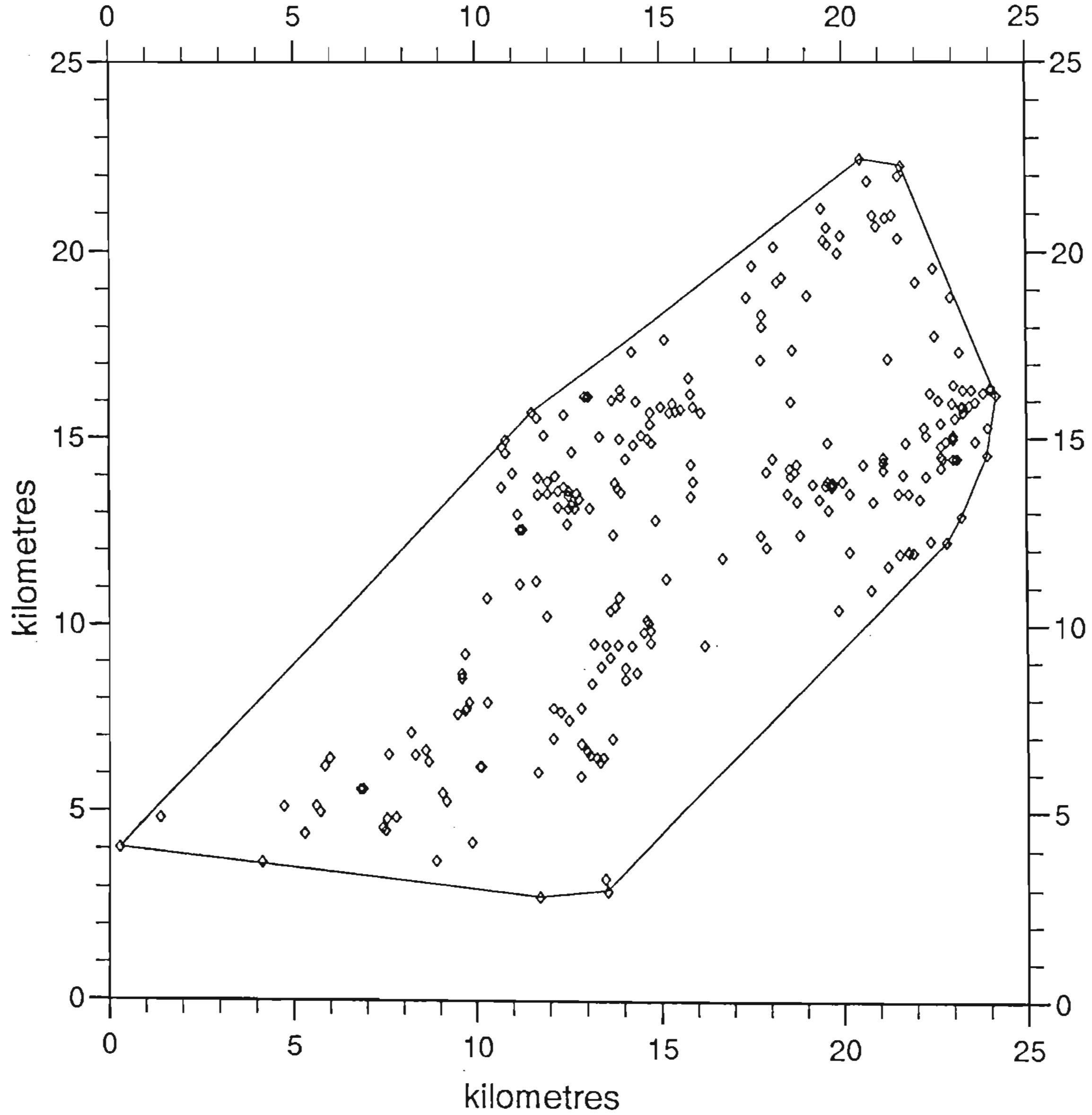

FIGURE 8 Minimum convex polygon drawn from the rest locations data set with all points plotted (n = 253)

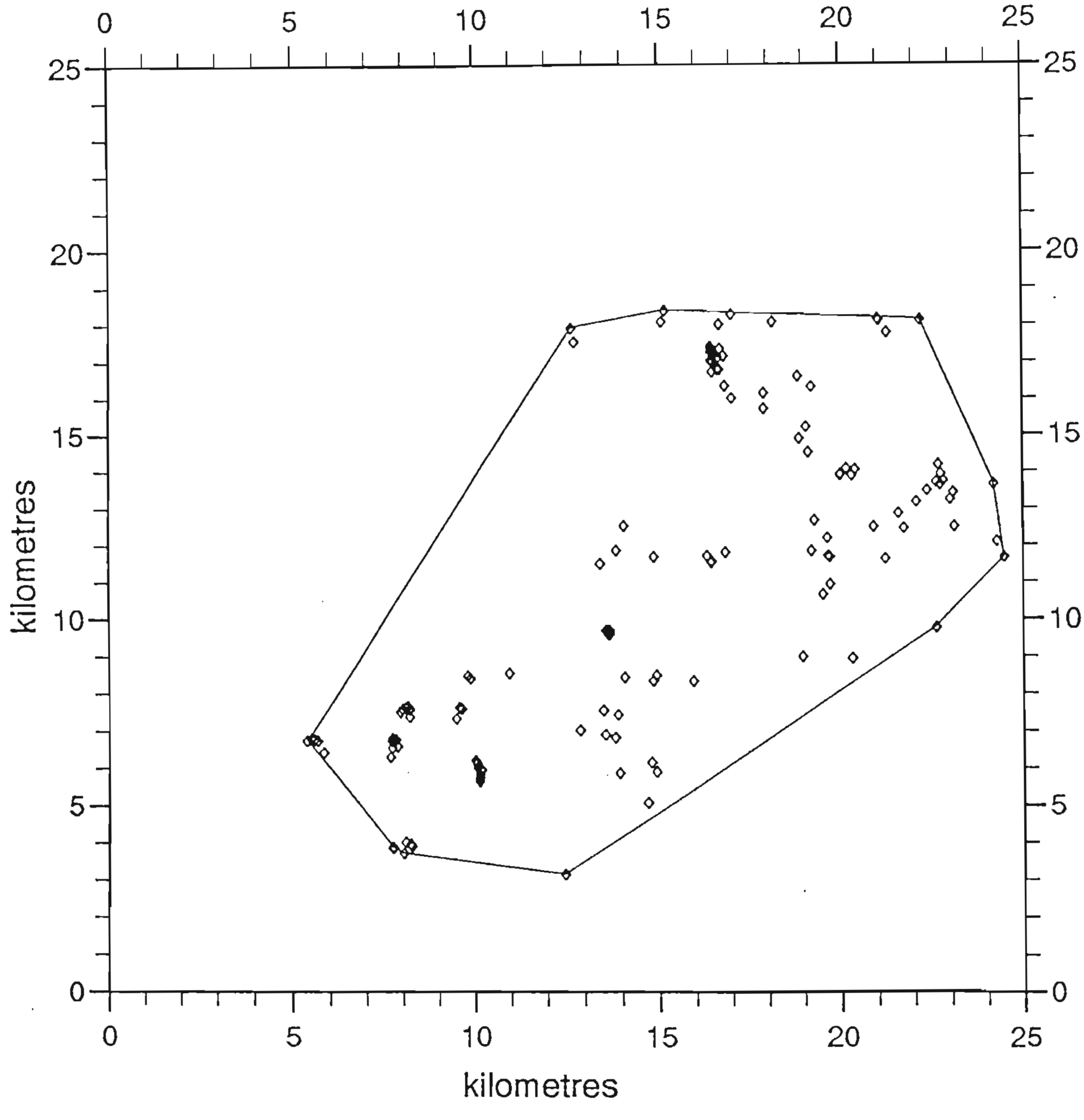

FIGURE 9 Minimum convex polygon drawn from the telemetry data set with all points plotted (n = 141)

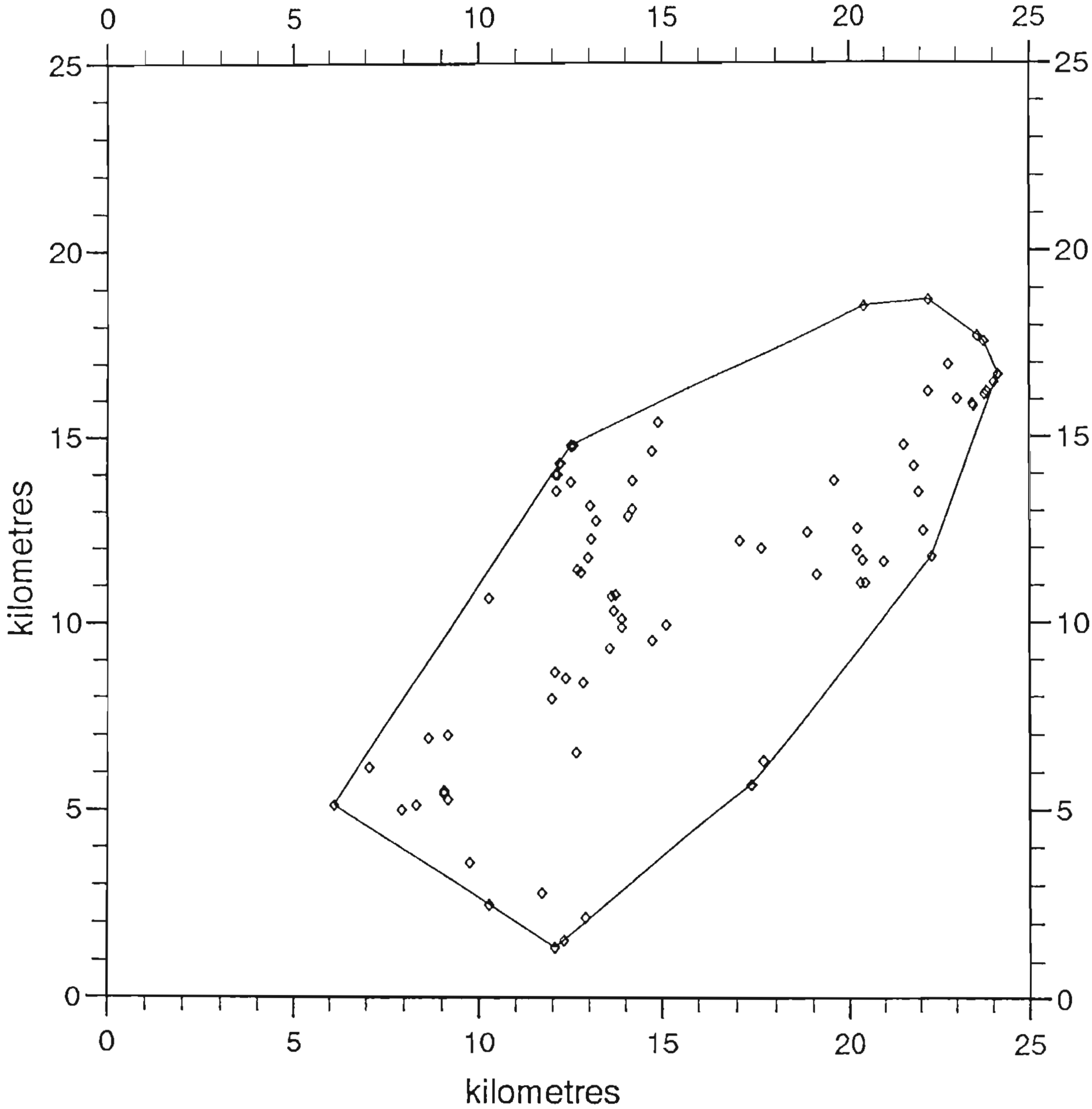

FIGURE 10 Minimum convex polygon drawn from the tourist - ranger data set with all points plotted (n = 83)

TABLE 6 Estimated home range areas of wild dogs, in km² enclosed by minimum convex polygons and the calculated eccentricity for each data set

DATA SET	AREA (km²)	% OF FULL DATA MCP AREA	ECCENTRICITY
Full data	242.35	100.00	2.34
Rest locations	223.29	92.14	-
Telemetry data	184.13	76.00	2.29
Tourist/ranger data	156.22	64.46	2.28
Full data (-2 outliers)	218.37	90.10	2.32

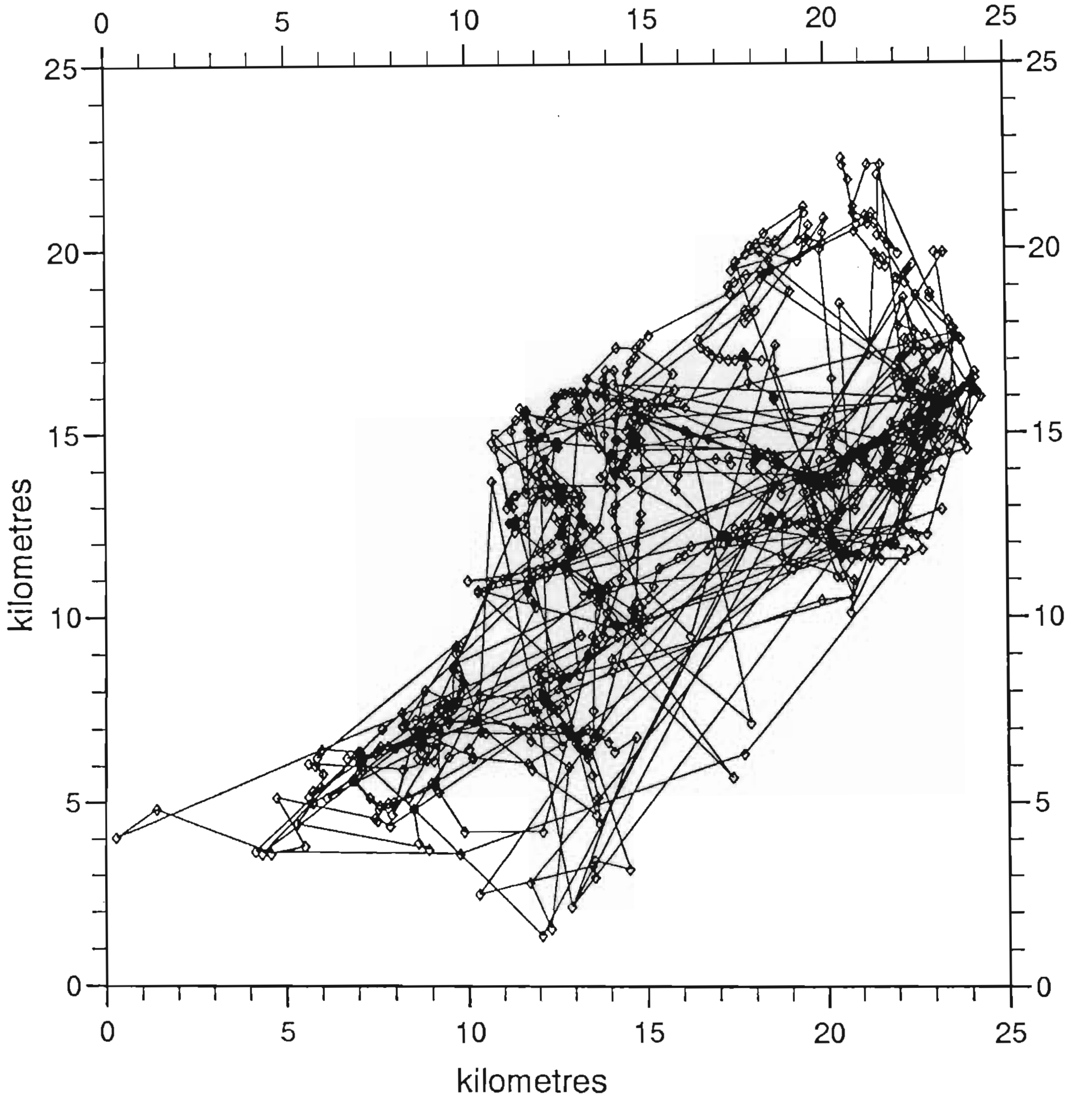

FIGURE 11 Plot of fixes for the full data set with fixes joined in temporal sequence

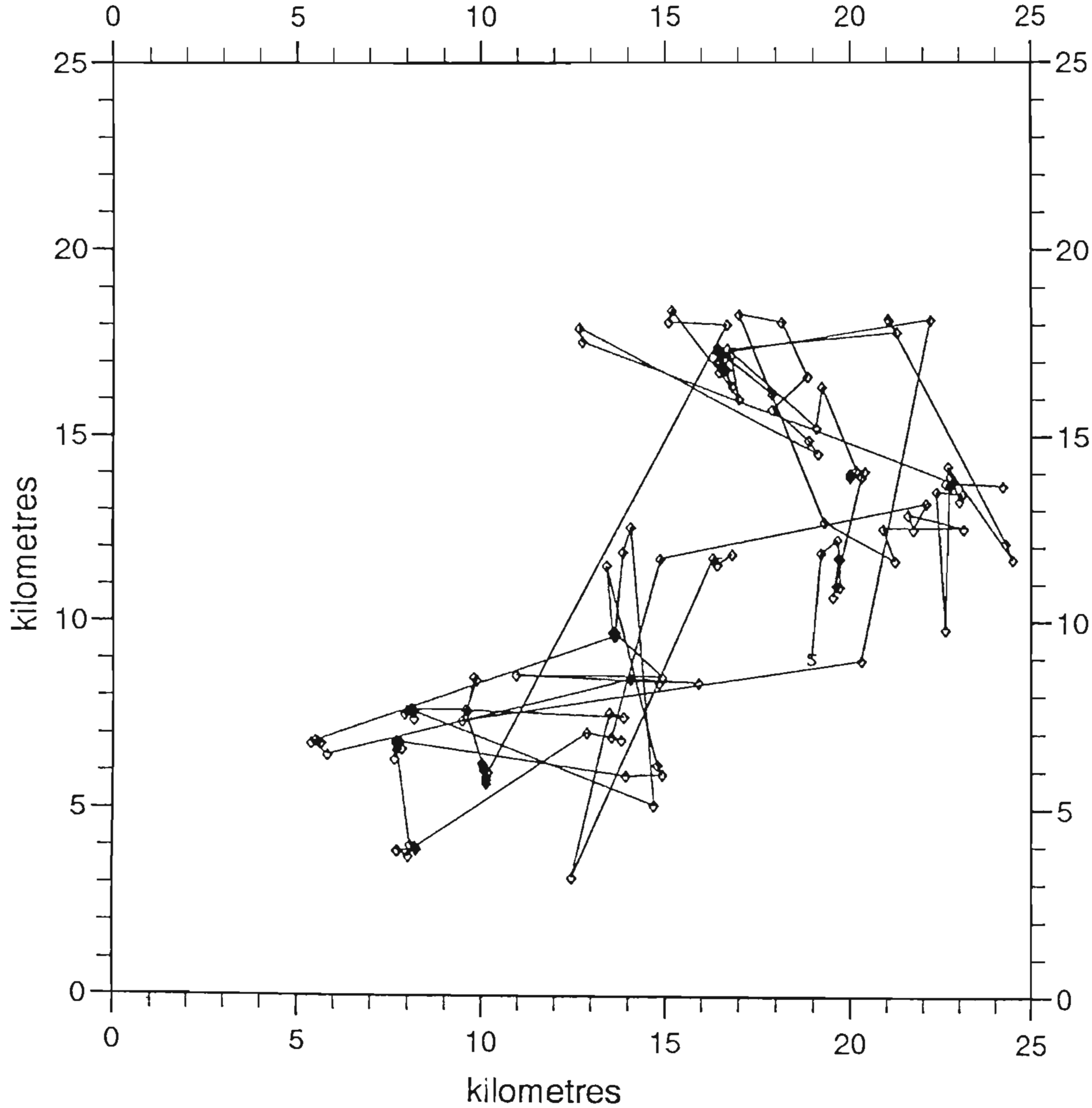

FIGURE 12 Plot of fixes for the telemetry data set with fixes joined in temporal sequence

```
1
 MTB > boxp c2

                      -----------.--
            ---------I     +      I----------------* **  **     *    O
                      ------------
          ----+----------+---------+---------+---------+----------+--C2
             3.0        6.0       9.0      12.0      15.0      18.0

 MTB > noou
```

FIGURE 13 Boxplot generated by a stem -and - leaf analysis. A single outlier is designated by the 'O'

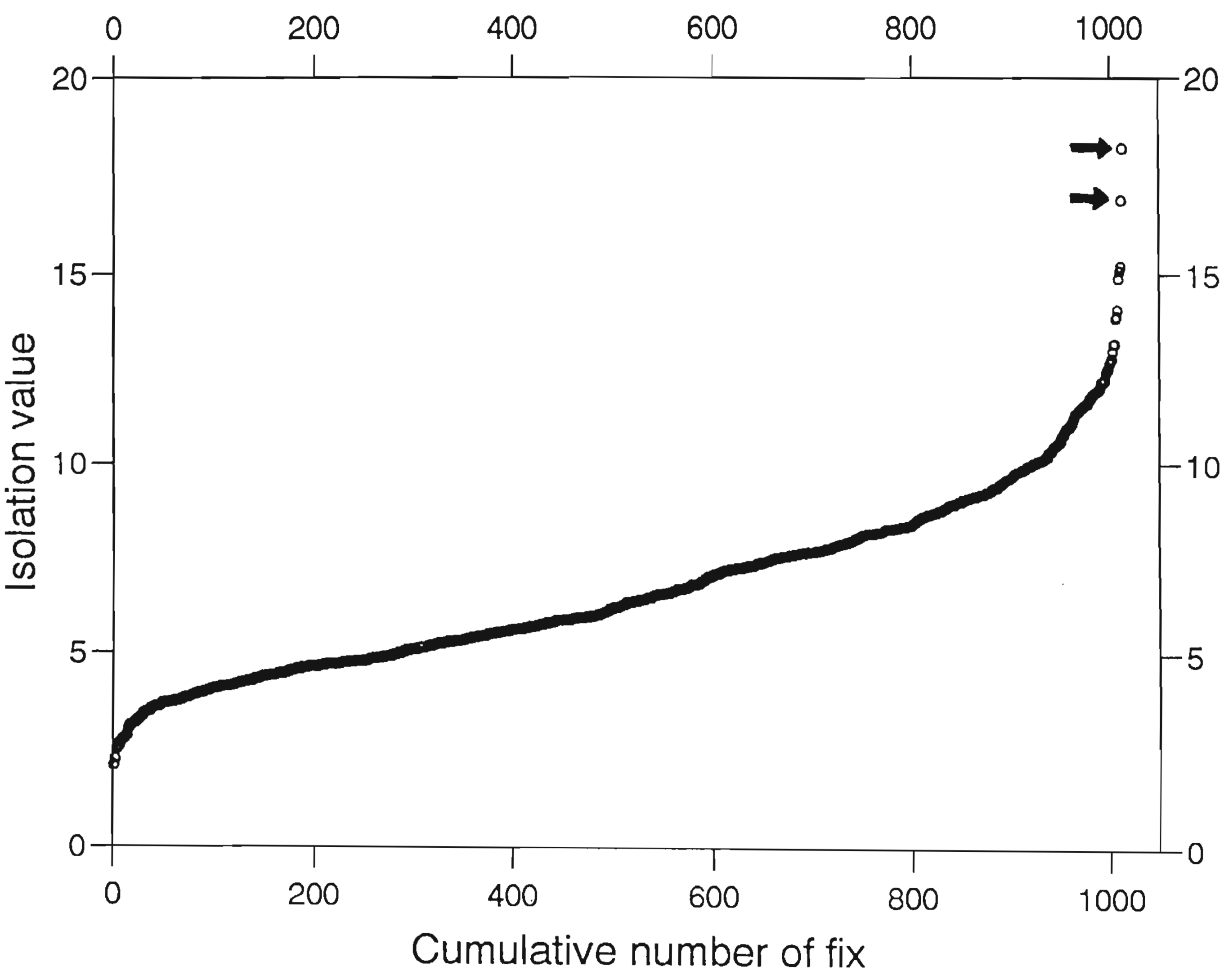

FIGURE 14 Cumulative graph of isolation values. Two outliers indicated by the arrows

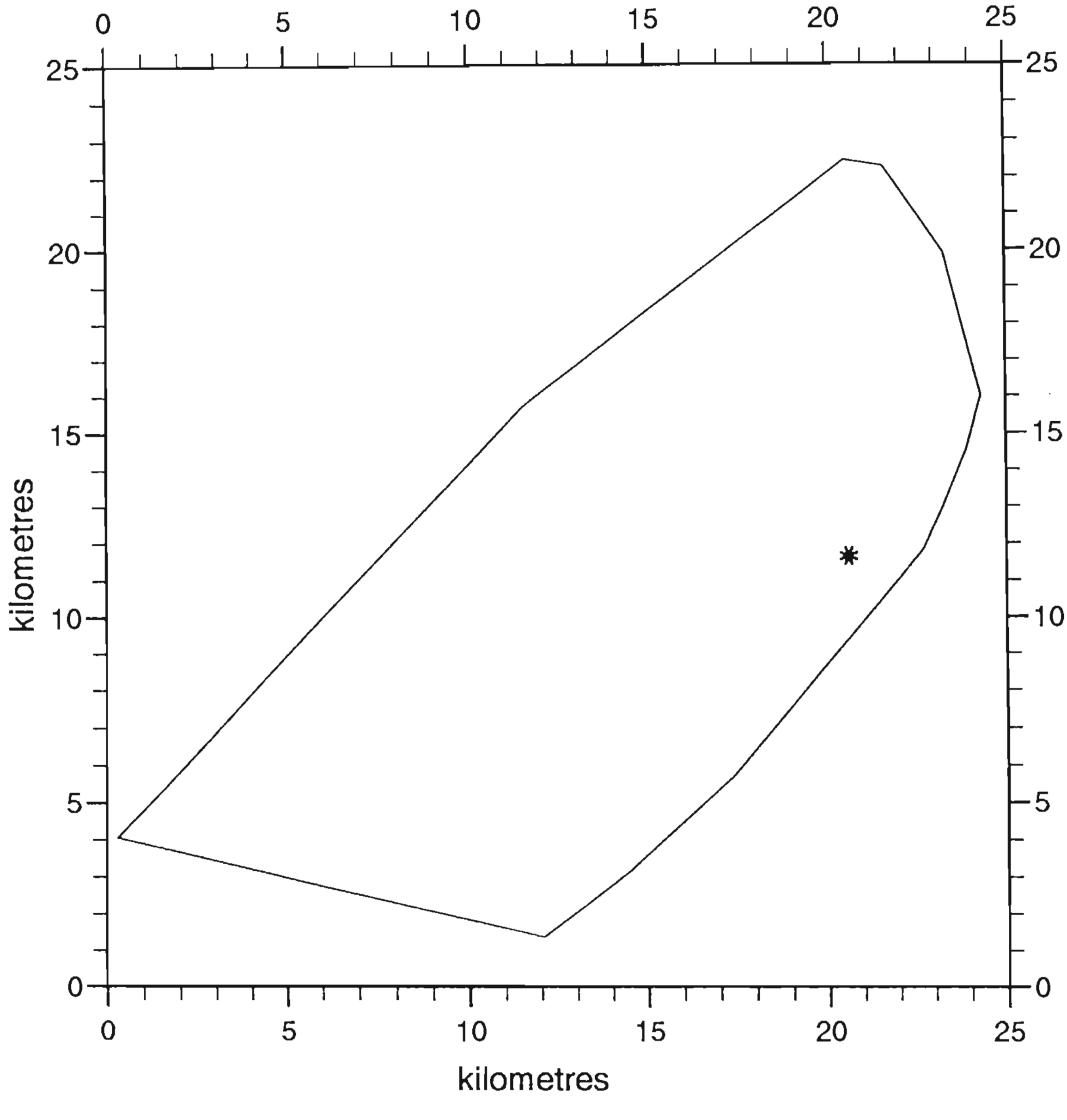

FIGURE 15 Minimum convex polygon from the full data set including outliers, with the harmonic mean centre of activity indicated by the *

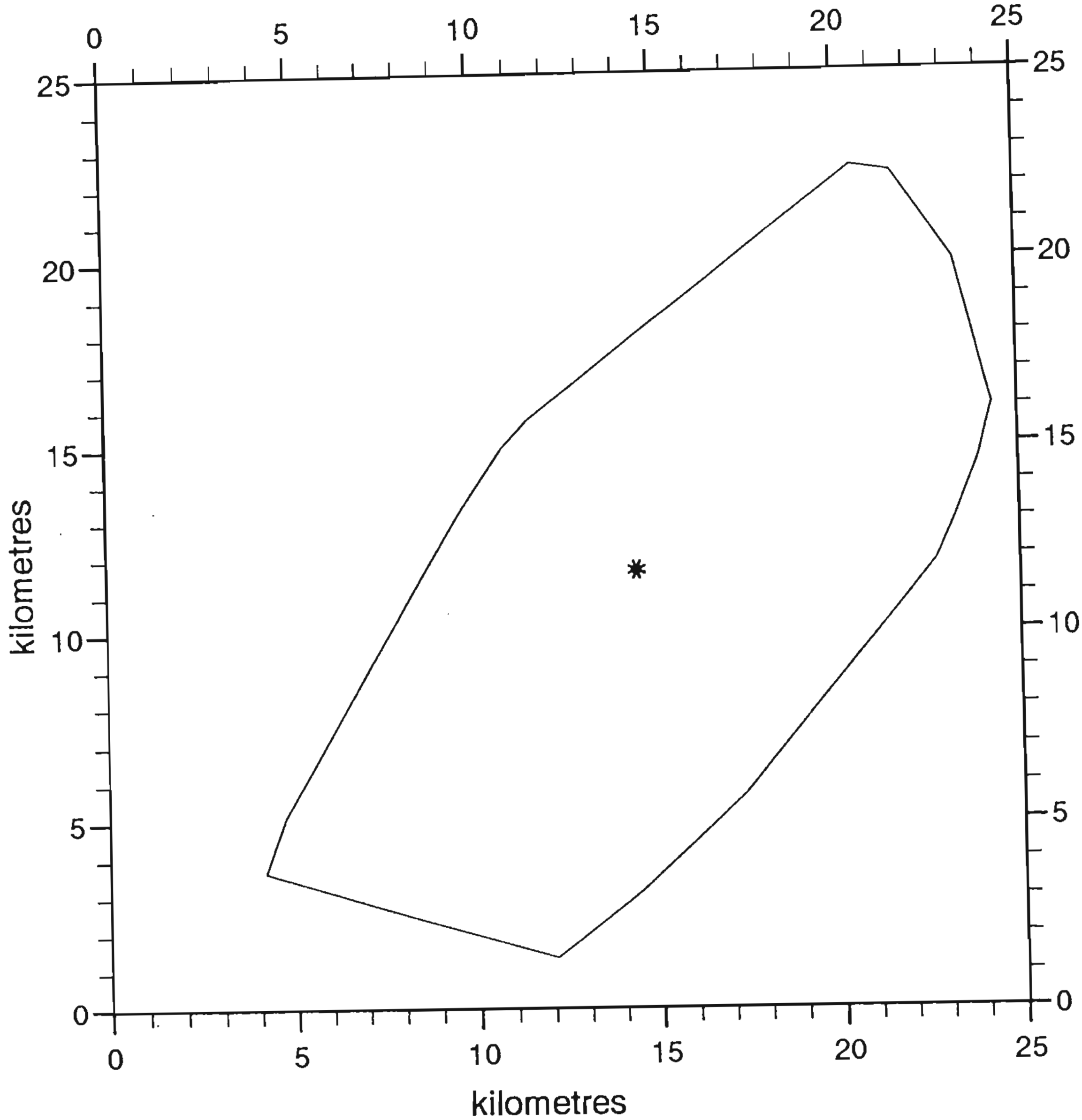

FIGURE 16 Minimum convex polygon from the full data set less the two outliers, with the new harmonic mean centre of activity indicated by the *

(Table 6). The blank peripheral area in the south west of the MCP is reduced (Figure 17). Some blank areas remain within the MCP, suggesting a slight overestimate of home range area. However, since the MCP is delimited by the outermost points at which the animal was observed, it is likely that the wild dogs used a small amount of space outside the observed MCP. Therefore, it is reasonable to assume that these two affects counter each other to some extent, and that the MCP from the full data set less the outliers can be accepted as a good estimate of the true home range of this population of wild dogs (I. Linn, 1995, pers. comm. [9]).

Home Range identified only one outlier in the northeast corner of the range for the telemetry data (Figure 9). However, visual examination of the plot did not support this finding and the possible outlier was not removed. The smaller home range area (Table 6) was expected as home range area tends to increase with an increase in the number of data points. The similarity between the full data and telemetry data MCPs is illustrated in Figure 18.

The Home Range package identified no outliers in the tourist - ranger data. The appearance of the fix locations (Figure 10) and the configuration of the MCP are very similar to those of the other data sets (Figure 18). The MCP area is smaller as expected for the smaller number of fixes (Table 6).

All the normality tests applied by the Home Range package were failed by these data sets ($p<0.01$) and data were thus severely non-normal in all cases. Jennrich & Turner (1969) employed an elliptical home range model based on a bivariate normal distribution (Koeppl *et al.* 1975) which analysed home range as probabilistic ellipses. The lack of bivariate normality for these data made attempts to generate ellipses totally inappropriate. The test for bivariate uniformity was failed by all the data sets except the tourist - ranger data ($p<0.01$). This is because these data show less clumping than the other sets.

Use of space by the wild dogs during the study period is illustrated by simple plots of fix locations of the data sets (Figures 11 and 12). Isometric (Figure 19) and contour (Figure 20) plots created from the harmonic mean utilisation distribution data produced by the Home Range

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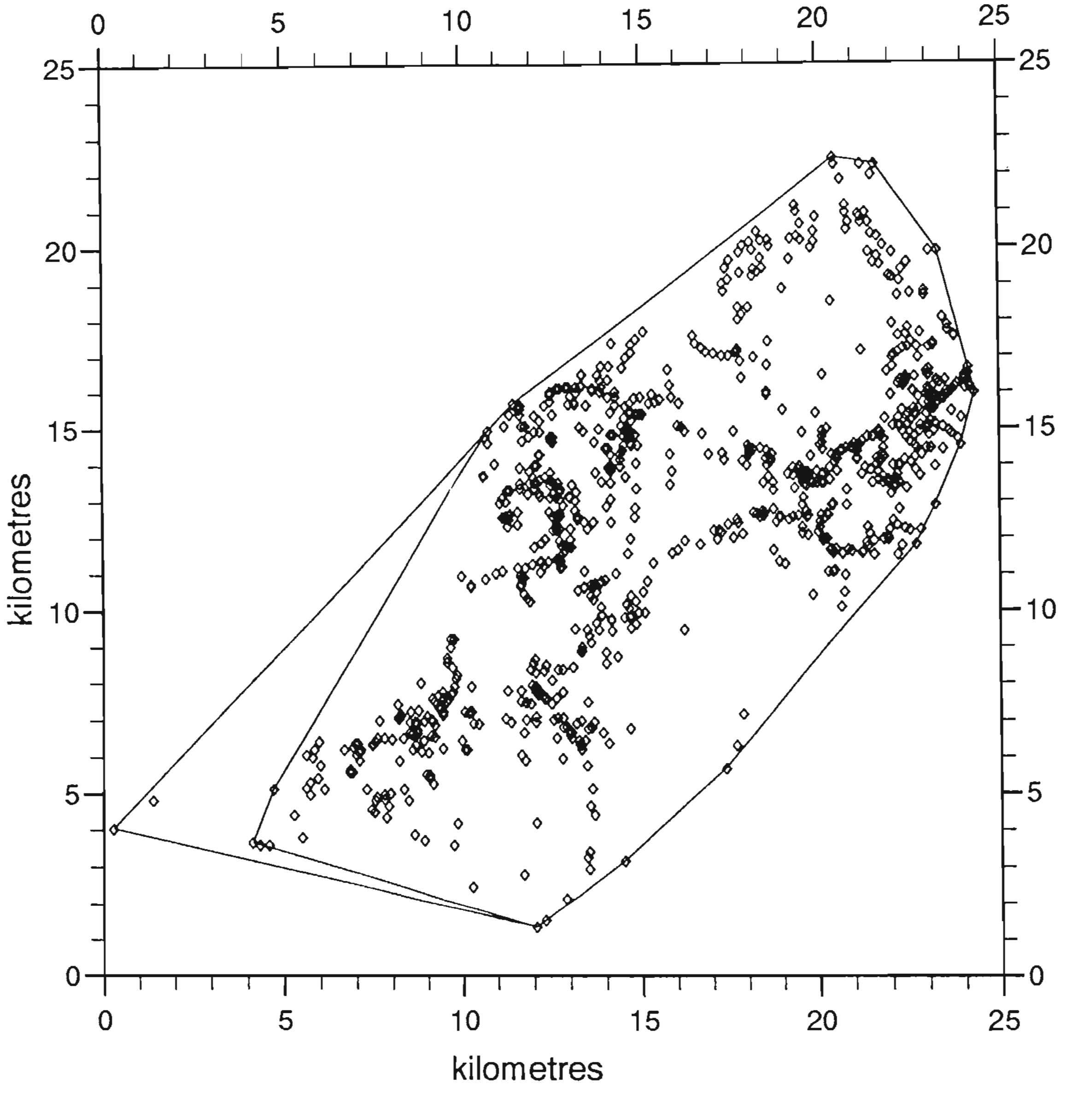

FIGURE 17 Minimum convex polygons from the full data and the full data less two outliers, illustrating the effect of the removal of the outliers on the area of the MCP and the blank areas within the MCP

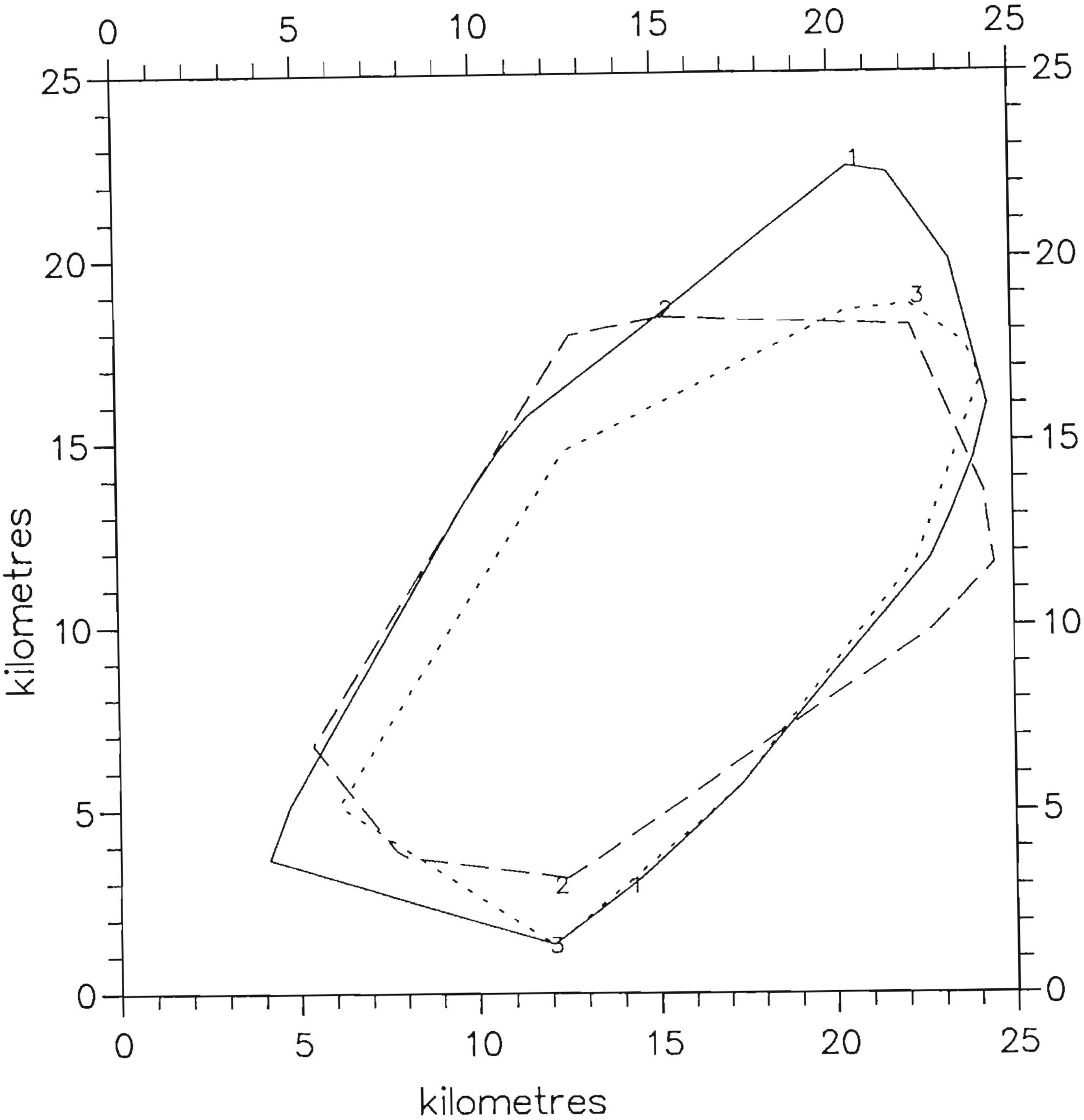

FIGURE 18 Superimposed minimum convex polygons of all the data sets. Contour 1 represents the full data set less the two outliers; contour 2 represents the telemetry data sets; and contour 3 represents the tourist/ranger data

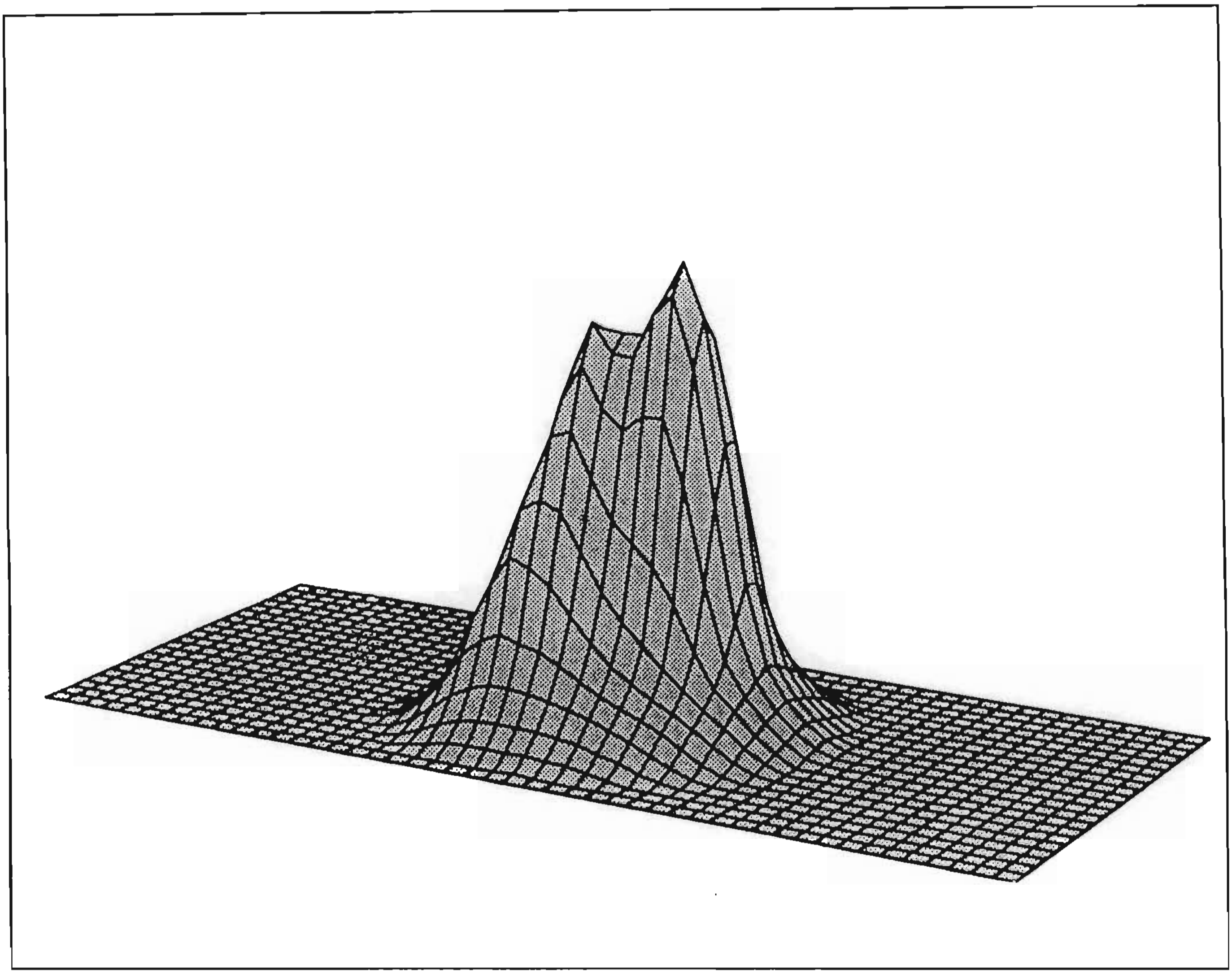

FIGURE 19 Isometric plot created from the harmonic mean utilisation distribution data produced from the full data set. Height represents the intensity of usage. Single smooth peaks indicate symmetrical use of space (viewed from south-east corner)

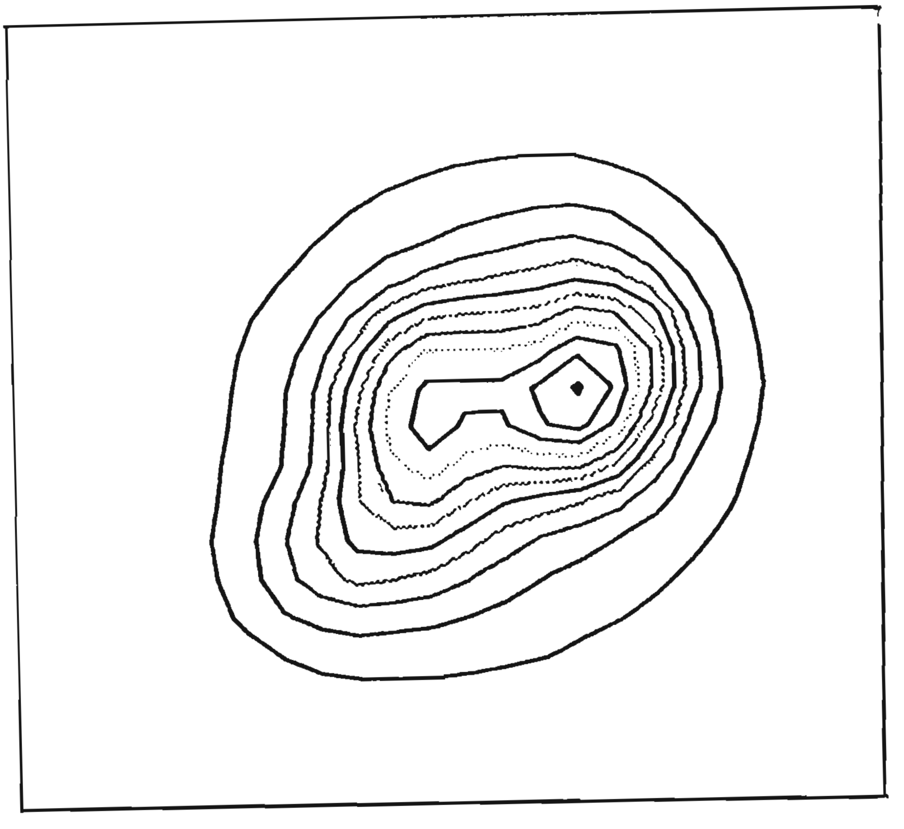

FIGURE 20 Contour plots created from harmonic mean utilisation distribution data produced from the full data set. The north-east - south-west elongation is illustrated

package from the full data set show a reasonably symmetrical use of space by the wild dogs with the expected north-east - south-west elongation, and a small but distinct bimodal peak. This was confirmed by calculating the eccentricity (ratio of major to minor axes) which was very similar for each of the data sets (Table 6). A perfectly symmetrical circular home range would have an eccentricity of unity. No biologically significant core areas were identified because of the very compact use of space by the wild dogs. Grid cell utilisation plots were constructed for the full data and rest location data sets (Figures 21 and 22) to illustrate space use in greater detail. The height of the columns represent the number of fix records within each 1km x 1km square of the 25km x 25km square.

Space use and general movement patterns of wild dogs in HUP is illustrated by plots of all fix locations recorded during the study period with fixes joined in time sequence (Figures 11 and 12). These plots indicate extensive use of a relatively compact home range, with few if any exploratory excursions outside the range during the study period.

Sequential plots of activity on a monthly basis are illustrated in Figure 23 a - p. These plots highlight some interesting movement patterns by the dogs and emphasize the large distances which they cover within their home range. In most months, the dogs moved between the extreme northern and southern sections of the home range, spending varying amounts of time in certain areas. Some preferred areas were identified, namely the Gontshi forest area in the extreme north (Figures 23 g,h,l,m), Hidli Vlei area near the northern gate of the Park (Figures 23 d,g,i,m,p), Mansiya River Valley in the west cental area (Figures 23 h,i,m,p), and the Seme Pan area in the south west part of the range (Figures 23 g,h,i,n,o). Main roads, which were used by the dogs, were distinguished on the movement plots (Figures 23 d,h).

2.3.3 Daily activity patterns

Certain constraints such as inability to locate the dogs, inclement weather, inaccessible terrain, 'bounced' telemetry signals and the nomadic habits of the wild dogs made full-day observational periods extremely difficult. A total of 55 full-day observational periods was obtained during the study.

Observations of the activities of the wild dogs recorded over full-day observational periods

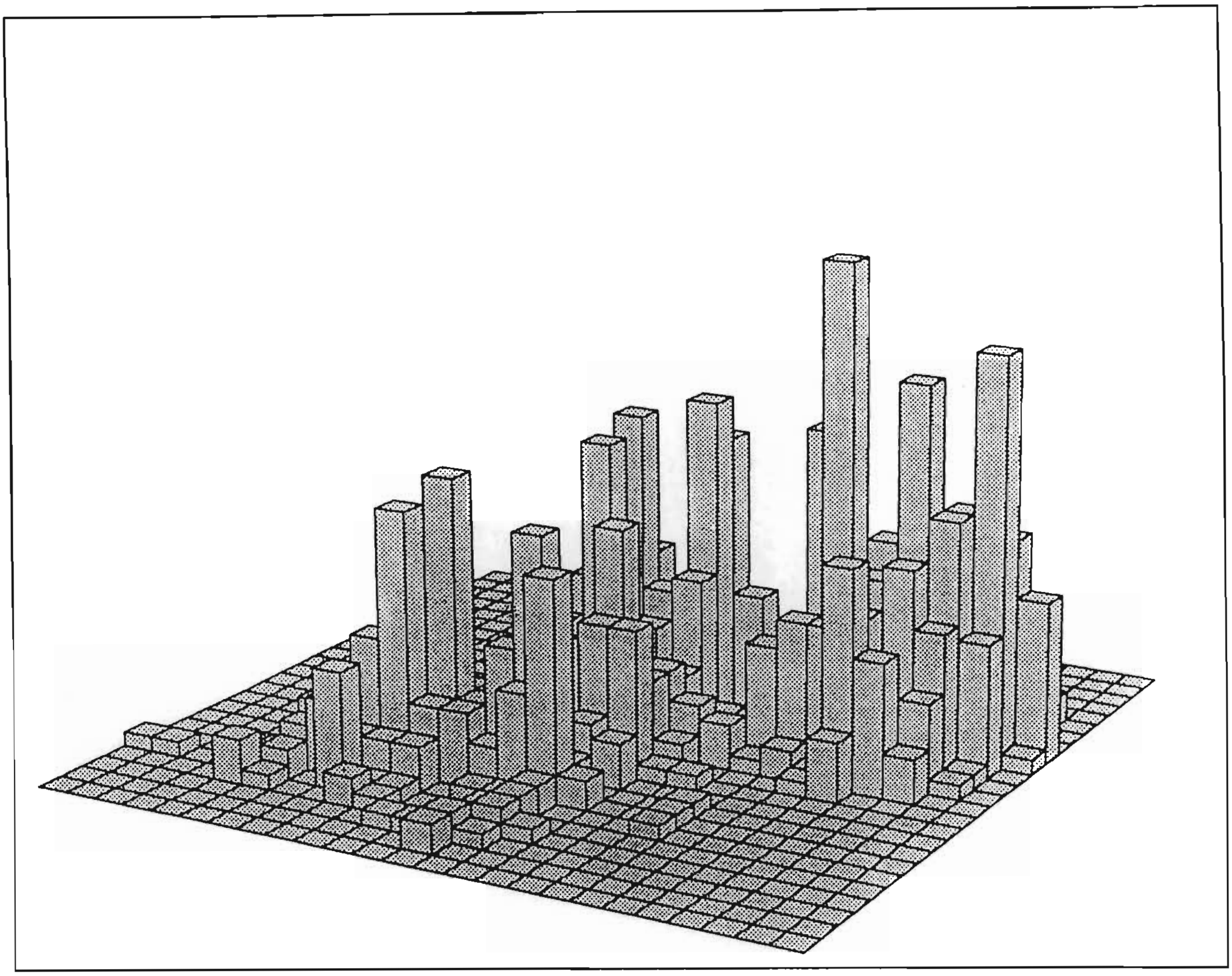

FIGURE 21 Grid cell utilisation plot from the full data set. Grid cells are 1km X 1km. Height of the columns represents the number of fixes within the square (viewed from the south-east corner)

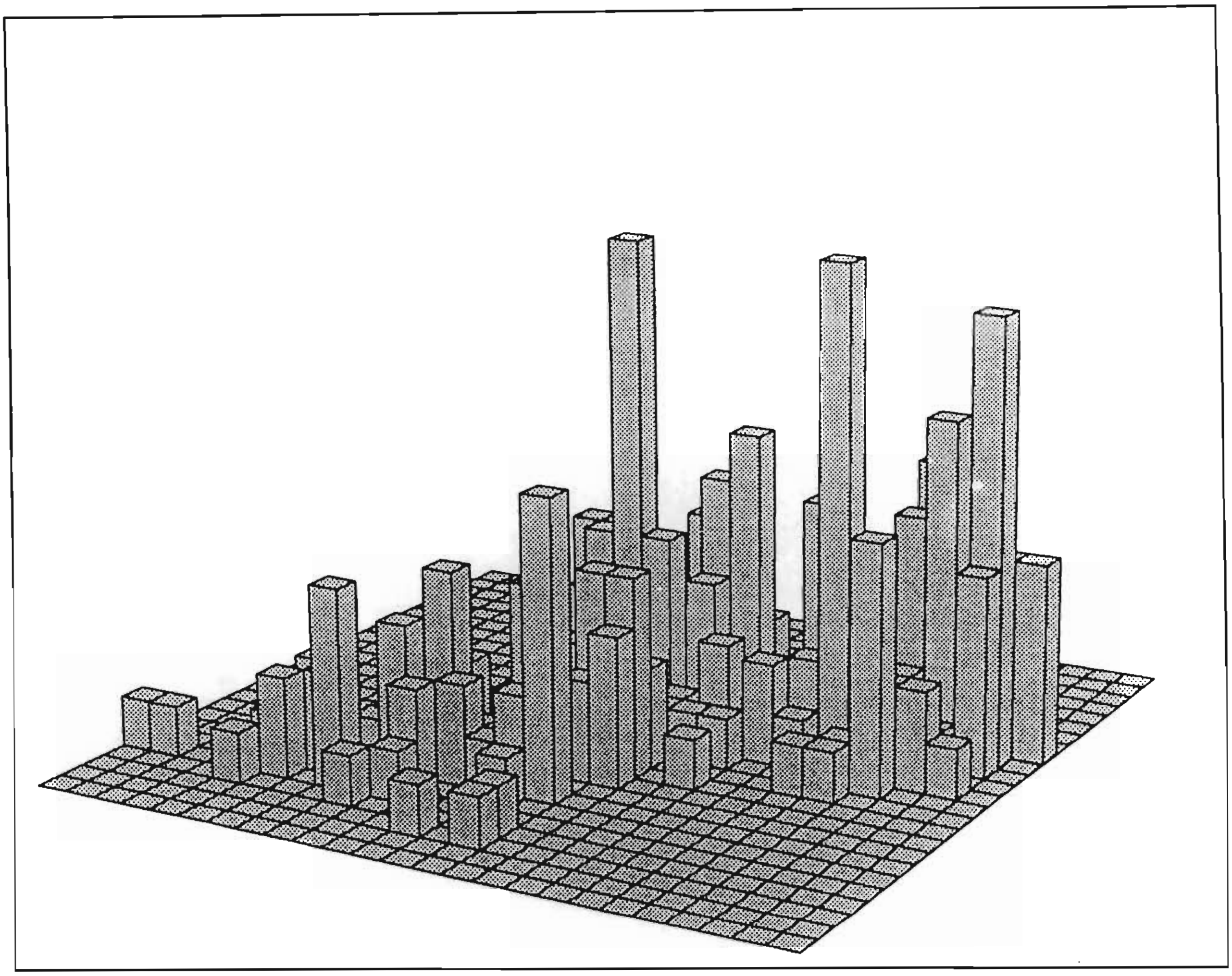

FIGURE 22 Grid cell utilisation plot from the rest locations data set. Grid cells are 1 km X 1 km. Height of the columns represents the number of fixes within the square (viewed from the south-east corner)

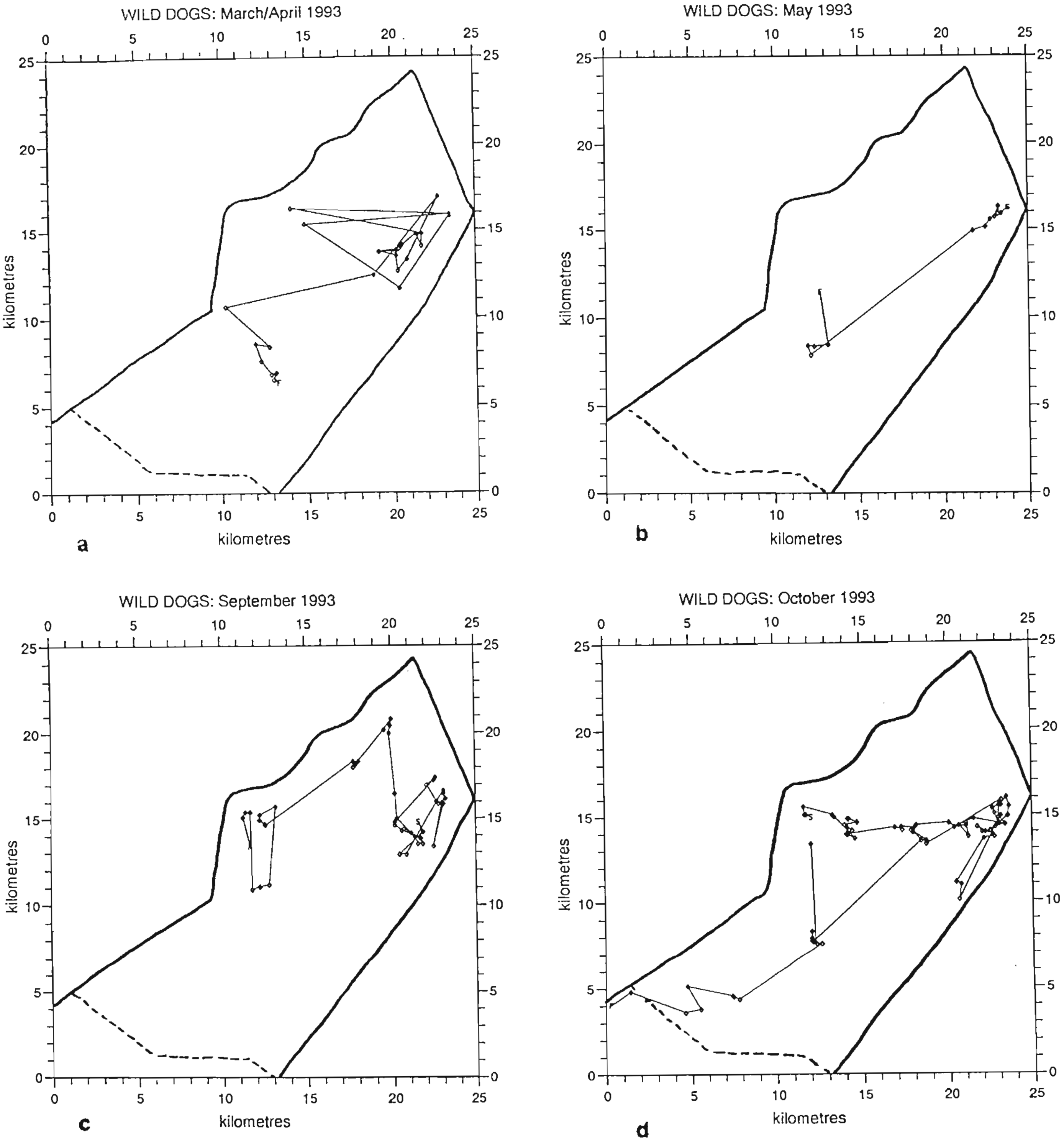

FIGURE 23 a-d Monthly sequential movement plots with fixes joined in temporal sequence. S is the first location in the month; F is the last. Arrows indicate areas referred to in the text

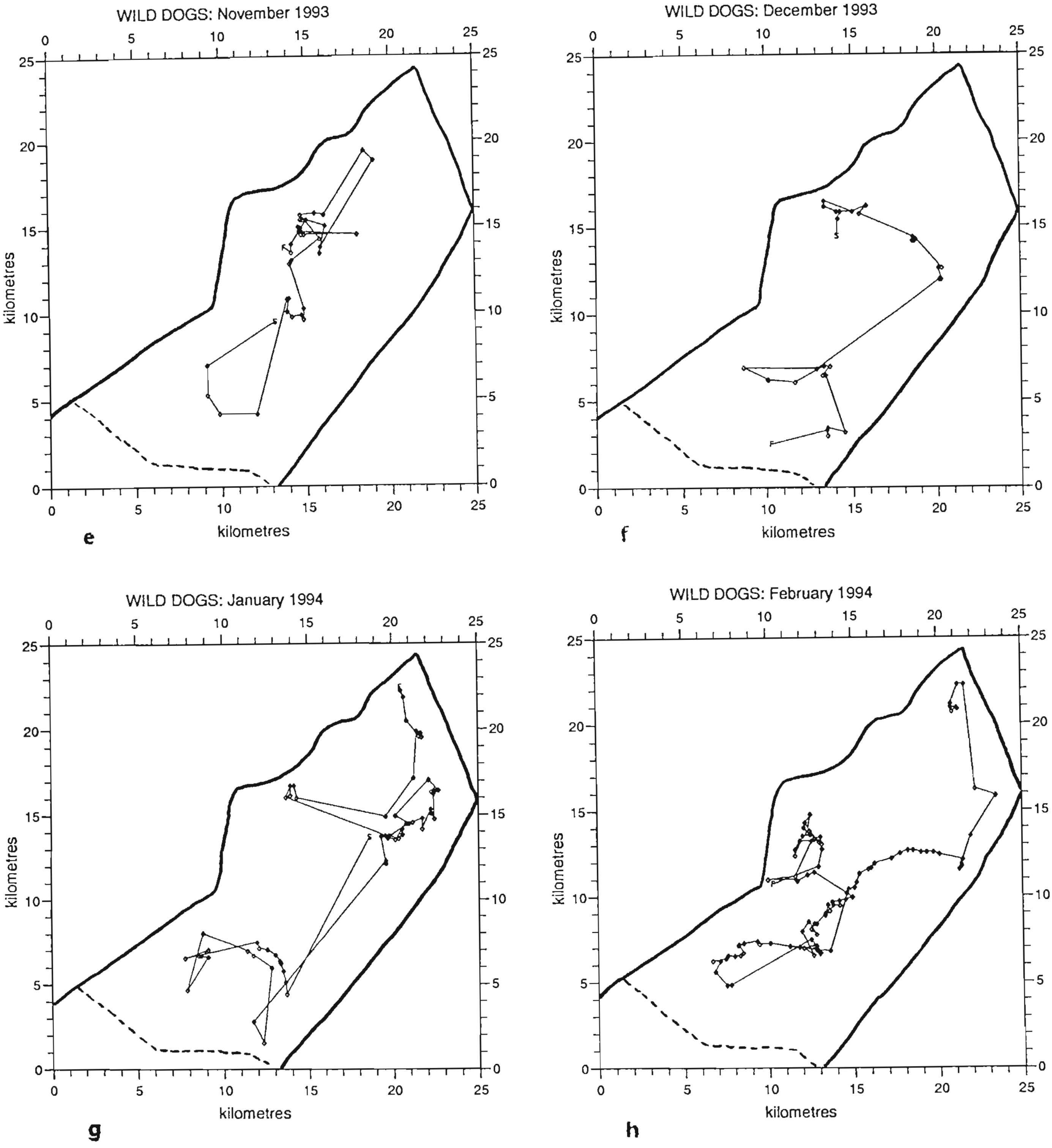

FIGURE 23 e-h Monthly sequential movement plots with fixes joined in temporal sequence. S is the first location in the month; F is the last. Arrows indicate areas referred to in the text

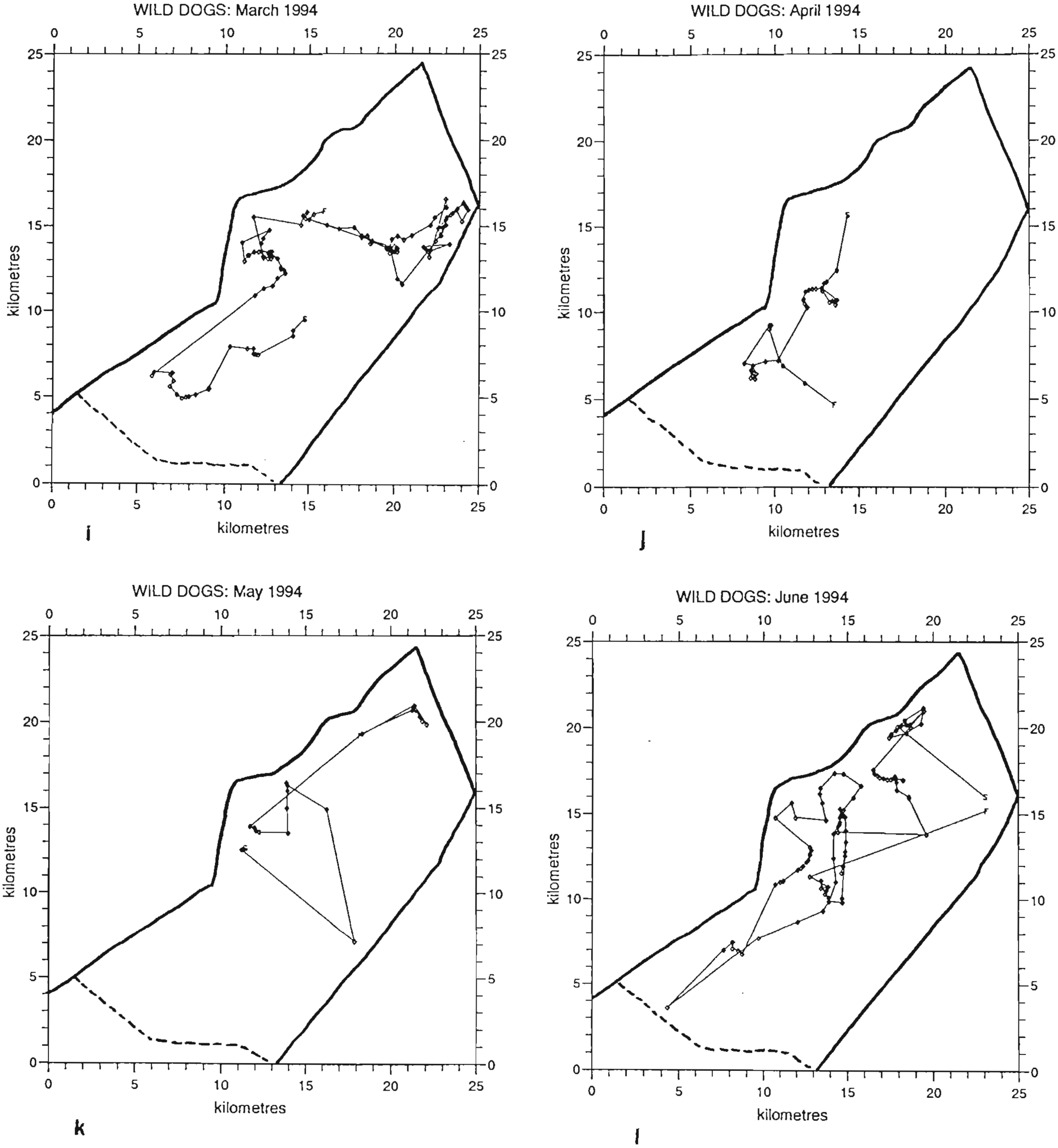

FIGURE 23 i-l Monthly sequential movement plots with fixes joined in temporal sequence. S is the first location in the month; F is the last. Arrows indicate areas referred to in the text

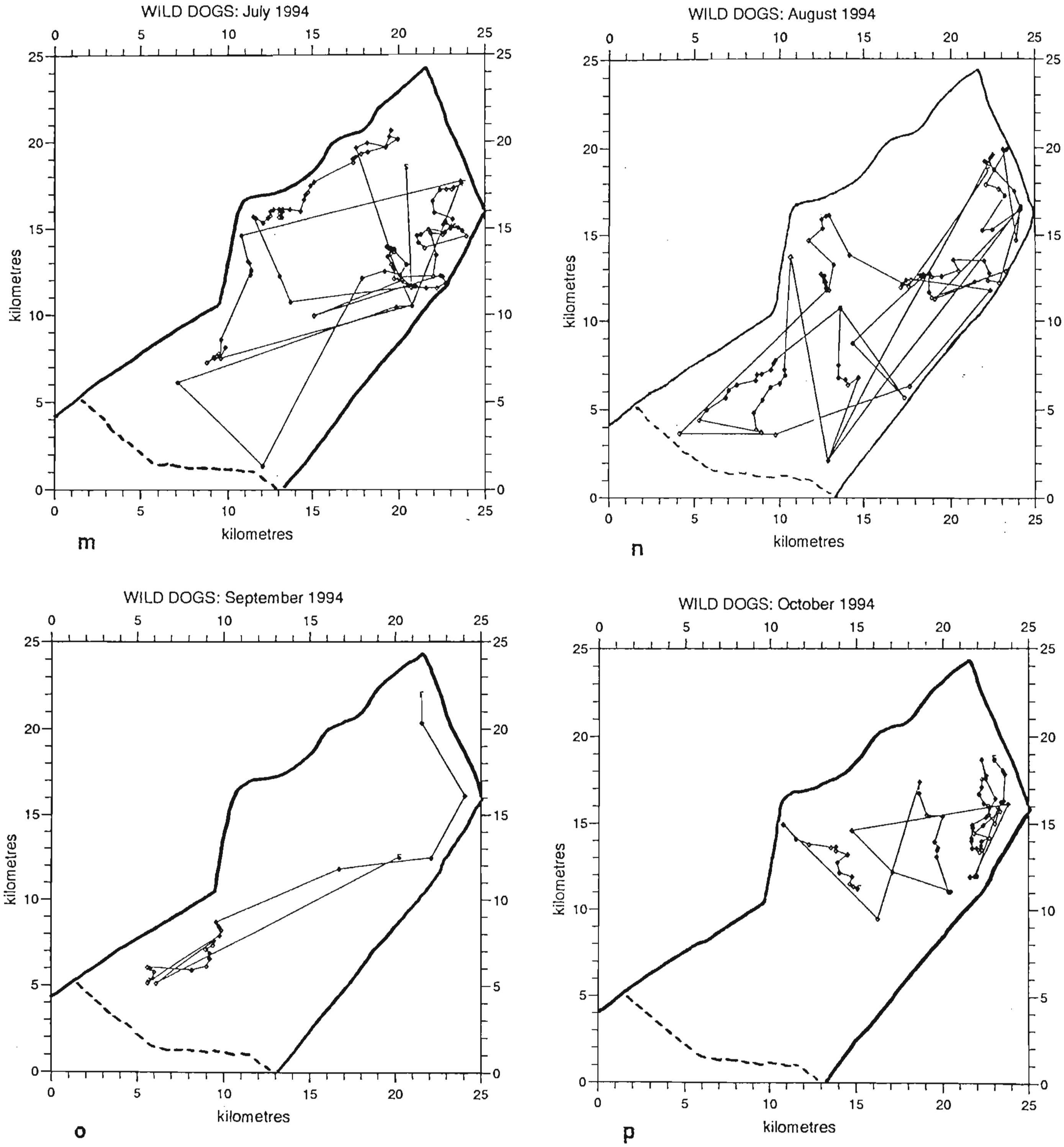

FIGURE 23 m-p Monthly sequential movement plots with fixes joined in temporal sequence. S is the first location in the month; F is the last. Arrows indicate areas referred to in the text plotted against the time of day clearly showed a bimodal pattern of activity for the HUP wild dogs. Figure 24 showed peak movement periods to be between about 05h30 - 09h00 and 15h30 - 19h00. The warmer midday period between ± 09h00 - 15h00 was generally spent resting in some shaded area. Figure 25 showed that peaks of hunting and feeding activity generally coincided with the peaks of movement activity (Figure 24). A few observations of hunting and feeding were recorded in the midday hours.

2.4 DISCUSSION

Data collection in HUP was hindered by the undulating topography, dense vegetation, inaccessibility of many areas and the extreme mobility of the study animals. Underestimating the effect of such factors on data collection affects the final results.

Observation was the most reliable method of data collection. However, due to the circumstances mentioned, it was not possible to rely on observations alone for sufficient data collection. Radio telemetry was an extremely effective means of locating these highly mobile carnivores in this terrain, but the reliability of triangulation as a technique for plotting positions for home range analysis is questionable. It is important to note that a very small percentage of the total number of triangulations taken actually produced reliable locations. This was attributed largely to the hilly terrain together with the dense vegetation which combine to make accurate telemetry bearings extremely difficult to achieve. However, the relative similarity in area and shape of the full data and telemetry data MCP's (Figure 18) is an indication of the reliability of the telemetry data and suggests considerable stability of the home range of the wild dogs. It is thus suggested that telemetry should rather be considered as a tool to aid observational data collection, especially for highly nomadic animals such as wild dogs, rather than as the sole means of data collection.

Tourists and rangers have proved to be valuable aids in the collection of data for similar research projects (Maddock 1989; Maddock & Mills 1994). Care has to be taken however in using these groups as a source of data as reports can be unreliable, inaccurate and over-exaggerated.

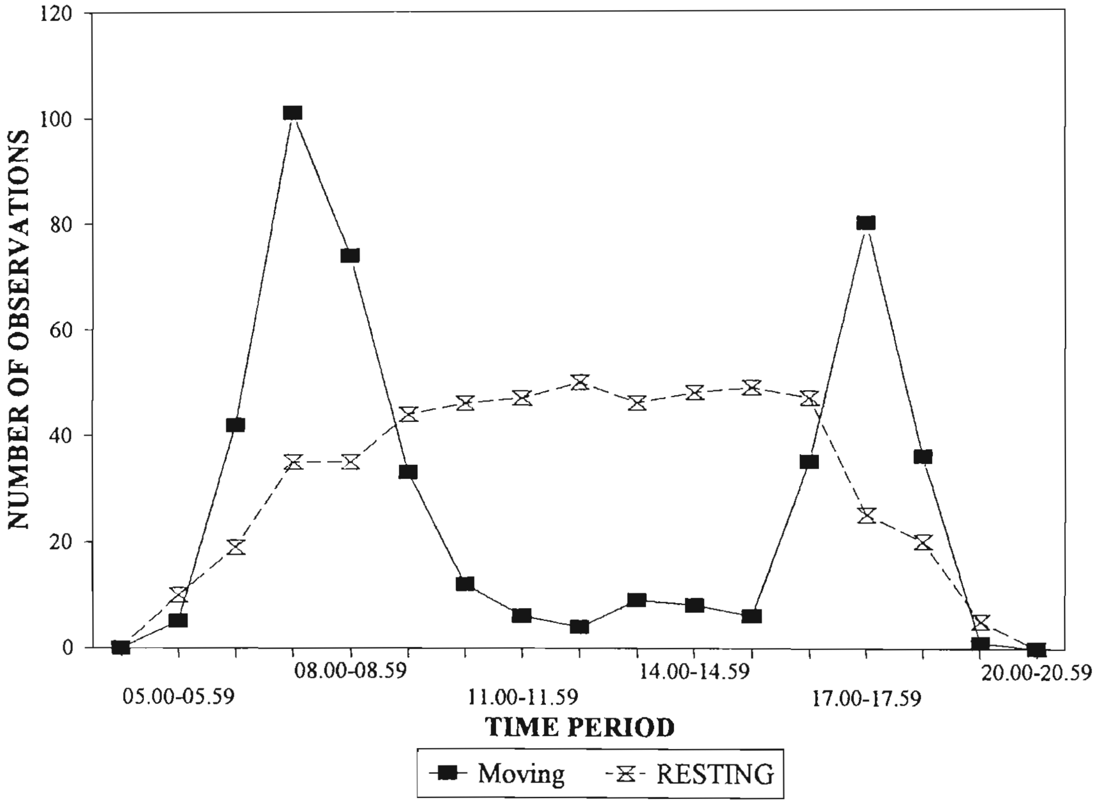

FIGURE 24 Moving and resting activities of wild dogs plotted against time of day for observations over 55 full-day tracking periods

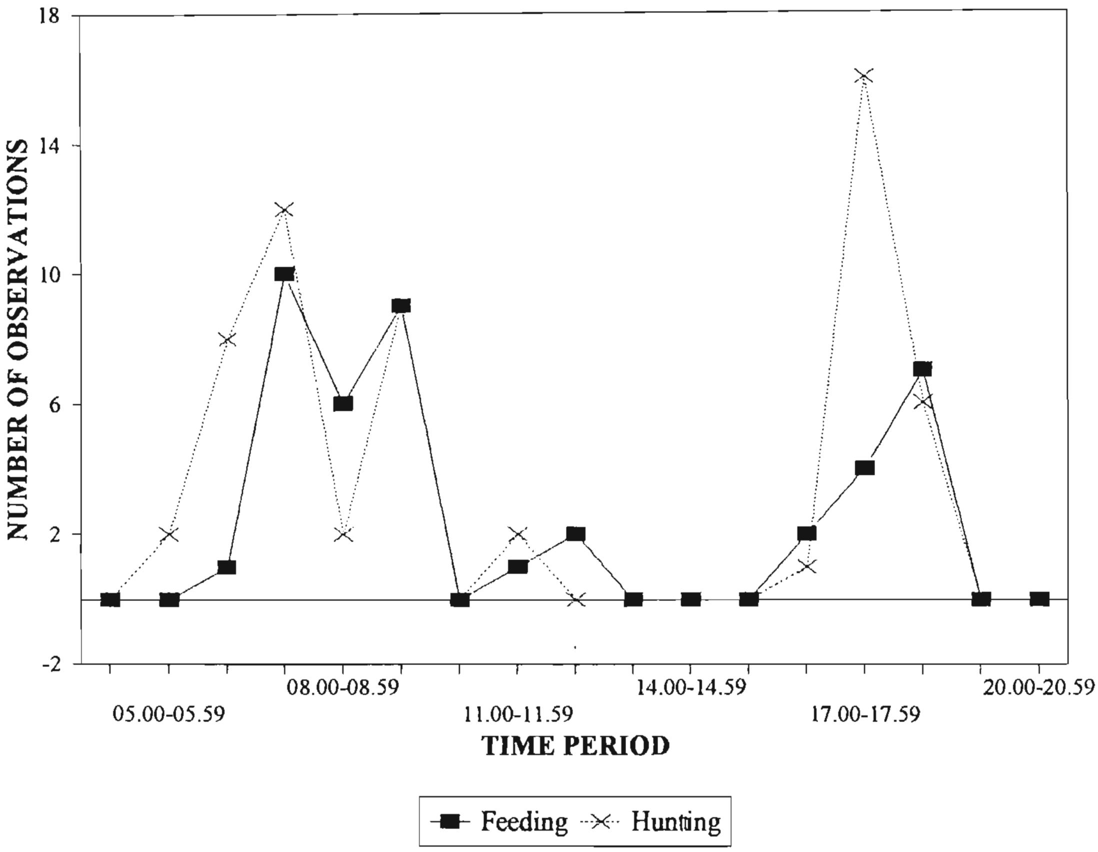

FIGURE 25 Feeding and hunting activities of wild dogs plotted against time of day for observations over 55 full-day tracking periods

The MCPs' and sequential activity plots suggest that the HUP wild dog population has a relatively stable home range which they utilise extensively and fairly evenly during their normal daily activities. They do not wander throughout HUP, but remain within the limits of their home range which is situated wholly with HGR.

Only one excursion to the extreme south east of the home range was observed during the study period and was regarded as a once-off excursion. The removal of the resulting points from the data had a significant effect on the home range analyses and provided a more reliable estimate of the true home range by removing areas which were not used by the dogs from the range. Some reports of wild dogs having been sighted in Umfolozi were received, but none could be reliably confirmed.

The true home range area was calculated at 218.37 km^2 (Table 6) which is approximately 72.8 % of the total area of HGR. This constitutes only 22.7 % of the total range available in HUP. Space available in HUP is thus severely underutilised by the present population of wild dogs. The boundaries of the home range have a very similar configuration to those of the HGR and lie very close to these boundaries. The wild dogs were thus extensively utilising the space available to them in Hluhluwe, but did not venture over the Corridor road into the UGR. After October 1993 some dogs did split off from the main pack and moved south to UGR. This pattern of activity is synonymous with the natural method of dogs splitting from a pack and seeking other packs or dogs to join or form a new pack (Frame & Frame 1976b; Fuller *et al.* 1992). The main group however remained in the home range recorded.

Core areas of high intensity space use within a home range are generated when activity is concentrated around resting sites, key feeding areas, or a den (Wray *et al.* 1992). Wild dogs cover larger distances for a few months each year to return to the same rest site at a den when pups are produced (Fuller & Kat 1990). No biologically significant core areas were identified by Home Range because of the very compact space use of the wild dogs. Some areas of concentrated use were identified, as illustrated by the two peaks on the isometric plot (Figure 19). The harmonic mean contours were also not significant for the same reason. There is no outer zone of sparse use as is seen with other animals eg. Lynx (Breitenmoser *et al.* 1993), resulting from exploratory excursions outside the intensively used home range. Consequently the harmonic mean contours contained large peripheral unused zones in which no fixes were observed, and it became a matter of guesswork to select a low percentage level which would generate a realistic contour (I. Linn 1995, pers. comm. [10]). It is important to remember that these dogs did not make use of a den site during the study period. Under normal circumstances where the dogs make use of such a den site for three to four months of the year, a core area, according to the definition of Wray *et al.* (1992) might be identified with similar analyses.

The grid cell utilisation plots (Figures 21 and 22) suggested a relatively extensive and fairly even use of the study area by the wild dogs. Rest areas were widely dispersed within the home range which suggests that the dogs did not utilise specific rest sites but seemed to rest wherever they found themselves at nightfall, or after a hunt. This space use pattern is congruent with the findings of researchers in other areas (Fuller & Kat 1990).

The size of the home range in HUP was relatively small when compared to the range sizes listed by Fuller *et al.* (1992)(Table 3). HUP, and specifically HGR, in which the home range is situated, has a high prey density and dense vegetation over much of the area. Permanent water is also well distributed throughout the area. Therefore, this relatively small home range was expected in concordance with the theories of Reich (1981) and Fuller *et al.* (1992). It is suggested that these dogs did not utilise UGR owing to sufficient prey density and availability in HGR.

The importance of the presence of readily available prey populations in the home range of wild dogs was supported by the correspondence of high prey density areas with movement patterns and areas of concentrated use by the wild dogs (S. Krüger 1995, pers. comm [11]). Density and distribution of prey populations are thus considered to have a large effect on the boundaries of home ranges for wild dogs through their influence on wild dog movement patterns. In HUP, the major prey species selected by the dogs are nyala (*Tragelaphus angasii*)

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[10] Ian Linn, Department of Biological Sciences, University of Exeter, Exeter

[11] Miss Sonja Krüger, Department of Zoology and Entomology, University of Natal, Pietermaritzburg

and impala (S. Krüger 1995, pers. comm [12])(Plate 5).

Wild dogs generally follow a bimodal i.e. crepuscular pattern of activity (Fuller & Kat 1990) with peaks of activity around sunrise and sunset (Skinner & Smithers 1990). The daily pattern of activity in HUP was consistent with the findings of Fuller & Kat (1990) who recorded a bimodal pattern of activity for wild dogs in Kenya, and with those of other researchers (Kuhme 1965a; Estes & Goddard 1967; Schaller 1972; Frame 1986; Maddock 1989). Most activity was in the early morning and late afternoon with the heat of the day spent resting, usually in some shady area. Malcolm & Van Lawick (1975 in Fuller & Kat 1990) recorded some hunts taking place during the heat of the day, but these represent the exception.

The general behaviour pattern is consistent with the nomadic nature of these carnivores and their tendency to cover large areas within their home range during their normal daily activities. Movement patterns were random in HUP. The monthly movement plots in Figure 23 indicate that a large portion of the home range was covered each few weeks during normal activities. Fixed routes were not generally followed, but preference was often shown for roads, especially when large distances were covered between the northern and southern areas of the range.

Although it is generally concluded that HUP is capable of supporting a larger population of wild dogs in terms of available space and a prey base (see Krüger in prep), this is meaningless if the habitat available within this area is not suitable or lacking. Habitat types and their availability, and the preferences of wild dogs for the various habitat types were investigated to further determine the suitability of HUP for more wild dogs. This is discussed in the next chapter.

[12] Miss Sonja Krüger, Department of Zoology and Entomology, University of Natal, Pietermaritzburg

PLATE 5 Wild dogs on an impala kill in HUP. The carcass is completely devoured within minutes

CHAPTER 3

HABITAT UTILISATION

3.1 INTRODUCTION

Wild dogs are facing rapid loss of habitat. They are extremely susceptible to fragmentation of continuous habitat because of their large home ranges and low population densities (Fanshawe *et al.* 1991). This problem is compounded by encroachment by human settlement which leads to more contact with man and his domestic animals.

Each species shows preferences for certain habitats. In a limited area, habitat becomes an important variable in determining the success of a population which is limited to certain areas within their total environment by morphological and behavioural restrictions (Ford & Krumme 1979). Factors governing herbivore habitat selection are primarily linked to vegetation type and structure, topographical features and water supply. Carnivores are however more dependant on the presence of suitable prey in their habitat, and are only indirectly dependant on vegetation.

Wild dogs occur in a wide variety of habitats, including grasslands, savannas, and open woodlands (Kingdon 1977; Rosevear 1974; Meester & Setzer 1971; Kruuk & Turner 1967) although more recent literature suggests that wild dogs occur mainly in woodland (Maddock 1989). Wild dogs are traditionally associated with open plains and avoid forest or woodland with a thick underbrush or tall grass cover throughout their distributional range (Skinner & Smithers 1990), although they have been sighted in dense forests (Dorst & Dandelot 1969; Meester & Setzer 1971). Wood (1932) recorded having frequently seen packs of wild dogs killing nyala in the 'densest forests' in the then Nyasaland (Malawi). They are found in montane savannas (Sheldon 1992) but avoid the adjacent montane forests (Skinner & Smithers 1990). In East Africa wild dogs have been sighted on the summit of Mt Kilamanjaro at 5894m (Thesiger 1970) and to over 2500 m on Mt Kenya (Dorst & Dandelot 1970).

In KNP wild dogs prefer woodland to open plains (Reich 1981). Maddock (1989) found that most of the packs in KNP were found in the western, more wooded areas while few packs occurred on the open, eastern plains. He linked this statistically to the distribution of their most important prey species, the impala (*Aepyceros melampus*; Maddock 1990). Competition with other predators, particularly lions (*Panthera leo*), may also determine habitat utilisation. Mills (1994, pers. comm. [13]) speculates that wild dogs in KNP are found in areas of low lion densities and generally avoid the more open plains where lion densities are relatively high.

Data on habitat utilisation collected in this study was aimed at determining the influence of habitat as a limiting factor on the status and survival of wild dogs in HUP; and therefore to address the question, the question is: is the relatively small home range of the dogs a consequence of unsuitable habitat in the rest of HUP ? Results are used to determine the suitability of HUP for wild dogs and the number of dogs and packs which HUP can support with the habitat available, within the framework of a management plan for this population.

3.2 METHODS AND MATERIALS

3.2.1 Physiognomic vegetation types

Data on habitat types utilised by the dogs were obtained by direct observation at each recorded location (see Chapter 2 for radio tracking methods). Locations of wild dogs were classified into physiognomic habitat types by matching the latitude - longitude coordinates with vegetation types on a vegetation map of Hluhluwe and the northern Corridor (compiled by Whateley 1975)(Figure 5). Natural processes including bush encroachment or management-initiated changes in vegetation type and structure through burning or bush control may have taken place since the compilation of the map. Such changes in the vegetation were noted and corrected in the data collected if field observations indicated that changes had occurred. All locations were in HGR. The respective vegetation categories used in habitat utilisation calculations were forest, riverine forest, woodland, thicket (including induced thicket) and grassland (Table 7).

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[13] Dr. Gus Mills, Specialist Scientist, Kruger National Park, National Parks Board, Private Bag X 402, Skukuza, 1350

TABLE 7 Habitat variables and the abbreviations used in figures, text and Correspondence Analysis of data of wild dogs in HUP

HABITAT VARIABLE	CATEGORY	ABBREVIATIONS USED IN FIGURES AND TEXT	ABBREVIATIONS USED IN CORRESPONDENCE ANALYSIS
Structural vegetation	Forest	F	VF
	Riverine Forest	RF	VRF
	Woodland	W	VW
	Thicket	T	VT
	Grassland	G	VG
Floristic vegetation			
Forest	*Celtis africana-Harpephylum*	CAHC	CAHC
	C. africana-Euclea schimperi	CAES	CAES
Riverine forest	*Spirostachys africana-E.*	SAES	SAES
	Acacia robusta-Ficus	ARFS	ARFS
Woodland	*Euclea divinorum*	ED	ED
	S. africana	SA	SA
	Combretum molle	CM	CM
	Acacia nilotica	AN	AN
	A. karroo	AK	AK
	A. burkei	AB	AB
Thicket	*A. caffra*	AC	AC
Induces thicket	*Dichrostachys cinerea-A.*	DCAK	DCAK
Grassland	*Themeda triandra*	TT	TT
	Panicum maximum-Cyperus	PMCT	PMCT
Grass length	short (< 50 cm)		GS
	medium (50 cm-100 cm)		GM
	long (< 100 cm)		GL
Visibility	Good (>120 m)		VGO
	Moderate (50 m-120 m)		VM
	Long (<50 m)		VP
Position	Riverbank		PRB
	Bottomland		PBL
	Valleyside		PVS
	Ridgetop		PRT
Slope	Flat (0°)		SF
	Moderate (>0-25)		SM
	Steep (>25)		SS
Aspect	north		ASN
	north-east		ASNE
	east		ASE
	south-east		ASSE
	south		ASS
	south-west		ASSW
	west		ASW
	north-west		ASNW

The proportion of locations in each vegetation type were compared to the relative availability of the respective vegetation type in the study area (Murphy *et al.* 1985).

The approximate areas of the physiognomic vegetation types in the study area were obtained from figures in the HUP Management Plan which were derived from the 1937 aerial photographs and the 1975 vegetation map. The expected utilisation of each vegetation type was calculated by multiplying the area of the relative vegetation by the actual number of observations (observed utilisation) made during the study period (Table 8).

Two statistical tests were carried out on the data set to test the hypothesis that wild dogs utilise each vegetation category in equivalent proportion to its occurrence. The chi-square goodness-of-fit test was used to determine whether there was a significant difference between the expected utilisation of the vegetation types (based on their availability) and the observed frequency of their usage (Byers *et al.* 1984). The chi-square test does not determine preference or avoidance of individual categories. In the case of the null hypothesis being rejected, the data need to be further inspected to determine which observations contributed most to the calculated chi-square value, and whether a specific category was preferred or avoided (Neu *et al.* 1974). Bonferroni confidence intervals were used to determine which vegetation types were preferred. Where the expected proportion of usage did not fall within the confidence interval, it was concluded that the expected and actual utilisation were significantly different at a given level of probability.

The following assumptions were made with regard to the data collected for these tests : 1) animals have access to and opportunity to be observed in all habitats (Byers *et al.* 1984), and 2) all observations are independent of each other (Thomas & Taylor 1990).

3.2.2 Floristic vegetation types

Each location was classified by a floristic vegetation type according to the vegetation map (Whateley 1975) (Figure 5). The floristic vegetation type categories utilised in this classification were those of Whateley & Porter (1983) which differ from the 1975 classification (Whateley 1975) by including the *Euclea divinorum* and *Acacia karoo* thicket communities in the woodland communities group. The floristic vegetation communities used are listed in Table 7.

TABLE 8 Habitat availability and utilisation data of wild dogs in HGR and HUP (n=1121)

VEGETATION TYPE	AREA (ha)		RELATIVE AREA		EXPECTED USE		OBSERVED USE	
	HGR	HUP	HGR	HUP	HGR	HUP	HGR	HUP
Forest	2940	3270	0.098	0.034	109.86	38.11	182	182
Riverine forest	3120	9588	0.104	0.100	116.58	112.10	155	155
Woodland	13920	62548.8	0.464	0.651	520.14	729.77	423	423
Thicket	8760	19122	0.292	0.200	327.33	224.20	312	312
Grassland	1260	1471.2	0.042	0.015	47.09	16.82	49	49
TOTAL	30 000	96 000	1.000	1.000	1121	1121	1121	1121

HGR : $\chi^2 = 78.97$; tabular value 13.277; df = 4; p = 0.01
HUP: $\chi^2 = 784.60$; tabular value 13.277; df = 4; p = 0.01

3.2.3 Topography

A number of topographical features of the habitats utilised by the dogs were recorded at each location :

- The position on the catena was classified into four categories (Table 7).
- The incline of the slope was classified into three categories by the use of a 1:50 000 topographical map (Table 7).
- Aspect, which is the compass direction towards which a slope faces, was classified into eight categories determined by the use of a map and a compass (Table 7).

3.2.4 Visibility and grass length

An attempt was made to record the relative visibility at each location at a height of about 65 cm i.e. average shoulder height of a wild dog (Walker 1981). This was done by bending down and estimating the visibility distance at approximately 65 cm off the ground into three categories (Table 7).

Grass length and density of the undergrowth are expected to have the greatest affect on the visibility afforded to the wild dogs by the vegetation. Grass length was recorded in three categories which are listed in Tables 7 and 9.

3.2.5 Water and roads

Distance to the nearest permanent water source and nearest road or track were measured on a 1:50 000 topographical map. Accuracy to within 50 m, equal to 1 mm on a 1:50 000 scale map, was considered acceptable.

3.2.6 Activity

The activity of the wild dogs at the time of observation was recorded in one of four categories (Table 4).

3.2.7 Correspondence analysis

A more objective means of assessing habitat use was suggested by Tinley (1969), and Hirst (1975) undertook a more comprehensive study of the factors affecting habitat selection by herbivores. Using principal component and multiple regression analyses, clear associations

TABLE 9 Description of the categories used to record grass length at observed positions of wild dogs in HUP

CATEGORY	GRASS LENGTH	DESCRIPTION AND MEASUREMENT
Short	< 50 cm	Shorter than knee height of the observer and affords good visibility to all dogs
Moderate	50 cm - 100 cm	Between knee and thigh height of the observer and affords reasonable visibility to adult dogs only, or dogs standing up on their hind legs
Long	> 100 cm	Above thigh height of the observer and affords poor to no visibility to all dogs

between animal species and their favoured habitats could be demonstrated and, additionally, preference evaluation of particular habitats by the different animal species determined.

The relationship between the wild dogs and their environment was further analysed using correspondence analysis (Benzecri *et al.* 1973), a technique which provides a graphical display of data arranged in a two-way table of rows and columns. The only assumption made was that the data were non-negative. The technique is described more fully by Greenacre (1978, 1981).

Correspondence analysis was applied to the wild dog habitat data to identify any possible interaction between seasonal (i.e. object) habitat use by the dogs and a number of habitat factors or variables. The four seasons into which the data was classified were as follows :

Summer	-	December to February
Autumn	-	March to May
Winter	-	June to August
Spring	-	September to November

The data show frequency counts of the four seasons (represented as rows) with 40 habitat variables (represented as columns)(Beardall *et al.* 1984).

3.3 RESULTS

3.3.1 Physiognomic vegetation types

A total of 1121 habitat use observations were recorded during the study period (Figure 26). Habitat availability and utilisation data are listed in Table 8.

There were significant differences between overall availability and use of the different vegetation types in HUP ($\chi^2 = 784.60$; tabular value $\chi^2 = 13.277$, df=4, P=0.01)(Table 8). All observations of habitat use were made in HGR and all further data analyses to determine habitat selection and preferences were thus restricted to this area.

Availability and use of vegetation types differed significantly in HGR ($\chi^2 = 78.97$; tabular value $\chi^2 = 13.277$, df=4, P=0.01)(Table 8). The null hypothesis is thus rejected, implying that wild

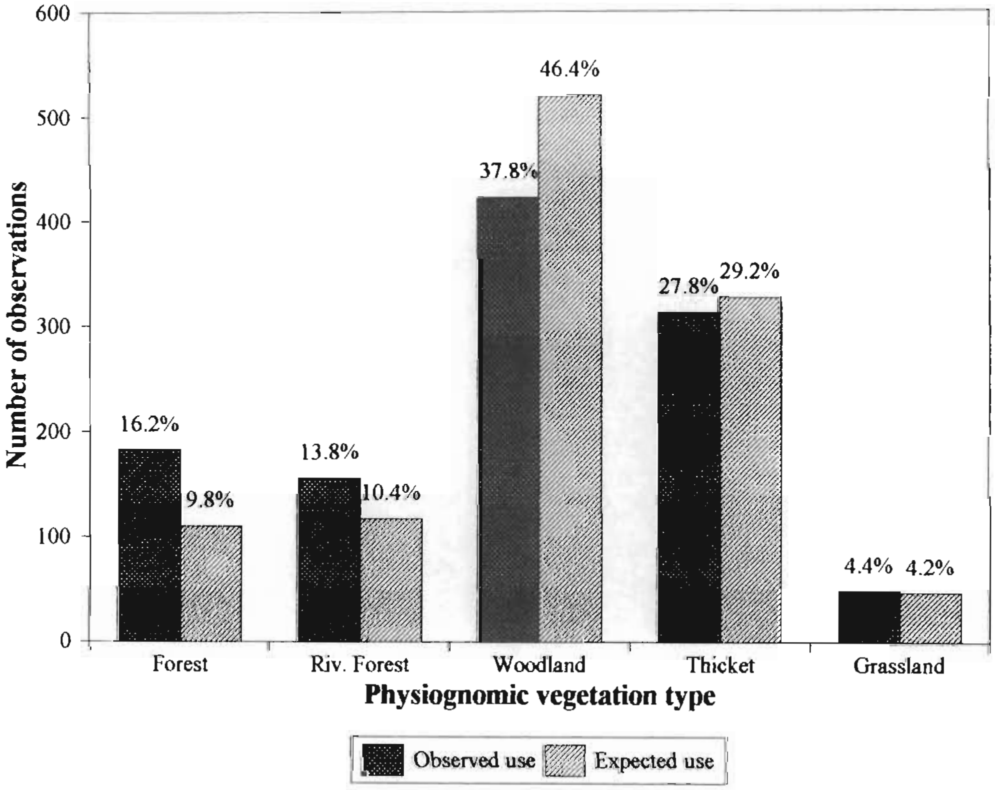

FIGURE 26 Observed and expected frequency of utilisation of physiognomic vegetation types by wild dogs in HGR

wild dogs show preference for certain structural vegetation types in HGR.

The Bonferroni intervals calculated for the data are listed in Table 10. Forest and riverine forest were used more than would be expected by chance whereas woodland was used less than expected by chance. Thicket and grassland were used in proportion to their availability (Table 10).

3.3.2 Floristic vegetation types

The observed use of the floristic vegetation categories in HGR by wild dogs is illustrated in Figure 27. The forest communities are found mainly in the north western areas of Hluhluwe, particularly the Gontshi, Qololenja and Mbombe forests (Figure 5). These accounted for 16.2% of the locations. *Acacia robusta* (Splendid acacia) - *Ficus sycamorus* (Sycamor fig) (ARFS) riverine forest is the dominant forest type along the banks of the larger rivers and their major tributaries in HGR, noticeably along the Hluhluwe river, and accounted for 12.4% of the dogs occupatial space use. *Spirostachys africana* - *Euclea schimperi* (Bush guarri) (SAES) riverine forest is found only in narrow strips along seasonal watercourses and accounted for only 1.4 % of the dogs locations.

Woodland communities cover a large area of HUP (65.16 %) and 46.4 % of HGR and were utilised relatively extensively by the dogs. *Euclea divinorum* (ED) woodland (13.5%), which covers extensive areas on gently sloping ground in the Hluhluwe river valley, and *Acacia burkei* (AB) woodland (12.7%) which covers extensive areas in western Hluhluwe on moderately steep hillsides and flat riverine terraces in valley bottoms, were utilised most often. *Acacia caffra* (AC) thicket, found on hillsides and ridges throughout the area, and *Dichrostachys cinerea* (Sickle bush) - *Acacia karroo* (DCAK) induced thicket, which is found on steeply undulating hillsides, were both utilised to a small extent by the wild dogs (2.4% and 5.0% respectively).

Few grassland areas, in which woody plants are rare, are present (Whateley & Porter 1983). *Panicum maximum* (Guinea grass) - *Cyperus textilis* (PMCT) grassland is found in the north eastern part of HGR along the Manzibomvu River while *Themeda triandra* (TT) grassland is limited to the top of certain high ridges and hills. Grassland was utilised by the dogs according

TABLE 10 Simultaneous confidence intervals using the Bonferroni analysis for use of physiognomic vegetation types by wild dogs in HGR

VEGETATION TYPE	EXPECTED PROPORTION OF USE	ACTUAL PROPORTION OF USE	BONFERRONI INTERVALS
Forest	0.098	0.162	0.1318 < 0.098 < 0.1882 +
Riverine forest	0.104	0.139	0.1133 < 0.104 < 0.1667 +
Woodland	0.464	0.377	0.3426 < 0.464 < 0.4174 *
Thicket	0.292	0.278	0.2454 < 0.292 < 0.3146
Grassland	0.042	0.044	0.0249 < 0.042 < 0.0551
	1.000	1.000	

+ used more than expected by chance (p = 0.01)
* used less than expected by chance (p = 0.01)

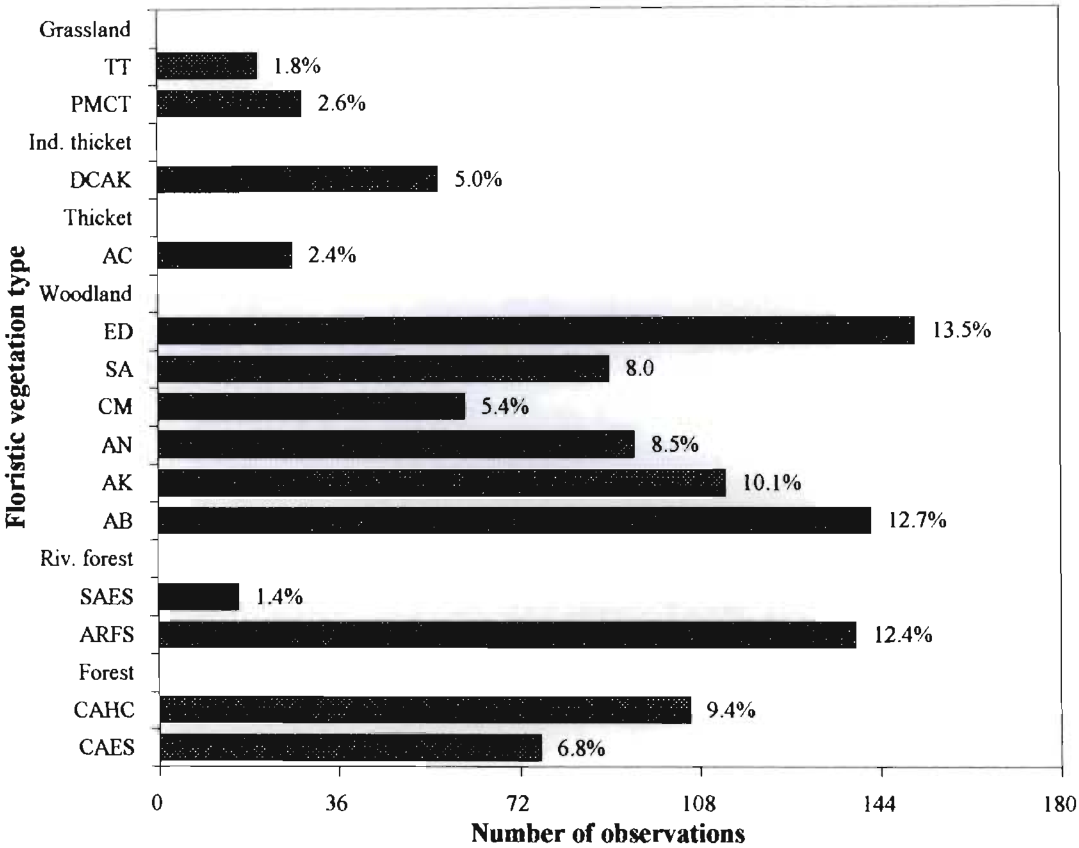

FIGURE 27 Frequency of utilisation of floristic vegetation types by wild dogs in HGR

to its availability, and therefore to a limited extent. It is important to note that the test deals with proportional use and is therefore biased against grassland because of the small area of grassland available.

3.3.3 Topography

The position used by the wild dogs on the catena is illustrated in Figure 28 and the position on the catena with the corresponding slope is illustrated in Figure 29. The dogs spent most of their time in low lying areas, namely riverbanks (12.8%) and bottomland (37.3 %) with corresponding flat ground. A large amount of time was also spent on the valleyside areas (45.3%) with steep (38.6%) to moderate (61.4%) slopes. Very little time was spent on ridgetop areas (4.6%). The recorded incline of the slope is illustrated in Figure 30 and the preference of the dogs for flat areas with no catena (51.9%) is clear.

The recorded aspect of the slope for all locations is illustrated in Figure 31. Southern (16.6%) and eastern (15.4%) slopes were utilised the most while north (6.7%) and northeast (8.6%) facing slopes were utilised less frequently. No particular aspect was preferred by the wild dogs.

3.3.4 Visibility and grass length

Visibility recorded at the locations over the different seasons is illustrated in Figure 32. Visibility is generally moderate to poor in the summer and autumn months, but moderate to good in the winter and spring months.

The recorded grass lengths at locations over the different seasons are illustrated in Figure 33. Grass was generally moderate to long in the summer and autumn months and moderate to short in the winter and spring months.

3.3.5 Permanent water

Only 21.2 % of the locations were more than 1000 m from permanent water while 17.0% were within 100 m (Figure 34). The distance to the nearest permanent water was measured for a data set of random points (n=100) in HGR. For this random data set, 52 % were further than 1000m from water, but only 28 % further than 2000m. These expected distances to water differed significantly from the observed distances (χ^2=38.01; tabular value = 6.635; df=1; p=0.01).

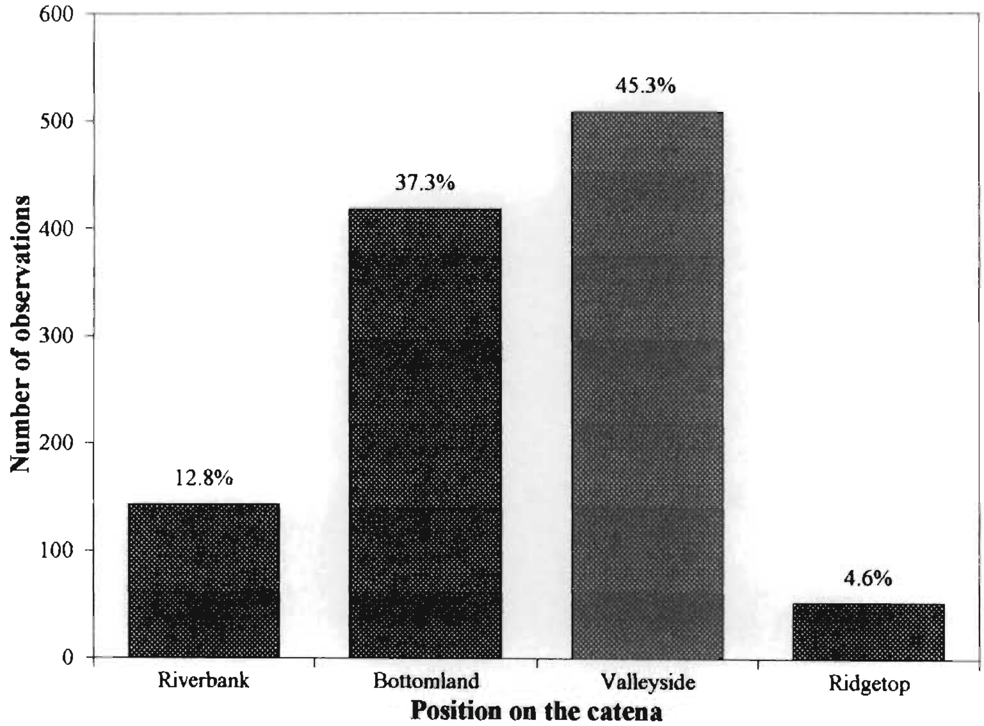

FIGURE 28 Frequency of utilisation of the position on the catena by wild dogs in HUP

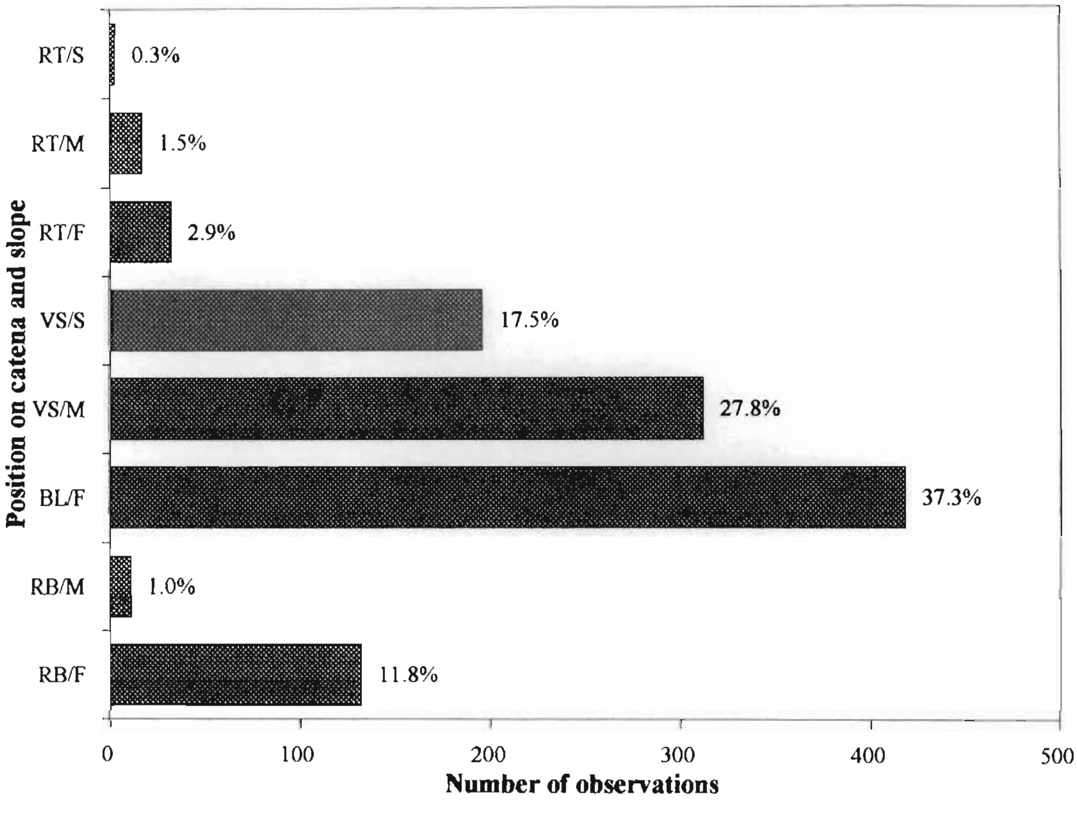

FIGURE 29 The position on the catena and the corresponding slope utilised by wild dogs in HUP

Position on catena: RT = ridgetop; VS = valleyside; BL = bottomland; RB = riverbank

Slope: S = steep; M = moderate; F = flat

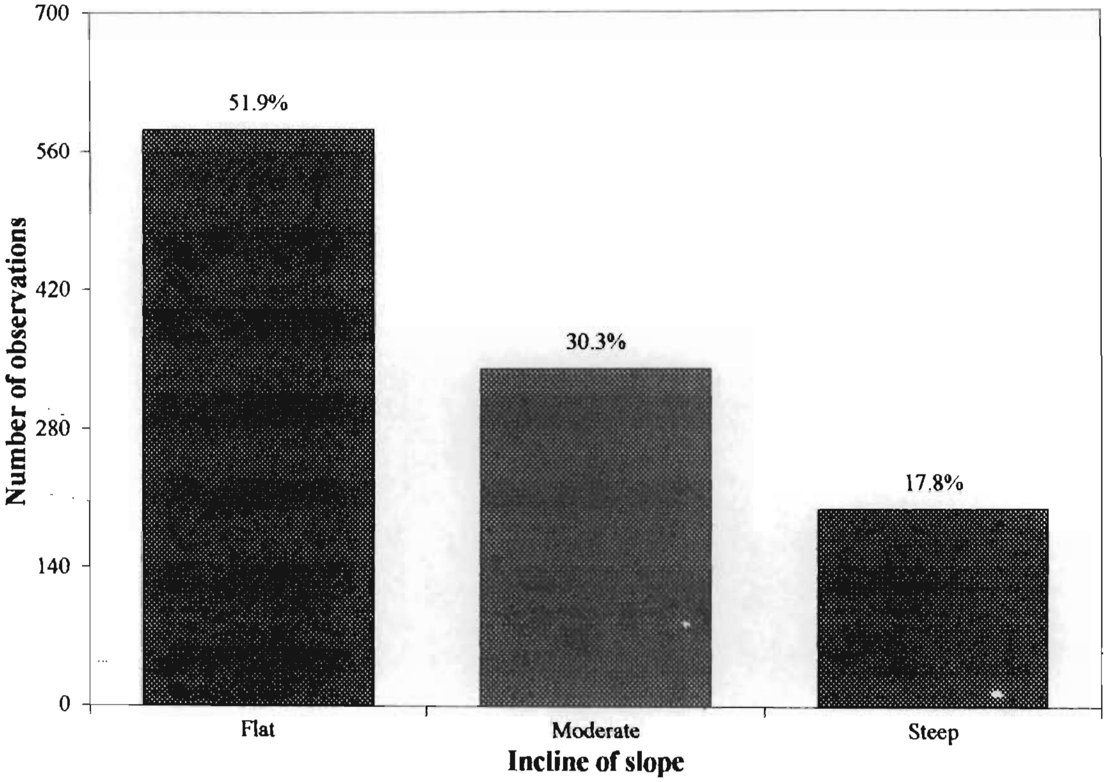

FIGURE 30 Observed incline of the slope in habitat areas utilised by wild dogs in HUP

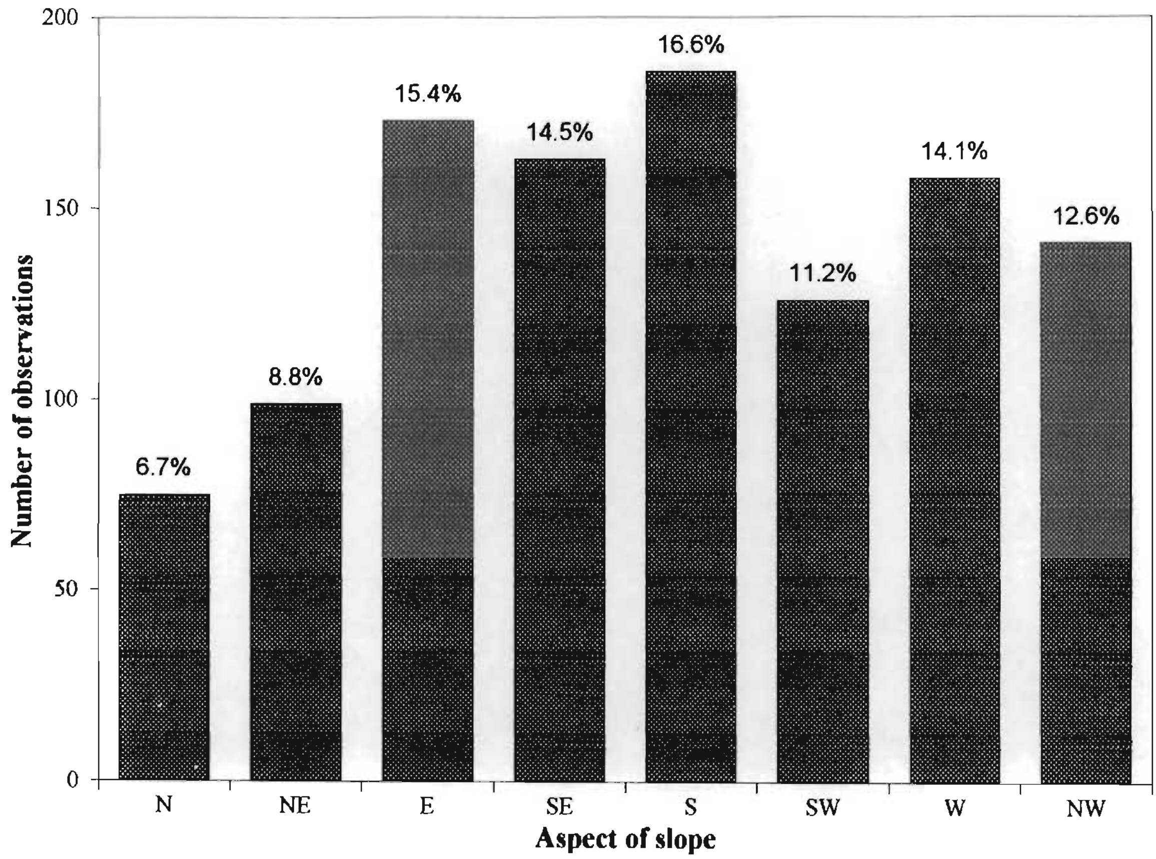

FIGURE 31 Observed aspect of the slope in habitat areas utilised by wild dogs in HUP

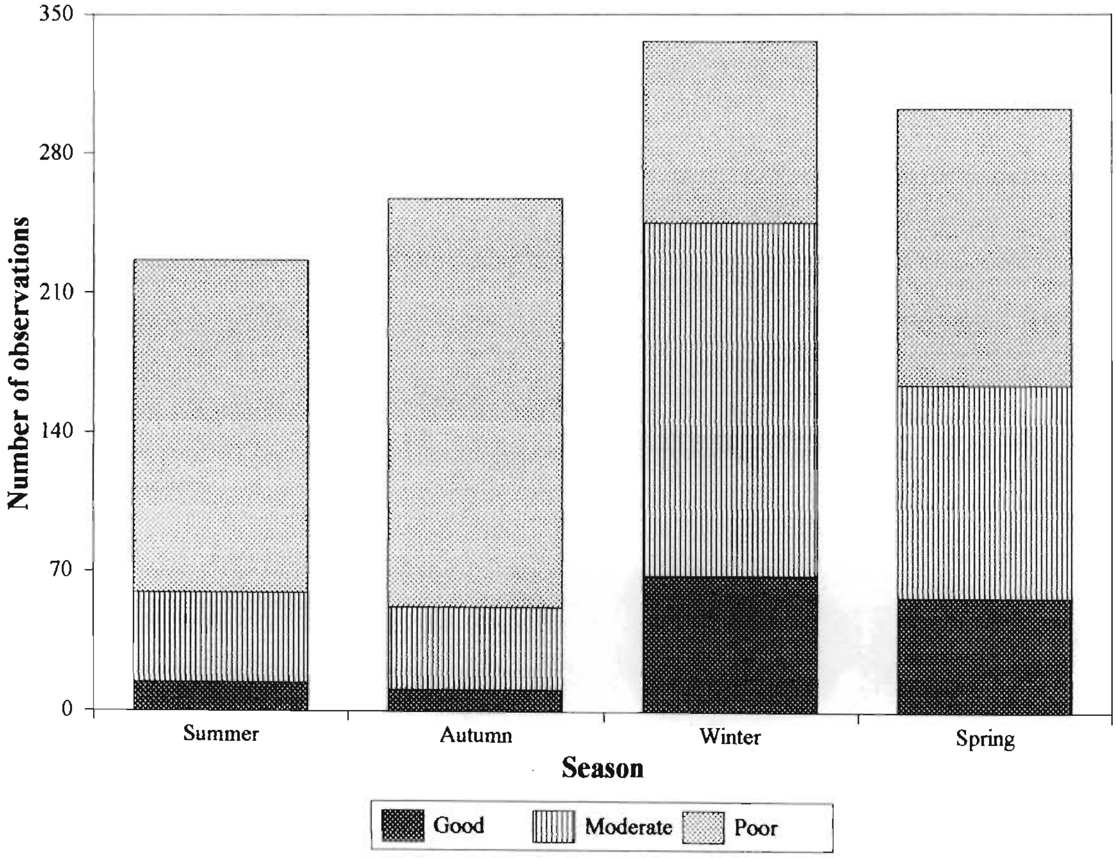

FIGURE 32 Recorded visibility at locations of wild dogs in HUP over the different seasons

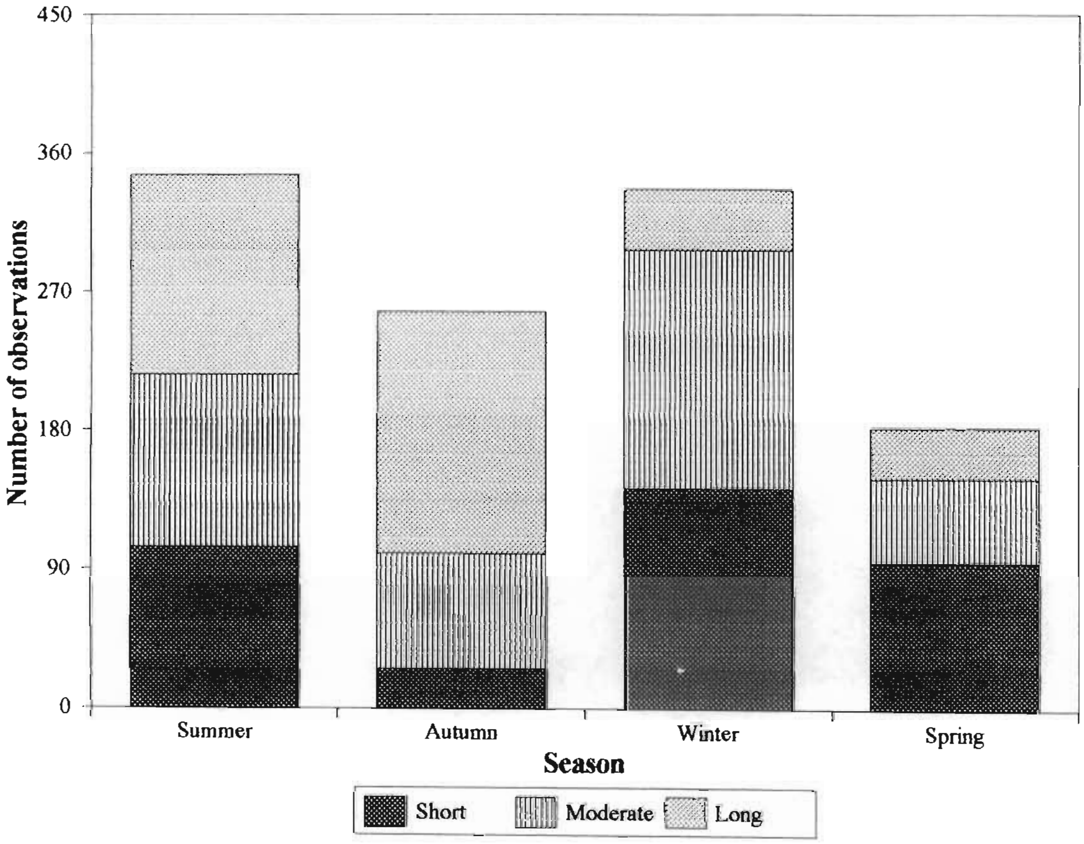

FIGURE 33 Recorded grass length at locations of wild dogs in HUP over the different seasons

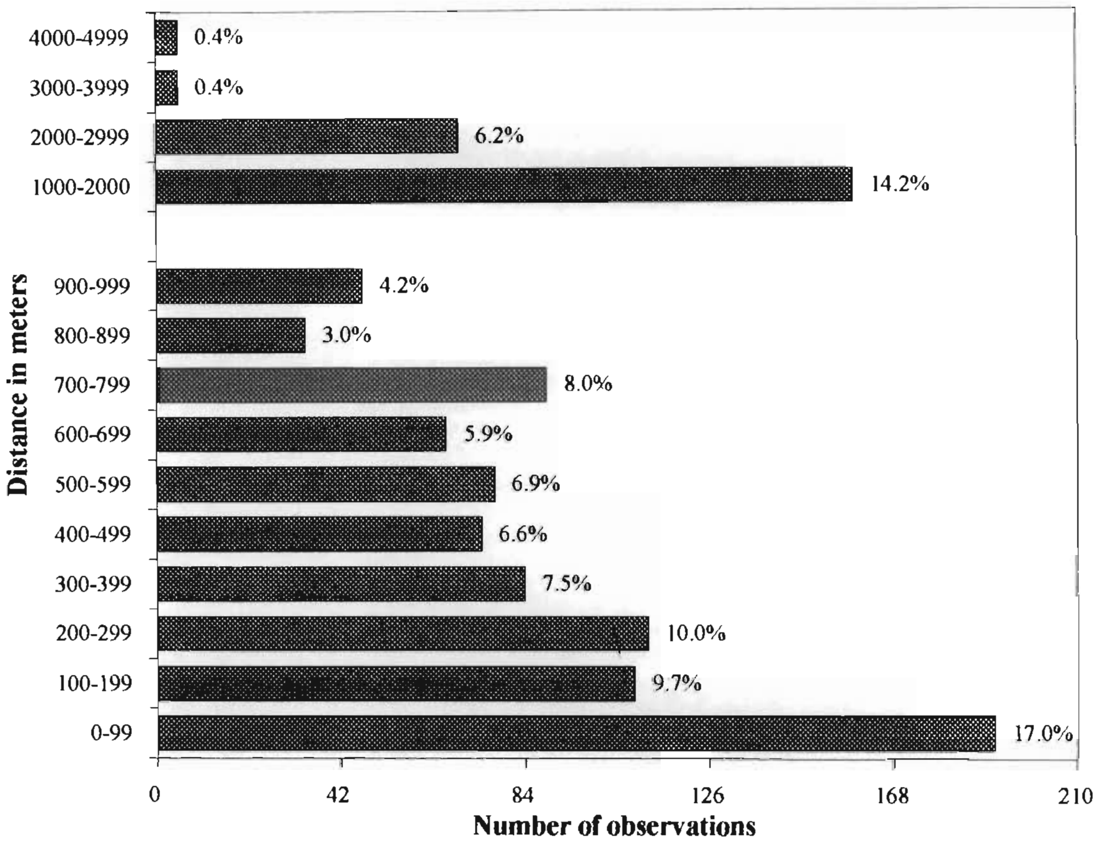

Figure 34 Recorded distance to the nearest permanent water source from locations of wild dogs in HUP

Fourteen percent of the random points were within 100m from water. The dogs were observed to drink after feeding on a number of occasions and usually drank from pools along the road.

3.3.6 Roads

The results of distances measured to the nearest roads for all the locations are illustrated in Figure 35. A large number of locations (94.6%) were less than 1000m from a road. Of significance is that 28.5% of the observations occurred on a road. It is interesting to note that of the ten roads or sections of road utilised the most by the dogs, six are part of major tourist roads linking the northern and southern sections of HGR. Only two were management tracks.

It is important to note that most observations were made from roads and this may have affected a certain degree of bias on these results. The distance to the nearest road or track was measured for a random set of data points. For this random data set, 25 % of the points were further than 1000m from the nearest road which differed significantly from the observed figure of 5.4 % (χ^2= 20.48; tabular value = 6.635; df=1; p=0.01). Only 10 % were within 100m from a road.

3.3.7 Activity

Full day observation periods (i.e. period of daylight) were used for the analyses of activity. Results of the activities of the wild dogs recorded in the physiognomic vegetation categories are illustrated in Figure 36a and 36b. Hunting was primarily conducted in woodland and thicket communities which corresponds with movement within the same communities. Resting was conducted in most vegetation communities, with woodland being utilised most frequently for resting. The dense forest and thicket communities were also utilised frequently by the dogs for resting.

3.3.8 Correspondence analysis

Interpretation of correspondence analysis is based on numerical output (Tables 11 and 12) and graphical display (Figure 37).

The total inertia (I) is calculated (Table 11) as the sum of the moments of inertia. In the column PERCENT each eigenvalue is expressed as a percentage of (I) and the cumulative percentages

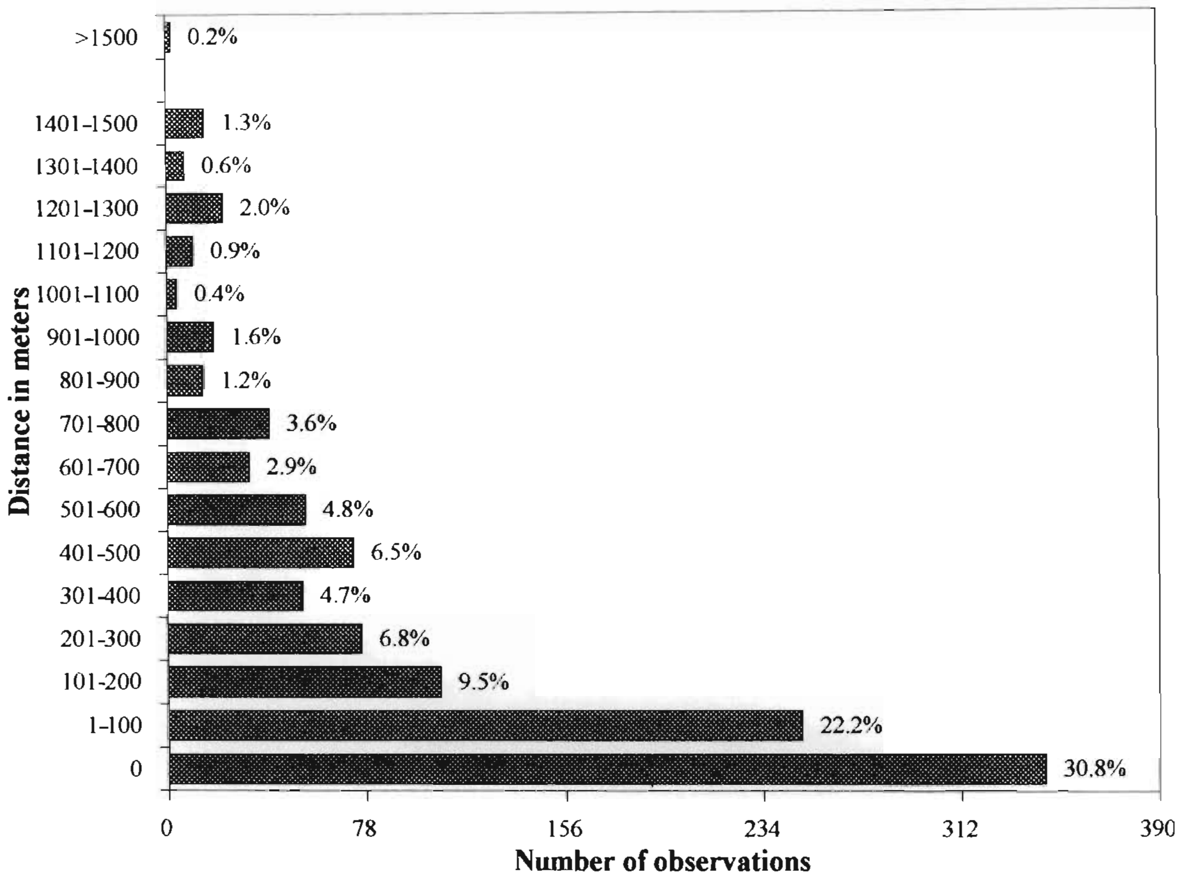

FIGURE 35 Recorded distance to the nearest road from locations of wild dogs in HUP

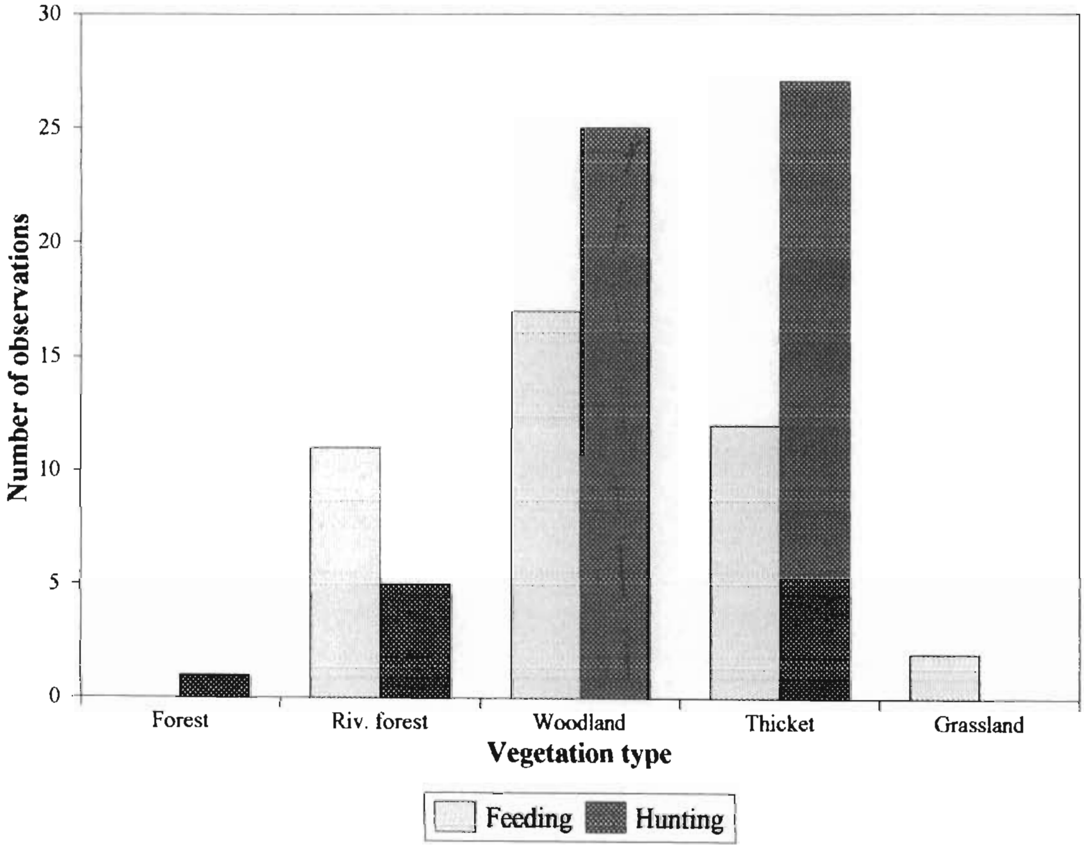

FIGURE 36a Frequency of feeding and hunting activity of wild dogs in the various physiognomic vegetation types in HUP

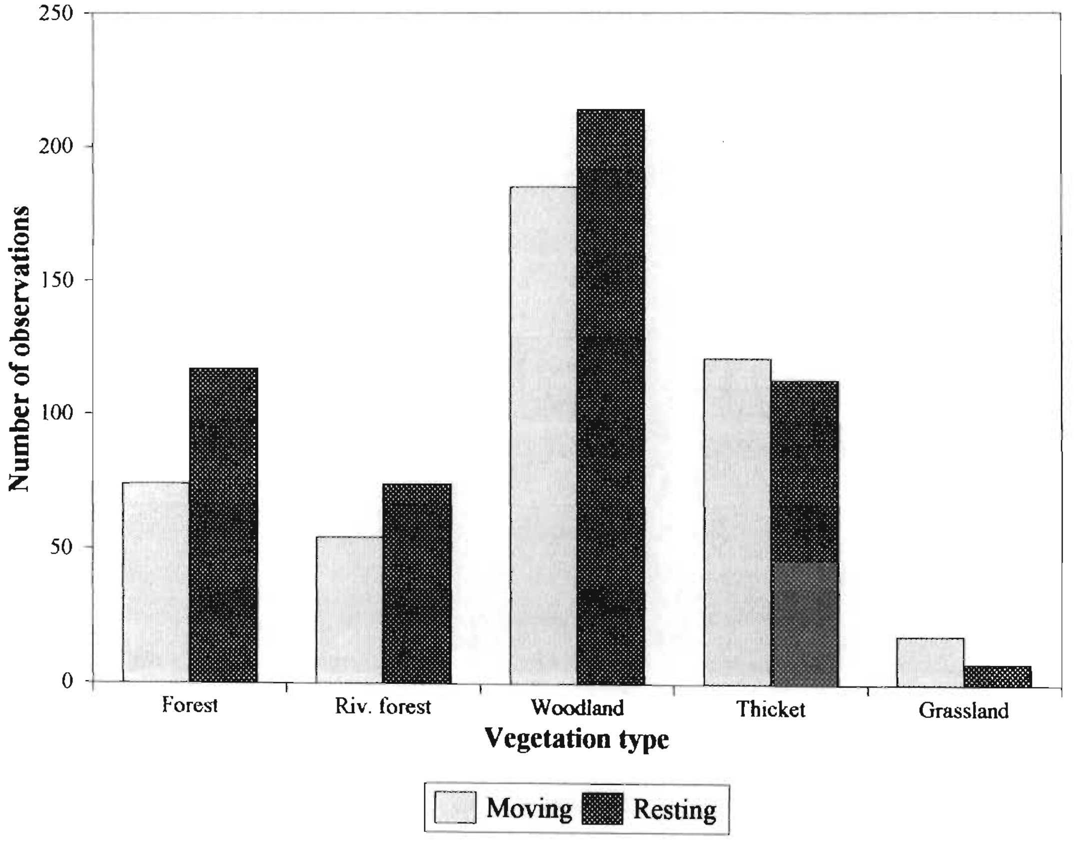

FIGURE 36b Frequency of moving and resting activity of wild dogs in the various physiognomic vegetation types in HUP

TABLE 11 Moments of inertia and their percentage of the total inertia for Correspondence Analysis of the HUP wild dog data

AXIS	INERTIA (EIGENVALUE)	PERCENT	CUMULATIVE PERCENTAGE
1	0.085	62.3	62.3
2	0.028	20.3	82.6
3	0.024	17.4	100.00
	Total inertia (I) = 0.137		

TABLE 12 Decomposition of the first two moments of inertia in terms of the habitat factors (variables) and the seasons (objects) for Correspondence Analysis of HUP wild dog data

No.	NAME	WEIGHT	#1F	RELCON	ABSCON	#2F	RELCON	ABSCON
1	Summer	701.00	0.1590	0.9445	0.2693	0.1702	0.9317	0.5782
2	Autumn	701.00	0.3916	0.9438	0.8397	-0.0684	0.9749	0.8653
3	Winter	700.00	-0.3496	0.9485	0.7521	0.1400	1.0510	0.8728
4	Spring	702.00	-0.2011	0.9881	0.3714	-0.2413	0.9826	0.9058
1	VF	68.00	-0.0917	0.2939	0.0146	-0.3627	0.3929	0.0110
2	VRF	52.00	-0.7933	0.7779	0.0260	-0.9622	0.9518	0.0002
3	VW	145.00	-0.0135	0.2928	0.0067	0.4907	0.5044	0.0000
4	VT	118.00	0.5779	0.6080	0.0115	0.1519	0.2151	0.0109
5	VG	17.00	-0.6062	0.6070	0.1720	-1.1704	1.1532	0.1338
6	CAHC	39.00	-1.2452	1.1676	0.0325	-1.0021	0.9912	0.0045
7	CAES	31.00	1.1570	1.0919	0.0220	0.3479	0.3740	0.0187
8	SAES	6.00	-1.0766	1.0225	0.0123	-0.6021	0.6115	0.0021
9	ARFS	45.00	-0.8752	0.8466	0.0268	-0.9770	0.9663	0.0002
10	ED	56.00	0.2479	0.3630	0.1098	1.8724	1.8264	0.0121
11	SA	34.00	-0.7670	0.7463	0.1056	1.1243	1.1070	0.0704
12	CM	22.00	-1.8860	1.7460	0.1847	-1.3102	1.2853	0.1368
13	AN	30.00	0.4550	0.4972	0.1826	2.1726	2.1172	0.0509
14	AK	39.00	1.7271	1.8091	0.2840	-1.5382	1.5010	0.2180
15	AB	48.00	1.0854	1.0371	0.0351	0.3394	0.3612	0.0319
16	AC	10.00	-1.7634	1.6291	0.1739	-2.4553	2.3939	0.0058
17	DCAK	22.00	-0.0910	0.3065	0.0403	-1.1713	1.1510	0.0021
18	TT	8.00	-0.3416	0.4075	0.1151	1.0745	1.0588	0.0829
19	PMCT	9.00	-0.8414	0.8037	0.4688	-3.1658	3.0830	0.1894
20	GS	117.00	-2.0643	1.8997	0.0519	-1.2916	1.2698	0.0054
21	GM	131.00	-0.6140	0.6347	0.0239	0.5155	0.5273	0.0165
22	GL	153.00	2.0759	1.9142	0.0119	0.5919	0.5933	0.0021
23	VGO	41.00	-1.9116	1.7663	0.0528	0.7819	0.7792	0.0357
24	VM	111.00	-1.6148	1.5010	0.0782	1.2613	1.2371	0.0338
25	VP	248.00	1.0378	0.9879	0.0258	-0.6859	0.6868	0.0127
26	PRB	45.00	-0.6050	0.6260	0.0138	-0.3975	0.4223	0.0094
27	PBL	150.00	0.4694	0.5234	0.0150	0.5567	0.5631	0.0063
28	PVS	186.00	-0.2461	0.3604	0.0123	-0.3893	0.4166	0.0081
29	PRT	21.00	0.4191	0.4832	0.0101	0.5906	0.5956	0.0004
30	SF	203.00	0.1479	0.3287	0.0120	0.4697	0.4837	0.0058
31	SM	118.00	0.1287	0.3016	0.0241	0.3024	0.3406	0.0215
32	SS	80.00	-0.2179	0.3527	0.0830	-1.7218	1.6824	0.0003
33	ASN	26.00	-1.2326	1.1597	0.3984	3.7696	3.6663	0.0022
34	ASNE	37.00	0.0305	0.2360	0.3346	-0.1231	0.2234	0.3341
35	ASE	62.00	-0.0767	0.2979	0.0025	-0.2744	0.3162	0.0004
36	ASSE	58.00	1.0952	1.0421	0.0035	0.2749	0.3082	0.0014
37	ASS	66.00	-0.4936	0.5409	0.0560	1.2122	1.1888	0.0150
38	ASSW	47.00	-0.4678	0.5047	0.0619	-0.9206	0.9131	0.0382
39	ASW	55.00	-0.7929	0.7769	0.0031	0.3248	0.3599	0.0002
40	ASNW	50.00	1.4388	1.3518	0.3751	-2.7787	2.7043	0.1598

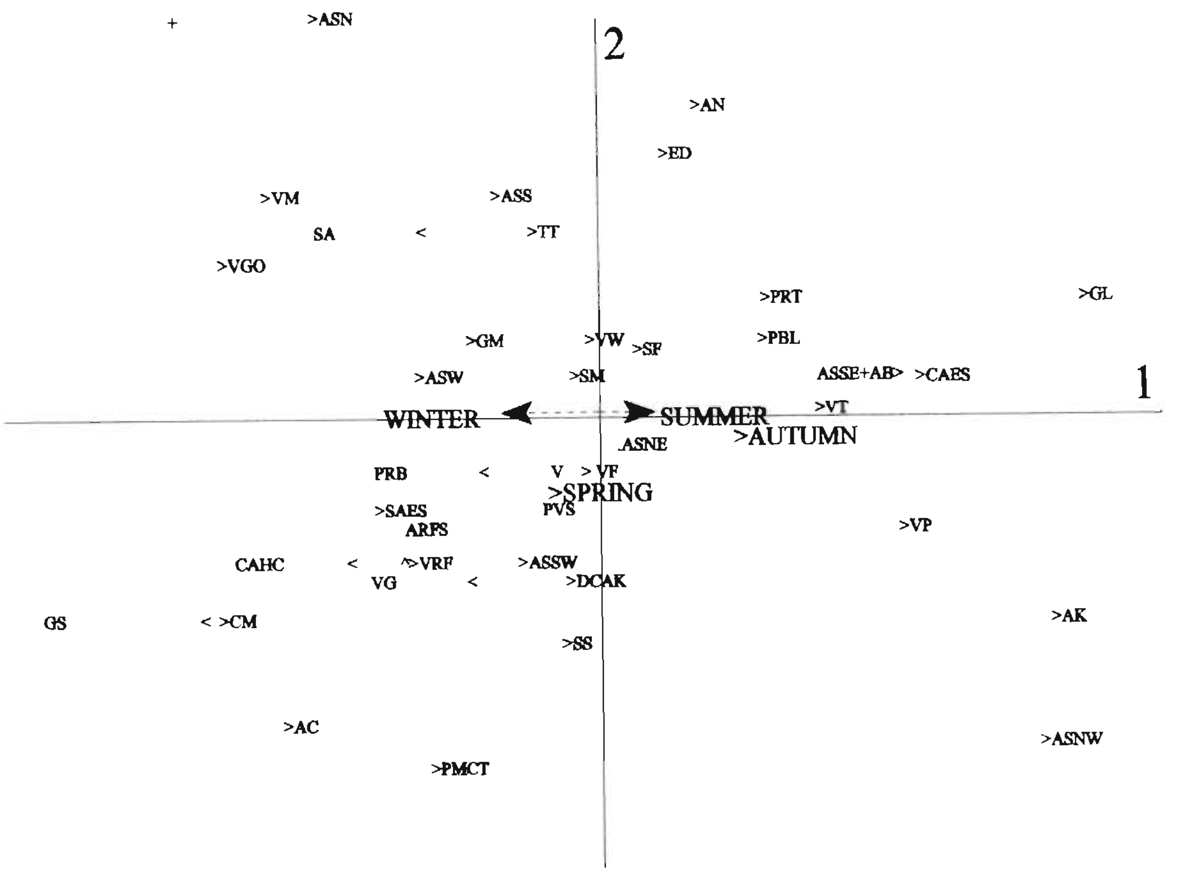

FIGURE 37 Projections of seasons (objects) and habitat variables on to plane of principle axes 1 and 2 for Correspondence Analysis of wild dog data

Locations of items in the plane are denoted by:
> if the name of the item is printed at the right
< if the name of the item is printed at the left
^ if the name of the item is printed above

of inertia are listed in the column headed CUMULATIVE PERCENTAGE (Beardall *et al.* 1984).

The results in Table 12 provide the following information for each element, i.e. object (season) and variable (habitat factor), and axis :

WEIGHT : The proportion of observations of each object - variable with respect to the first axis.

RELCON : Describes the importance of the axis to the element.

ABSCON : A measure of the importance of this element to the axis.

Objects and variables which correlate highly with this axis are indicated by large values in the column RELCON, and the sign of the correlation is indicated by the sign of the coordinate in column #1F.

To illustrate this interpretation, axis 1 is largely dominated by Autumn, with an absolute contribution of 0.8397. Axis 2 is dominated by Winter. Similarly axis 1 is dominated by variables AK (ABS CON = 0.2840), ASNE (ABS CON = 0.3346) and ASNW (ABS CON = 0.3751). Axis 2 is dominated by the variable VG (ABS CON = 0.1338).

Axis 1, accounting for 62.3 % of the total inertia (Table 11), contrasts summer, autumn, long grass and thickets with winter, spring, short grass, good visibility and grassland areas (Table 12).

Axis 2, accounting for 20.3 % of the total inertia (Table 11), contrasts summer, woodland and north facing slopes with spring, forest, riverine forest and north east facing slopes (ASNE) (Table 12).

Figure 37 shows the projection of seasons and habitat factors into a common subspace of axes 1 and 2 of the correspondence analysis. For the interpretation of this figure a small angle forms when two points are joined to the origin, and vice versa, indicating a high correlation (Beardall *et al.* 1984). Points close to the origin have weak correlations. It is important to realise that there is no interpretation of distances between objects and variables (Greenacre 1978, 1981).

However, the angle formed when joining two elements to the origin with straight lines gives a fairly good indication of their closeness. The larger the angle, the weaker the correlation. For example, the angles formed when joining SPRING, VG (Grassland) and GS (short grass) are all small, indicating a close association. If the angle between the line approaches 180°, the elements are strongly negatively correlated with each other. However, if an element's position is very close to the origin, such interpretations become weaker, since the element probably does not correlate highly with the subspace depicted.

In the top right quadrant, a close association is illustrated between summer, long grass (GL), ridge-top areas (PRT), bottomland areas (PBL) and woodland types ED (*Euclea divinorum*) and AN (*Acacia nilotica*). A strong association is also indicated with south east facing slopes (ASSE).

In the bottom left quadrant a number of significant associations can be seen; spring is closely associated with forest and riverine forest types (VF, VRF, CAHC, SAES, ARFS) as well as short grass (GS), good visibility and grassland areas (VG, PMCT).

Winter is generally associated with areas with moderate to good visibility (VGO, VM) and north-facing slopes (ASN).

3.4 DISCUSSION

Wild dogs in HUP favoured forest and riverine forest habitat types. This is in marked contrast to the open plains and savannas of east Africa, and even the woodland areas in KNP, with which wild dogs are traditionally associated. Maddock (1990) found that wild dogs selected habitat primarily on the basis of the availability of prey. The wild dogs of HUP selected areas of high prey density and nyala and impala were the primary prey species selected (S.Krüger 1995, pers. comm. [14]). Nyala are associated with thicket (Skinner & Smithers 1990) and are

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generally found in dense forest, riverine forest and woodland areas in HUP. It is thus likely that nyala are the main reason why the wild dogs occur in dense vegetation types as well as the possibility that the dense vegetation may increase hunting success.

The forest and riverine forest habitat types are however not exclusively selected by the dogs. All other habitat types are utilised, with woodland and thicket communities being utilised relatively often. This habitat utilisation pattern is likely linked to the distribution of preferred prey, namely nyala and impala in the woodland areas. The structural vegetation type is thus only an indirect influence on habitat selection by the wild dogs through its influence on prey population distribution.

Frequency of utilisation of the floristic vegetation types by the wild dogs corresponds with the data for the structural vegetation types. The woodland, thicket and induced thicket communities utilised most by the dogs are typical habitat types utilised by impala. Impala browse on the leaves of *Acacia* spp., *Combretum* spp., *Dichrostachys* spp. and *Spirostachys africana* (Skinner & Smithers 1990) all of which are commonly available in these communities. These data lend support to the theory that the wild dogs select habitat on the basis of prey availability in HUP.

At HUP topography was not found to have any direct influence on habitat selection or utilisation by wild dogs. Some preference was shown for the low lying flat areas, but they were not deterred from utilising an area because of a moderate to steep slope. Once again the low lying areas, ranging from the river valleys to the lower slopes, were areas most commonly frequented by herbivore species, and in particular those species preferred by wild dogs as prey.

Visibility was predominantly poor in the habitat types used by the dogs and the moderate to long grass length, together with dense undergrowth, was probably mostly responsible for this. These factors may hinder movement and could also affect hunting success. Frame (1986) reported that 88 % of wild dog hunts took place in short and medium grass habitats. It was suggested by Skinner & Smithers (1990) that it is to their advantage to utilise relatively open country because they rely on sight rather than smell when hunting. Certainly on the open plains they rely on high speed and long chases to catch their prey (Sheldon 1992) and Fanshawe &

FitzGibbon (1993) found the vegetation and amount of cover to have no effect on the hunting success rate of wild dogs in the Serengeti. In KNP the wild dogs have adapted to hunting in the woodland type habitats where visibility is often limited and high speed chases are difficult to execute (G. Mills 1994, pers. comm. [15]). However, detection and avoidance of packs by potential prey may also be a reason why wild dogs select dense vegetation in which to hunt.

Wild dogs are independant of water, but it may have a bearing on the presence of potential prey species dependant on a permanent water supply, such as impala (Skinner & Smithers 1990). The tendency to be in proximity to permanent water may be ascribed to the fact that such a water supply is close to virtually any point in Hluhluwe. Even distances in excess of 1000m are relatively small if the nomadic nature of the dogs is considered. Water is relatively well dispersed due to the permanent rivers which flow through the Park from west to east. These are principally the Hluhluwe River and the Manzibomvu River. In the southern sections of Hluhluwe, permanent water is less readily available than in the northern and central sections. The relatively high rainfall results in non-perennial surface water being available through much of the year in addition to the perennial rivers. Water *per se* is thus not considered to be a limiting factor to wild dogs in Hluhluwe but it may affect them indirectly through prey distribution.

The dogs were observed to make relatively extensive use of roads, partially as a result of the use of the road network for data collection. This is clearly reflected in the data. However, the use of roads by the dogs may be linked to the ease of movement which they offer, especially through areas with very dense vegetation. Bush clearing is practised in many areas along the roads, particularly tourist roads, improving visibility. The dogs may thus use the roads as a tool to aid hunting. In spite of this however, there are few indications that the poor visibility and dense vegetation have any effect on hunting success rate in HUP (personal observations; S. Krüger 1995, pers. comm. [16]).

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In KNP Reich (1981) recorded that the wild dogs utilised the road system extensively for moving and hunting. The fact that 31 % of the observed locations were on a road suggests that the HUP wild dogs are also using roads extensively, inspite of possible bias from observations being made from the roads. HGR has a relatively extensive road network consisting of tourist roads which are open to the public and closed management tracks. The dense vegetation and undulating topography of much of the area may make the roads an efficient means of locomotion for the wild dogs. Certainly the extensive use of the Gontshi management track supports this assumption as it winds through a reasonably densely forested area in northern HGR. It is important to note here that the dogs were often not seen for extended periods, inspite of a reasonably high use of roads by staff and tourists. Game trails, especially rhino paths, may thus serve a similar purpose as roads during such periods.

Correspondence analysis produced a few interesting associations between the wild dogs and the habitat variables. High rainfall results in long grass over most of the area in summer, which was confirmed in these analyses. Grass may be shorter and possibly less of an obstacle in terms of movement and visibility for the wild dogs in the woodland areas, accounting for the association of woodland with summer.

HUP has a burning program which is implemented in late winter each year before the spring - summer rains. This results in large areas producing new vegetative growth in early summer which consequently attracts herbivores and thus potential prey species. The wild dogs made use of forest areas to rest up in (Plate 6), moving out onto these burnt and generally more open grassland and woodland areas to hunt, thus taking advantage of the prey species concentrations.

The possible influence of lion density and distribution on wild dog distribution in HUP was not investigated in this study. It is interesting to note that lion densities were highest in UGR (Maddock *et al. 1996)*. In HGR, where the dogs concentrated their activities, there were no or very few lions. It is thus possible that lions are influencing the distribution and habitat utilisation of wild dogs in HUP but further research is required to test this hypothesis. Dr Gus

PLATE 6 Inside the Gontshi Forest in northern Hluhluwe which is often utilised by the wild dogs

Mills has found similar avoidance of high lion density areas by wild dogs in KNP and is currently developing this theory with ongoing research (G. Mills 1993, pers. comm. [17]).

3.5 CONCLUSIONS AND MANAGEMENT IMPLICATIONS

Availability of open habitats is clearly not a limiting factor for wild dogs, as many in southern Africa survive in predominantly closed bush and woodland habitats (e.g. Reich 1981 and Maddock 1990 in KNP; personal observations in HUP). Their presence in an area is more strictly governed by the presence of their primary prey (Skinner & Smithers 1990; Maddock 1990).

The HUP wild dogs prefer dense forest and closed woodland habitat types and have habituated successfully to hunting and surviving in this kind of environment. Their primary prey species include nyala, a species which frequents dense thicket and forest habitat types, and thus require different hunting techniques to those used in open flat habitat types. The wild dogs are equally well adapted to the woodland and thicket where prey includes mostly impala. They seem to take advantage of open areas for hunting where available, but it is certainly not a prerequisite for hunting success for this population of dogs.

In HUP specifically, availability of suitable habitat does not seem to be a limiting factor for the wild dog population. Optimum population size calculations should take account of the ratios between predator (i.e. lions, wild dogs, hyaenas, leopards and cheetahs) and prey populations because prey populations have a major affect on the distribution and habitat utilisation of wild dogs. Habitat type in terms of structural and floristic vegetation composition, topography, water and visibility has an indirect affect on habitat selection and utilisation by wild dogs in HUP.

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CHAPTER 4

EFFECTS OF DISEASE AND GENETICS ON POPULATION STATUS

4.1 INTRODUCTION

Disease

In recent years, population biologists have become increasingly aware of the importance of disease in the dynamics of wild populations (Anderson & May 1979). In small, isolated populations that are highly vulnerable to extinction from chance environmental events, disease epidemics may play a particularly important role (Gascoyne *et al.* 1993a) and outbreaks of infectious disease can ruin conservation programmes (Lyles & Dobson 1993). The threat of extinction posed to a small population by disease was illustrated by an epizootic of canine distemper in black-footed ferrets (*Mustela nigripes*) in Wyoming (USA) in 1985, in which the population fell from 129 individuals to <20 individuals (Williams *et al.* 1988). To minimise catastrophic disease outbreaks, it is important to understand the dynamic relationship between populations of threatened hosts and potential pathogens.

Wild dogs appear to suffer from the same diseases as domestic dogs (*Canis familiaris*) and direct or indirect contact with domestic dogs may result in outbreaks of disease (Van Heerden 1979, 1980; Colly & Nesbit 1992). A relatively large population of feral and domestic dogs in areas around conservation areas such as HUP act as a potential source of infection to the wild dog population. In all cases of infection it appears that the wild dogs are the victims of disease rather than the vectors (Van Heerden 1979, 1980).

Research has been conducted on disease and the effects thereof on similarly isolated populations of wild dogs in wildlife reserves in Kenya and Tanzania (Alexander & Appel 1994; Alexander *et al.* 1993b; Gascoyne *et al.* 1993a, b). Alexander & Appel (1994) described a canine distemper epizootic among domestic dogs in an area just north of the Masai Mara Reserve in Kenya which they believe was introduced into local populations of African canids. This region is characterised by a high density of wildlife species living in an area populated by the Masai tribe and their domestic animals, including a large number of domestic dogs.

Gascoyne *et al.* (1993 a,b) identified domestic dogs as a likely source of rabies infection for African wild dogs in the Serengeti region in Tanzania. Research indicates various levels of contact between domestic dogs and jackals *(Canis mesomelas)*, bat-eared foxes *(Otocyon megalotis)* and African wild dogs in Kenya (Alexander & Appel 1994), Tanzania (Gascoyne *et al.* 1993a,b) and Botswana (Butinski 1974). Therefore, disease epizootics among domestic dog populations may have a significant impact on susceptible sympatric wild canid species (Alexander & Appel 1994).

Wild dogs are highly social animals which live in packs, the members of which spend nearly all their time in proximity to each other (Mills 1993). All pack members frequently interact with each other, for example with mouth-licking and regurgitation of food to pups (Skinner & Smithers 1990) and conspicuous greeting ceremonies (Kuhme 1965b; Schaller 1972) which entail dogs gambolling about uttering a chittering sound and coming together to muzzle and lick each other around the mouth (Mills 1993). This highly social nature of wild dogs thus facilitates rapid transmission of disease within a pack and possibly a population.

Diseases which have been reported to affect free-ranging wild dog popu!ations include canine erlichiosis, canine distemper (Van Heerden *et al.* 1995), rabies (Alexander *et al.* 1993a; Gascoyne *et al.* 1993b; Van Heerden *et al.* 1995) and anthrax (Turnbull *et al.* 1991; Van Heerden *et al.* 1995).

Evaluation of the role of disease in free-living wild dogs is hampered by a number of practical factors such as the difficulty of locating the animals and keeping a constant watch on their activities (Van Heerden 1986). This is certainly true in HUP. No evidence or reports exist of disease-related mortalities for this population. A numbers of factors suggest however that disease may play a role in the status of these dogs. Most significant is the isolated nature of the population. The long fence line around HUP increases the edge effect which increases the possibility of contact with a very substantial population of domestic dogs, each a potential source of infection, in rural areas around HUP. These domestic dogs occasionally enter HUP and wild dogs have been reported to leave HUP. The potential for disease transmission between wild dogs and domestic dogs thus exists, a situation very similar to that identified by Alexander *et al.* (1993b) in Kenya.

Genetics

Morphological and mitochondrial DNA data show that wild dogs from southern and eastern Africa are distinct subspecies (Girman *et al.* 1993). Girman *et al.* (1993) hypothesize that the topographic barrier formed by the Rift Valley lakes, Lake Tanganyika and Lake Malawi, and the associated northern mountainous regions divides the two populations. This divergence has both evolutionary and conservation implications and is particularly important to projects contemplating reintroductions (Fanshawe *et al.* 1991).

Small effective population sizes increase the potential for extinction (Soulé 1987). In a closed population, the presence of only a small number of individuals, sustained over several generations, will lead to the depletion of genetic variation (Lande & Barrowclough 1987) through the " extinction vortex" (Gilpin & Soulé 1986; Caughley 1994). This is produced by a positive feedback loop (i.e. getting increasingly worse) between the size of the population and the average fitness of its members (Figure 38). The number of individuals is thus a crucial parameter in determining the amount of genetic variability that can be maintained in a population.

In a wild dog pack, a single dominant pair is usually responsible for all breeding (Frame *et al.* 1979). Owing to the behavioural dominance exhibited by the alpha female, the subordinate females normally remain in anestrus (Frame *et al.* 1979) although recent observations in KNP indicate that two or more females may produce litters in a pack during the same period (G. Mills 1995, pers. comm [18]). Generally though, only two individuals effectively contribute towards population increase within a pack. Therefore, in HUP where only one pack of wild dogs exists, the effective population size (Ne) is equal to two, as one alpha male - female pair remains dominant over the pack.

Non-breeding female and male wild dogs may disperse from a pack to join or form other packs in order to increase their reproductive success (Frame & Frame 1976a,b; Fuller & Kat 1993). These are often subordinate females which leave their pack and join another pack which is

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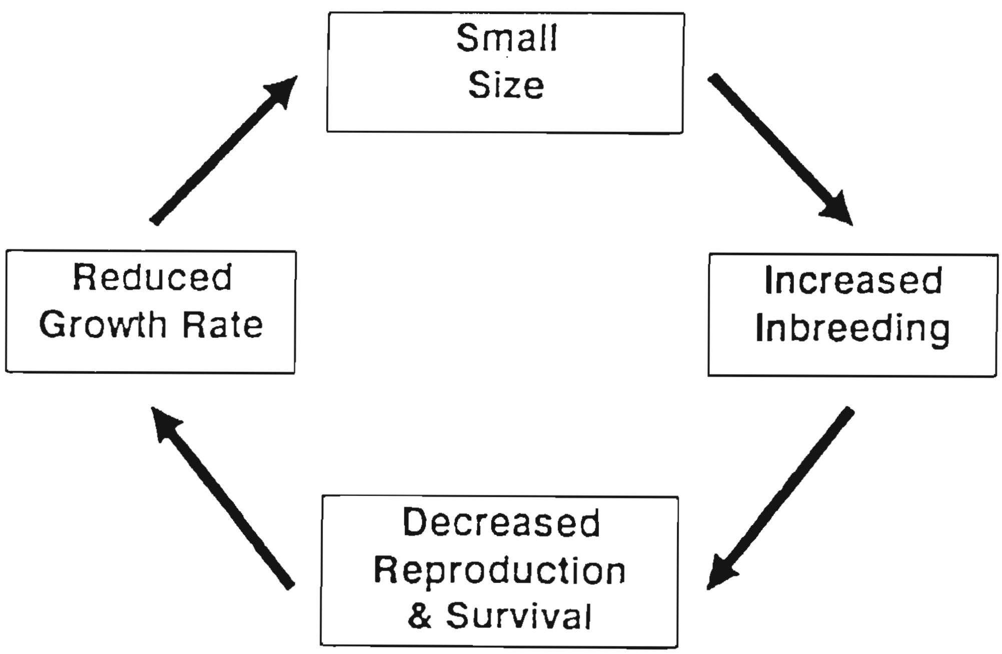

FIGURE 38 A graphical portrayal of the"extinction vortex" caused by negative feedback effects of inbreeding in small populations

without a breeding female (Frame & Frame 1976b). Such dispersal may be the primary mechanism to counteract inbreeding within a population (Girman *et al.* 1993) but isolation and small population size prevents this dispersal and levels of genetic variability are expected to decline owing to repeated breeding between close relatives.

The maintenance of genetic diversity within a population is required to ensure its long term survival (Ballou 1992). Viable populations consisting of several packs, can only be maintained in large areas. In KNP where a viable population consisting of a number of packs exists, the population is able to maintain its genetic variability without management intervention while the captive population of wild dogs at Kapama Game Reserve, which is a larger population than in HUP, was found to be highly inbred (D. Girman 1995, pers. comm.[19]).

4.2 OBJECTIVES

The objectives of the investigation of disease and genetics in the HUP wild dog population were :

- To determine the significance of disease as a cause of mortality in the HUP wild dog population.
- To identify diseases which pose a possible threat to the survival of the wild dogs.
- To estimate the threat posed by domestic and feral dogs in the areas surrounding HUP to the wild dog population in terms of disease transmission.
- To identify feasible methods to prevent and/or minimise the impact of disease on the wild dog population within the structure of a management strategy.
- To determine the genotype of the wild dogs in HUP.
- To estimate the degree of heterozygosity in the HUP population.
- To determine the importance of genetic management of the HUP wild dog population within the structure of an active management strategy.

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4.3 DATA COLLECTION

4.3.1 Observations

The wild dogs were located with the assistance of radio collars and observed on a daily basis (Plate 7). General observations of injured dogs, dogs in a poor condition, dogs lagging behind the rest of the pack and dogs exhibiting signs of disease or ill health were recorded.

4.3.2 Immobilisation

Initially it was planned to immobilise the entire population at least once during the study period. This proved to be an impossible task due to the nomadic habits of the dogs and the difficult terrain in which they move and live.

Darts were delivered with a Telinject system. Dogs were immobilised with a combination of ketamine (Ketamine, Kyron Laboratories)(100-150 mg) and xylazine (Rompun, Bayer)(40 mg) or a fentanyl (Fentanyl, Janssen)(1,5 - 2,5 mg) and xylazine (Rompun, Bayer)(20 mg) combination (Plate 8). The fentanyl - zylazine combination was reversed with the intravenous administration of yohimbine (Yohimbine, Kyron Laboratories)(0.5-0.75 ml @ 6.25 mg/ml) and naloxone (Narcan, Boots)(3-5 ml @ 6.25 mg/ml).

4.3.3 Physical examination

Immobilised dogs were sexed, aged (relatively using dentition), weighed and given a general physical examination when circumstances allowed.

4.3.4 Specimen collection

Disease

Venous blood was collected in vacutainers without anti-coagulant (Vac-u-test, Radem Laboratory Equipment). Blood smears were made from blood obtained by pricking the dogs ears. Blood specimens were collected within 30 minutes of darting. Faeces was collected from the rectum. Ticks were collected by hand picking from the dogs.

Scats were also collected at random from the field and stored in alcohol for the purpose of parasite identification carried out by Mr Thabang Mosala and Prof C. Appleton, Department of Zoology, University of Natal, Pietermaritzburg.

PLATE 7 One of the wild dogs fitted with a Telonics radio collar during the study in HUP

PLATE 8 Immobilisation of a wild dog to fit radio collars and draw blood samples for disease and genetic analyses

Blood samples (n=48) were collected from domestic dogs in the rural areas surrounding HUP with the assistance of the State Veterinary Department and the KwaZulu Veterinary Department. Sample collection was combined with clinics run by the Veterinary Departments at various locations outside HUP. Venous blood was collected in vacutainers without anti-coagulant (Vac-u-test-, Radem Laboratory Equipment).

Blood specimens were either centrifuged within one hour of collection or stored in a coolbag until transferred to a laboratory where they were centrifuged and the serum stored at -20°C until analyses were conducted according to described methods (Van Heerden *et al.* 1985). Blood smears were fixed in alcohol and stained with rapidiff (Clinical Sciences Diagnostics, Johannesburg). Ticks were identified by microscopic examination carried out by Dr Van Heerden at Onderstepoort.

Genetics

Five to ten ml of blood were placed in an equal volume of the following preservative : 100mm tris pH 8.0, 100mm EDTA (ethylenediamine-tetracetic acid), 2% SDS (sodium dodecyl sulfate) and mixed thoroughly. Containers were stored in a refrigerator. Two to three samples were collected from each dog sampled.

Samples were analysed by Dr R.K. Wayne and Dr D. Girman at the University of California. Mitochondrial control region sequences were generated for the samples. The deoxynucleotide chain termination method of Sanger *et al.* (1977) was used to sequence 736 base pairs from the cytochrome b gene of the mitochondrial genome following amplification by the polymerase chain reaction (PCR)(Saiki *et al.* 1988).

4.4 RESULTS

4.4.1 Observations

A number of mortalities (n=4) were noted during the study period, three of which were wild dogs fitted with radio collars. These were all adult males which died a month, two months, and five days, respectively, after being collared. Two collars were recovered. It was not possible to obtain samples for tests since the carcasses were in an advanced state of decay when found.

Some clinical observations, including loss of body condition, ataxia and dogs lagging behind the rest of the pack, were made (n=5) which may relate disease to these mortalities.

4.4.2 Immobilisation

Table 13 lists details of the samples collected from all immobilised dogs. Eight individuals were immobilised (Table 13) and one dog was inadvertently immobilised twice. Samples were collected from four dogs and radio collars were fitted to five dogs. Down time was approximately 3-5 minutes for both drug combinations. After the administration of yohimbine and naloxone with the fentanyl - zylazine combination the dogs were up and running within 60 seconds. The lack of an antidote for ketamine caused the recovery period for the ketamine - zylazine combination to be in excess of two hours, with full recovery taking up to five hours. In an area where lion (*Panthera leo*) and spotted hyaena (*Crocuta crocuta*) pose a threat to a drugged wild dog and where dense vegetation makes constant observation difficult during the recovery period, this is a problem. Excessive salivation and vomiting were also associated with recovery from ketamine - zylazine. With the ketamine - zylazine combination the wild dogs only reunited with the pack between 24 and 48 hours after recovery. With the fentanyl - zylazine combination this time was reduced to less than 12 hours. One dog showed a negative reaction to the drugs with respiratory depression and bleeding from the mouth caused by trauma (P. Rogers 1995, pers. comm. [20]). Dopram was administered followed by the antidote and the dog recovered well.

4.4.3 Physical findings

All immobilised wild dogs examined were in relatively good condition except for one dog which was in very poor condition (Dog C, Table 13). Dog C also had old scar tissue on the right abdomen and a fresh wound on the right front leg where the skin had been removed. All dogs examined had some visible scarring and lesions caused by tick bites. An adult male wild dog (Dog A, Table 13) had a permanent limp from a previously broken right front leg and was blind in the right eye.

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TABLE 13 Physical details of and details of samples collected from wild dogs immobilised in HUP during the study period

	A	B	C	D	E	F	G	H
Sex	M	M	M	M	M	M	F	M
Weight (kg)	*	*	*	*	18.5	24	18	22
Age	A	A	A	A	J	A	J	A
Dentition	G	G	G	G	VG	G	G	VG
Condition	G	G	VP	M	G	G	G	G
Collared	Y	Y	Y	Y	Y	N	N	N
Sampled:								
Blood	N	N	N	N	Y	Y	Y	Y
Blood smear	N	N	N	N	Y	N	Y	Y
Hair	N	N	N	N	Y	N	N	N
Faeces	N	N	N	N	Y	N	Y	Y

Symbols used in Table 13:

Sex: M = male; F = female

Age: A = adult; J = juvenile (< 1 year)

Dentition/Condition: VP = very poor; G = good; VG = very good

Sampled: Y = yes; N = no

4.4.4 Serology

Results of the serological investigations of wild and domestic dogs are presented in Table 14.

4.4.5 Blood smears

Hepatozoan spp., presumably H. canis, was identified in two of the three blood smears of wild dogs examined.

4.4.6 Blood chemistry

The results of the blood chemistry investigations are presented in Table 15. The blood chemistry parameters were all within acceptable ranges for wild dogs (J. Van Heerden 1995, pers. comm.).

4.4.7 Endoparasites

Ancylostoma caninum was identified in one of the two faecal samples examined that were collected from immobilised wild dogs.

The following parasites were identified in the wild dog scat samples collected from the field (n=12) :

- Amoebae Entomoeba coli cyst (n=2; Moderate infection)
- Coccidia Sarcocystis (n=1)
- Nematoda Ascarid types ova (n=3; Scarce infection)
  Trichurid types ova (n=2; Scarce infection)
- Trematoda ova (n=3; Moderate infection)
- Cestoda ova - Tapeworm type (n=1)

4.4.8 Ectoparasites

All dogs were infected with ticks which included one or more of the following species : *Amblyomma hebraeum*, *Rhipicephalus appendiculatus* and *R. simus*. Tick infestations were relatively heavy, but no attempts were made to quantify them.

TABLE 14 Results of tests done on wild dog and domestic dog sera

ANTIGEN	WILD DOGS		DOMESTIC DOGS	
	n	Percent positive	n	Percent positive
Canine adenovirus	3	100	48	77
Canine corona virus	3	6	48	56
Canine distemper virus	3	100	48	98
Canine parainfluenza virus	3	33	48	86
Canine parvo virus	3	66	*	*
Rotavirus	1	0	48	85
Toxoplasma	4	100	48	94

* Results not available

TABLE 15 Blood chemistry parameters of wild dogs in HUP

	MEAN	n	RANGE
Albumin g/l	30.75	4	28-33
Alanine transaminase U/l	50.25	4	38-64
Alkaline phosphatase U/l	29.75	4	11-50
Amylase U/l	687	3	625-729
Aspartate dehydrogenase U/l	35	4	21-45
Bilirubin μmol/l	4.33	3	4-5
Calcium mmol/l	2.18	3	2.17-2.21
Chloride mmol/l	111.25	4	107-115
Creatine kinase U/l	196	4	115-58
Creatinine μmol/l	65.5	4	46-2
Cholestrol mmol/l	3.875	4	3.5-0.3
Gammaglutamyl transferase U/l	5.25	4	3-7
Glucose mmol/l	7.2	3	4.2-12.9
Iron mmol/l	12.27	3	8.9-14.3
Lactate dehydrogenase U/l	189.75	4	125-288
Magnesium mmol/l	1.0	3	0.93-1.06
Phosphorus mmol/l	2.17	3	1.47-3.39
Potassium mmol/l	4.475	4	3.7-5.3
Sodium mmol/l	146.5	4	138-151
Total proteins g/l	63.25	4	60-66
Triglyceride mmol/l	1.075	4	0.38-1.83
Urea mmol/l	15.65	4	10.5-22.7

4.4.9 Genetic analyses

The results of the DNA sequencing of the control region of the mitochondrial genome showed that all the HUP wild dogs have the same genotype as those found in KNP, DeWildt Breeding Centre, Kapama Game Reserve, Namibia, some dogs in Zimbabwe and some dogs in Botswana (D. Girman 1995, pers. comm. [21]).

A microsatellite analysis of the samples to determine the degree of heterozygosity in the population was not possible owing to cost constraints and the small sample size (n=4).

4.5 DISCUSSION

4.5.1 Observations

The four mortalities, together with five dogs which left HUP during the study period (i.e. n=9) are significant when it is considered that they constituted 47.4% of the population which was present in HUP at the initiation of the project in March 1993. There are a number of factors which have been identified as causes of mortalities amongst wild dogs, both natural and those caused by man. Natural causes identified in KNP by Van Heerden *et al.* (1995) include disease, desertion, predation by lions, intraspecific fighting, infanticide and siblicide. Mortalities caused by man include road kills, snares and shooting (Fanshawe *et al.* 1991; Van Heerden *et al.* 1995). Van Heerden (1995, pers. comm. [22]) suggests that a large percentage of mortalities can be attributed directly or indirectly to trauma. A high mortality rate in a small population is a problem which needs to be addressed.

When a pack of wild dogs becomes too large, individuals or small groups split off from the pack to join similar groups from other packs. This increases reproductive success (Frame & Frame 1976a,b) and counteracts inbreeding. The small population size and presence of only one pack in HUP renders this natural process impossible. The emigration of dogs out of HUP could be ascribed to the lack of or search for other packs. It is a cause of concern as the chances of

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wild dogs being shot once outside the boundary fence are extremely high. Reich (1981) recorded similar instances in KNP where a pack of wild dogs left an area which contained ample food and water for no apparent reason. All possible efforts should be made to keep the wild dogs within the boundaries of HUP.

4.5.2 Immobilisation

Two different combinations of drugs were used for immobilisation, both of which were very effective. The ketamine - xylazine combination had the distinct disadvantage of taking a very long time to wear off. The fentanyl - zylazine combination was more effective and this combination is recommended by Van Heerden *et. al.* (1995). One of the dogs recovered more quickly than expected. Van Heerden (1993) notes that immobilisation time is unpredictable for this combination. The long period taken to reunite with the rest of the pack may induce extreme stress on the immobilised wild dog. After a recent dramatic decline in numbers of wild dogs under study by researchers in the Serengeti ecosystem in Tanzania it was suggested that the stress experienced by wild dogs due to handling caused immune suppression and the subsequent reactivation of latent rabies viruses in carrier animals, resulting in their deaths (Burrows 1992), but this view was criticised. It is the opinion of De Villiers *et al.* (in prep) that there is no evidence that immobilisation causes a stress-response capable of reactivating latent viruses through immune suppression, nor does there appear to be any causal link between handling and mortalities of wild dogs. Creel (1992) and MacDonald *et al.* (1992) considered it unlikely that vaccination ten months previously was causally related to the wild dog mortalities or disappearance. Creel (1992) states that studies of four major wild dog populations so far show no effect of darting and radio collaring on mortality. It is interesting to note that three of the five dogs fitted with radio collars in HUP died within two months after handling and all three were immobilised with the ketamine - xylazine combination. One of these dogs disappeared only days after immobilisation and was never recovered.

All the dogs immobilised with fentanyl - xylazine in this study recovered well and no mortalities have been recorded. It is thus possible that the stress induced by the long recovery period and the long period taken to reunite with the pack associated with the ketamine - zylazine drug combination may be related to these mortalities.

4.5.3 Physical findings

Most dogs immobilised were in good physical condition. The very poor condition of the one dog, a case of straight ataxia, together with the fact that this dog disappeared five days after being handled, could possibly be ascribed to canine distemper induced by the stress associated with handling. The high incidence of some form of skin lesions is in agreement with findings in KNP (Van Heerden *et al.* 1995) and were probably caused by traumatic events in the harsh environmental conditions in HUP (dense forest and bush vegetation and undulating terrain) or intraspecific aggression, and the high abundance of ticks. Injuries associated with limping may have caused stress on inflicted dogs as they experienced difficulty in keeping up with the pack.

4.5.4 Serology

Although HUP is relatively small in comparison to KNP, the likelihood of contact with domestic dogs is much greater because of the increased edge effect (periphery to area ratio) created by the long fence line, the very large and mostly unvaccinated population of domestic dogs in the areas surrounding HUP (for example 26 % of domestic dogs sampled were not vaccinated; n=50) and the nomadic nature of the wild dogs. Domestic dogs which venture into HUP are destroyed on sight.

The strong presence of antibodies to canine distemper and canine parvovirus in samples tested indicates that these dogs have been exposed to these antigens. This is in direct contrast to the absence of these viruses in KNP (Van Heerden *et al.* 1995) as well as the absence of canine distemper virus and very low levels of canine parvovirus in wild dogs in the Masai Mara in Kenya (Alexander *et al.* 1993b).

Canine distemper is a contagious viral disease encountered worldwide, and is characterized by high mortality in dogs and other carnivores (Appel & Gillespie 1972). The disease is transmitted mainly through inhalation of airborne virus (Appel 1987) between susceptible species, but domestic dogs remain a primary reservoir for the viruses (Gorham 1966). The highly social nature of wild dogs increases the likelihood that the entire pack will be infected by the virus (Mills 1993). Depending on the virus strain, domestic dogs may develop a humoral and cellular response and recover. Failing this the dog will die of acute or subacute disease or become persistently infected (Alexander & Appel 1994). It is unlikely that canine distemper would kill all the dogs in HUP, although it may reduce the population to below a viable threshold. Canine parvovirus infection has also been reported worldwide in domestic dogs (Appel 1987) and sporadically in a few species of non-domestic carnivores (Spencer & Burroughs 1990). Both viruses are pathogenic to domestic dogs and observed mortalities of wild dogs in the HUP population could have been caused by either or both of these viruses (J. Van Heerden 1995, pers. comm. [23]).

Canine coronavirus is antigenically closely related to feline coronavirus and to transmissible porcine gastro-enteritis virus (Bartz & Montali 1987) and causes diarrhoea. A high prevalence of coronavirus antibodies (64,5%) was found by Van Heerden *et al.* (1994) in the KNP wild dog population, similar to the 66% found in HUP. This is probably indicative of a high exposure to enteric viruses to which animals living in close association are subjected (Van Heerden *et al.* 1995).

Canine adenovirus Type 1 is the only type which has been reported in non-domestic carnivores (Van Heerden *et al.* 1995). Van Heerden *et al.* (1995) believe that the high prevalence rate may be due to the environmental resistance of the virus and the fact that dogs harbour the infection for months in their kidneys which may serve as a source of infection for other dogs. Canine parainfluenza was only found in one dog but infection can spread rapidly within a pack.

4.5.5 Blood smears

Hepatozoon is often found in wild dogs and generally regarded as apathogenic (J. Van Heerden 1995, pers. comm.[24]). Gametocytes of *Hepatozoon canis* were regularly observed in captive wild dogs (Van Heerden 1985). However, despite the signs of clinical disease, the parasite may induce localised inflammatory reactions and should be regarded as an opportunistic pathogen (Van Heerden *et al.* 1995).

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4.5.6 Parasites

Ancylostoma, identified in a faecal sample, is an important potential pathogen and has been recorded in both captive and free ranging wild dogs (Van Heerden *et al.* 1994) and to cause the death of captive wild dogs. Hookworms can perhaps be regarded as the most pathogenic nematode parasite of young domestic dogs and cats (Van Heerden *et al.* 1994). Although hookworm infections have not been found to be pathogenic in free-ranging wild dogs, ancylostomosis may well become a contributing mortality factor in pups or subadults under adverse conditions. The social organisation of the wild dog, especially in the den situation, facilitates spread of the infection. Control or eradication of the hookworm in free-ranging populations is virtually impossible (Van Heerden *et al.* 1994).

The ticks identified did not include the species which are known to be important vectors of *Erlichia canis* (canine erlichiosis) or *Babesia canis* (canine babesiosis) in domestic dogs. All the species of ticks have been identified on wild dogs (Horak *et al.* 1987; Van Heerden 1985; Van Heerden *et al.* 1995)

4.5.7 Genetic considerations

Particularly in areas where relict populations exist, reintroduction of a distinctly different subspecies is inadvisable (Fanshawe *et al.* 1991). Interbreeding between the two forms might result in outbreeding depression due to dissolution of co-adapted gene complexes and loss of local adaptations (Templeton 1986). This restricts the choice of wild dogs for further reintroduction in HUP to the Southern African sub-species.

The number of wild dogs in HUP has remained low (i.e. 3 - 30) since their reintroduction in 1980. Although the population has bred successfully several times, inbreeding is likely as they are all related to one another and no new blood has been introduced. Inbreeding can have detrimental effects on fitness through increased expression of deleterious alleles leading to developmental abnormalities, infertility and higher juvenile mortality (Allendorf & Leary 1986; Ballou & Ralls 1982; Laikre & Ryman 1991; Noble *et al.* 1990; Ralls & Ballou 1983). The loss of genetic variability may also render the wild dog population more susceptible to epizootics and parasites (O'Brien *et al.* 1985) and other stochastic environmental occurrences.

Isolated populations of wild dogs, such as the one in HUP, are restricted to small population numbers and low population densities. The present population is showing signs of the effects of demographic and environmental stochasticity. The fluctuating population size remains small which could be attributable to high juvenile and adult mortality rates and low birth rates. Disease has been identified as a threat to viability and no litters have been produced in the last two years which could indicate reduced fertility levels.

4.6 CONCLUSIONS AND MANAGEMENT IMPLICATIONS

Disease

The role of disease and handling stress as mortality factors amongst wild dogs is a controversial subject. Although the mortalities of handled dogs in this study is a cause for serious concern, it is not possible to link this causally to handling stress.

Owing to the small sample size, it difficult to draw any definite conclusions about the role of disease in the survival of the HUP wild dog population. There are however strong indications that disease does indeed pose a threat to this population. The source of this threat is almost certainly the domestic dog population around HUP and further study is required in this regard.

Of all the viral diseases, canine distemper appears to have the most serious consequences for susceptible free-living and captive carnivores (Montali *et al.* 1987). Control of viral diseases such as distemper by regular immunisation, although effective in captive wild dog populations (Spencer & Burroughs 1990), is not likely to be a feasible solution for a wild population. Vaccination may offer a solution for protecting rare species from diseases and has been suggested as a means of safeguarding endangered canids from the threat of rabies (Ginsberg & MacDonald 1990). Should additional wild dogs be reintroduced into HUP, vaccination with killed vaccines should be implemented for diseases such as rabies and distemper. These are difficult to obtain and all are vaccines for domestic dogs and not specifically for wild dogs. In HUP it would be virtually impossible to implement an immunisation programme due to various constraints which make immobilisation extremely difficult. Since vaccination should be carried out on a regular basis to be effective and maintain levels of antibodies, such a programme is not considered feasible in HUP.

The prevalence of potential infectious diseases in the domestic dog population around HUP is the greatest threat facing the wild dog population. It is not possible to quantify the relationship between the prevalence of diseases in domestic dogs around HUP and mortalities of the wild dogs. As in Kenya (Alexander & Appel 1994), the importance of monitoring populations of domestic animals that are in close contact with endangered species is recognised. Domestic dogs should not be allowed into wild dog habitats. An effective fence and shooting of any domestic dogs within the HUP boundary should assist in controlling this problem. Health programmes inclusive of population control programmes and strict regular disease preventative programmes, such as control of endo- and ectoparasites, and regular vaccination against viral diseases (Van Heerden *et al.* 1995) should ideally be carried out in the areas surrounding HUP. This is a huge task which will require close cooperation between the State Veterinary Department, which is already implementing such a health programme, the Natal Parks Board and the local inhabitants.

Genetic considerations

Further study is required to determine the genetic status of the HUP wild dog population. It is clear that genetic variability is an important factor governing the survival of species, particularly in isolated circumstances, and that this requires careful consideration in long term management programmes.

In spite of the restrictions and various factors which threaten the future of this population of dogs, management options exist which can ensure their survival and a positive contribution to the future conservation of the species in Southern Africa through the metapopulation management approach . A metapopulation involves the subdivision of the total population of a species into a number of smaller independent or semi-independent sub-populations (Craig 1994) and the consequent management of each individual sub-population including the population as a whole. The metapopulation as a management option is discussed in Chapter 5.

CHAPTER 5

MANAGEMENT PROPOSALS

5.1 INTRODUCTION

Before implementing an effective active management strategy, a decision needs to be made as to whether wild dogs are going to be actively conserved in HUP in the future. This is in contrast to the present 'hands-off' management approach. The HUP management committee should thus make a decision based on NPB policy guidelines with regards to the conservation of endangered species, particularly wild dogs, and the reintroduction and management of such species in areas where they formerly occurred. The first positive step in this direction was taken with the original reintroduction of wild dogs in HUP in 1980/81. Further consolidation of this reintroduction is now required.

Considering the endangered status of the wild dog (Ginsberg & MacDonald 1990; Fanshawe *et al.* 1991; also refer Chapter 1), wild dogs should be conserved in HUP. It is clear that, although the original reintroduction of wild dogs was successful, certain problems threaten the future of this population and that active management steps are required (Griffith *et al.* 1989) to ensure their survival in the future.

Therefore, in accordance with one of the objectives of this project (Chapter 1), the following management proposals are formulated for short term (approximately next five years) and long term (thereafter) management of the wild dog population in HUP.

5.2 OBJECTIVES OF THE MANAGEMENT STRATEGY

1) To enhance and ensure the long term survival of the HUP wild dog population;
2) to ensure that the HUP wild dog population makes a positive contribution to the conservation of the species;

3) to ensure survival of wild dogs in HUP; and

4) to ensure that wild dogs provide long term ecological and cultural benefits to HUP.

To achieve these objectives, the major step required is the supplementation of the present population of dogs with individuals or groups from other wild or captive populations. It is this basic step around which the management strategy has been formulated.

5.3 SHORT TERM

5.3.1 Pre-initiation phase

Any management strategy should be based on good scientific principles and data collected on the species or population concerned such as space use, home range sizes, habitat preferences, shelter requirements and foraging and feeding behaviour (Kleiman 1989).

5.3.1.1 History

Reintroduction is defined as the release of animals of any origin into an area within their historic geographic range, usually where populations have significantly declined or disappeared owing to human interference or natural catastrophes (Kleiman 1989; Moore & Smith 1990).

At the time of the original reintroduction, very little information was available on reintroduction methods for this species, because none had been attempted. One of the main problems associated with this release, in retrospect, was the lack of adequate monitoring before and after the release which makes it impossible to determine whether the techniques used were successful and cost effective (Kleiman 1989). Some basic guidelines for group (a number of individuals of the same sex) and pack (a number of individuals of both sexes comprising a stable social unit and which actively reproduce) combinations and release methods are available today.

5.3.1.2 Space and Habitat

The release area must have sufficient carrying capacity (Brambell 1977) to sustain the growth of the reintroduced population (Kleiman 1989) in terms of space and habitat availability. It was concluded that the movements of the HUP wild dogs within their home range are determined to a large extent by the distribution and movements of their preferred prey species, namely nyala and impala. The single wild dog pack in HUP only utilised 22.7 % of the area available to them (Chapter 2) while the available prey base in the HGR and UGR was considered sufficient to support a larger population of dogs.

Although they were found to prefer forest and riverine forest habitat types, all available habitat types were utilised extensively by the dogs (Chapter 3). Again, the areas frequented showed great similarity to the habitat types utilised by their main prey species (Krüger, M.Sc study in prep.).

Space, habitat and prey availability in HUP suggest that HUP is large enough to support at least a second and even a third pack of wild dogs, depending on the size of the packs. Wild dogs are not territorial (Kruuk 1972; Schaller 1972) and overlapping of home range areas is not uncommon (Chapter 2). A more efficient use of space is thus expected from a larger population of dogs as the presence of two or three packs of dogs, even with home range overlap, is expected to force the population to utilise a greater area.

5.3.1.3 Disease & genetic considerations

Disease has been identified as a threat to the wild dogs in HUP (see Chapter 4). A number of potentially dangerous antigens were identified in the population, indicating that they have been exposed to these diseases at some stage. Management steps with regard to disease are discussed under long term proposals.

Inbreeding and the related effects is likely in the HUP wild dog population owing to prolonged low population numbers, all the dogs are related and no new blood has been introduced since the original reintroduction (Chapter 4). Immediate supplementation of the present population with new blood would alleviate this situation. HUP will not be able to support a self sufficient population and therefore a program of regular supplementation of the population must be implemented over the long term to maintain an acceptable level of genetic variability. It is thus possible to solve this problem through continued active management and the implementation of a metapopulation management system (see long term proposals).

5.3.1.4 Conflict with other predators

Wild dog mortalities attributable to other predators such as lions *Panthera leo* (Reich 1981), leopards *Panthera pardus* (Bertram 1982) and spotted hyaenas *Crocuta crocuta* (Frame & Frame 1981) have been recorded. Mills (1994, pers. comm. [25]) speculates that wild dogs in KNP avoid the more open plains where lion densities are high. The greatest number of wild dog mortalities in KNP are attributed to lions (Van Heerden *et al.* 1995) which have also been observed to kill wild dog pups (G. Mills 1994, pers. comm.). Loss of kills to larger carnivores such as lions and spotted hyaenas may pose a threat to wild dogs in some areas (Fanshawe *et al.* 1991).

Some interactions between wild dogs and spotted hyaenas were observed during the study period in HUP, usually over kills made by the wild dogs. No contact between wild dogs and lions was observed. It was noted though that the lion population in HUP was estimated at <65 individuals (Maddock *et al.* 1996) of which the majority were concentrated in UGR. More research is required to ascertain if lion distribution is one of the factors preventing the wild dogs from using UGR more extensively as well as to establish an acceptable balance between predator - prey and predator - predator populations in HUP.

5.3.2 Initiation phase (short term)

5.3.2.1 Present population

Certain steps should be considered with the present population of dogs. A cause of some concern is the fact that only four pups reached maturity in 1993 and no litter was produced in 1994. This may or may not be attributed to decreased levels of fertility due to the effects of inbreeding (Allendorf & Leary 1986; Ballou & Ralls 1982; Laikre & Ryman 1991; Noble *et al.* 1990; Ralls & Ballou 1983). However, the alpha female has been the dominant female in the pack for a number of years i.e. since at least 1992 (Maddock in prep.). Her age is unknown. It is thus possible that she is simply too old to produce pups, but is still sufficiently dominant to suppress breeding in the other females.

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The removal of the alpha female, to allow another female to breed, is not suggested at this stage however as it is not possible to determine with certainty if she is infertile. The alternative is the introduction of additional dogs which should stimulate natural interaction between the existing pack and the new dogs, hopefully resulting in the formation of new packs.

5.3.2.2 Selection of individuals for reintroduction

Wild dogs are highly social animals (Mills 1993). May (1991) suggests that social animals should be released in cohesive groups wherever possible, to minimise stress and to facilitate reproduction. In selecting individuals for reintroduction, various criteria should be considered, including social compatibility, genetic viability, hunting ability (DeVilliers *et al.* unpubl.), sex ratio and age structure.

Origin of dogs for reintroduction

Candidate animals for reintroduction should be close genetically to the founding specimens of the region (Brambell 1977). All individuals selected for reintroduction or translocation to HUP must belong to the southern African sub-species as classified by Girman *et al.* (1993).

The reintroduction of wild-bred individuals rather than captive-bred dogs would effectively alleviate problems associated with the reintroduction of captive-bred animals. A complete pack or members of the same pack would probably ensure the social familiarity and stability required to minimise stress and reduce problems. KNP is the only likely source of wild-bred dogs as this is the only free roaming wild population large enough to supply a group or pack of dogs without adversely affecting the viability of the population (G. Mills 1994, pers. comm. [26]).

Captive populations of wild animals can serve to reinforce and replenish endangered wild populations (Anderson 1986; Seal 1986; Foose & Ballou 1988; DeBoer 1992). One of the ideals of a captive breeding programme is reintroduction. In the case of carnivores which depend on their hunting ability to survive, certain problems arise. Captive-bred individuals may have limitations to their learning abilities which significantly reduce their viability when they are

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released (May 1991). Their ability to hunt and provide for themselves is often lost in captive-bred populations (May 1991) as they learn to associate humans with food (Childes 1988b). Although reintroduction of captive-bred animals is possible (Childes 1988b) the chances of success are lower than with wild individuals (Griffith *et al.* 1989).

Despite the possible problems, captive-bred dogs should be considered for reintroduction because of their relative availability. A number of captive populations exist in South Africa (see Chapter 1). De Wildt Breeding Centre is prepared to provide dogs for such a reintroduction project (J. van Heerden 1994, pers. comm. [27]). The paring and reintroduction of captive-bred animals with experienced wild-bred individuals can be effective (Kleiman 1989). The first reintroduction into HUP consisted mainly of captive dogs. A pack consisting of both wild- and captive-bred dogs was recently reintroduced into Madikwe Game Reserve and all indications at this stage (i.e. > 12 months) are that this has been very successful (J. van Heerden 1996, pers. comm.). It is suggested that such a combined pack of dogs should be considered for reintroduction in HUP as an alternative to a group or pack of wild-bred dogs.

Sex ratio

The main goal of a second reintroduction would be to manipulate the demographic and genetic composition (Kleiman 1989) of the present population by boosting the population numbers and thus stimulating breeding to increase the genetic viability. There are a number of options as to how this can be accomplished in terms of pack composition.

First, a group of wild-caught individuals can be translocated in the hope that they will join with the existing pack or individuals from the existing pack and breed. Although a smaller number of dogs is required the chance of success is smaller as there is the possibility that they will leave the reserve without making contact with the existing pack. There are also no guarantees that the existing population will accept them or that individuals will split from this pack to join the new dogs. In nature, female wild dogs appear to be the 'outbreeders' (Frame & Frame 1976b) and so females are better candidates for translocation than males.

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The primary option is to reintroduce a pack of dogs. The importance of reintroducing animals in as natural a social context as possible is emphasised (Kleiman 1989) to ensure stability and compatibility within the pack. Should no mingling with the existing population take place in the short term, this pack should produce a litter. This situation is preferred as the chances of dogs splitting off to seek other dogs and form a new pack are much better after a successful litter. The natural breeding unit in the wild appears to be a group of male kin plus one or more unrelated female siblings that emigrated from another pack (Frame *et al.* 1979). The pack released in Madikwe consisted of three captive-bred female siblings and three wild-caught males which were probably unrelated (J. van Heerden 1996, pers. comm. [28]).

In wild dog societies males usually exceed females in number (Stevenson-Hamilton 1947; Estes & Goddard 1967; Pienaar 1969; Schaller 1972; Frame *et al.* 1979; Childes 1988a; Fuller *et al.* 1992). With reference to pup survival, the number of females in the pack appears to be more important than the number of males in KNP (Maddock & Mills 1994). The sex ratio of a pack for reintroduction should preferably consist of approximately equal numbers of male and female individuals. Van Heerden (1996, pers. comm.) feels that a single female with the three males in the Madikwe release would have been sufficient and would have prevented problems experienced with high pup mortality rates when all three females produced litters synchronously.

A third option is to reintroduce a pack and to translocate a smaller group of dogs of the same sex, preferably a group of females.

Number

The chances of successful habituation and survival of a pack of dogs in their new surroundings are higher with a large pack as this facilitates effective hunting, adequate protection against other predators (DeVilliers *et al.* unpubl.) and successful rearing of a litter. A pack consisting of at least four to eight dogs of equal sex ratios is thus suggested. This number will depend on the number and origin of the dogs available for reintroduction. A group of three or four females would be sufficient for the translocation option.

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5.3.2.3 Public relations exercise

Reintroductions will usually flourish only if they are supported by the local human population (Kleiman 1989; Moore & Smith 1990). This is particularly relevant in areas where a game proof fence does not separate the conservation area from the surrounding community or private land. However, the possibility of break-outs from HUP are a reality. The success of the Madikwe reintroduction is largely attributed to the fact that the local community were very well informed in advance as well as the excellent fences (J. van Heerden 1996, pers. comm. [29]).

It must be taken into account that should any dogs leave HUP, it will be the property in the form of livestock and game of these communities which will be affected and the dogs stand a good chance of being shot. Clarity on a policy to provide compensation for stock losses and the possibility of prosecution for the illegal shooting of an endangered species is of great importance here, and requires prior resolution.

Meetings with local people, farmers and hunting associations should be held to provide information on this population and wild dogs in general to increase awareness amongst the local community. Press releases should be issued to local and international newspapers and magazines as well as television coverage of the reintroduction from initiation to post release.

This study has shown that tourists know very little about wild dogs but there is a lot of interest in them. A large number of reports of sightings from tourists were received in response to pamphlets distributed at the gates of HUP (Appendix 1) and by keeping tour operating companies informed of the ongoing research. The ongoing research project on wild dogs in KNP has proven the value of tourists as assistants in such research (Maddock 1990; Maddock & Mills 1994).

5.3.2.4 Compensation policy

A compensation policy for stock losses due to wild dogs escaping from HUP should be made available to the public and specifically to farmers in areas directly around HUP. Any stock

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losses proved to have been caused by wild dogs are considered the responsibility of the NPB and compensation to the value of the stock will be paid to the owner thereof.

The NPB has clear policies for 'Compensation claims in respect of damage caused by lion, cheetah, wild dog and elephant to stock and crops' (Appendix 2) and 'Problem animal control' (Appendix 3).

5.3.2.5 Release programme

The main aim of a pre-release programme is to reduce stress on the wild dogs to an absolute minimum and in so doing hopefully increase the chance of successful reintroduction. The dogs should be kept in a camp within the release area for several weeks (i.e. a soft release programme) prior to release for the following reasons :

- To ensure the establishment of a stable social unit prior to release.
- To familiarise the dogs with the environment (DeVilliers *et al.* unpubl.) so that the dogs are settled in their new surrounds when released. Habituation is of crucial importance (Chivers 1991) when bringing animals into a new area.
- To study the social hierarchy within the group before release to assist with later interpretation of the post-release adjustment of the pack and its interaction with the existent population (DeVilliers *et al.* unpubl.).
- To determine the dominance hierarchy i.e. the dominant pair, the sex and age structure of the pack, and any other interactions between individuals which may be of significance later.
- A photo identikit of all individuals should be set up for purposes of identification later and to keep track of population trends in the future. This system has been applied with great success in KNP (Maddock & Mills 1994) and is being implemented in HUP (Maddock in prep.).
- Fit radio collars to the alpha-male and -female and some female pups to facilitate tracking and post-release observation and research.
- An inoculation programme could be administered at this time.

The time period which the dogs should be kept in the camp depends on the sex composition and origin. A pack or group of wild-bred dogs need only be kept for between six and 12 weeks, primarily to settle them in their new surrounds. A combination of wild- and captive-bred dogs should be kept for a longer period in order to establish social stability in the pack. Allowing such a pack to produce a litter in the boma is also a consideration. The pack released in Madikwe were kept in a camp for several months and allowed to breed before release (J. van Heerden 1996, pers. comm. [30]). This method has obvious time implications.

A problem with the soft release program is the association which the animals develop between humans and food, a factor which can lead to the failure of the operation (Childes 1988b). One reason for combining captive- and wild-bred individuals is that it can be an effective method of training captive-bred individuals for life in the wild (Kleiman 1989). Keeping the pack in a group in a camp for several months could have the opposite effect. However, this can be successfully overcome by avoiding association of feeding with humans. The Madikwe dogs were fed whole carcasses by means of a mechanical device (J. van Heerden 1996, pers. comm. [31]). Red wolves were prepared for hunting by exposing them first to carcasses and then to live prey before release in the southwestern United States (USFWS 1982). Some food provision can be done for a period after release when necessary. The captivity period should be reduced to a minimum by releasing dogs as soon as a social hierarchy is established.

5.3.2.6 Release site

Choice of a release site is important since it influences the time taken for the dogs to settle and adjust to their new surround (Chivers 1991). It may also influence the area in which they settle and utilise for a home range, although it is just as likely that they will roam over the entire area available to them.

Two objectives with reintroduced or translocated dogs is to promote contact with the present population and to stimulate the formation of a new pack or packs in HUP. Releasing a group of individuals of the same sex within the home range of the present population could ensure

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contact between the new group and existing pack. Alternatively a pack could be released outside this home range, possibly in UGR, thus forming two packs with separate or overlapping home ranges.

In HGR there are two release sites, the Gontshi area in the north or in the Seme area in the south (Figure 6). The other option is a release site in UGR. Since the dogs were observed to primarily utilise HGR during the study period, it is difficult to draw any conclusions as to why UGR was not utilised and therefore where the suitable release site should be.

The following points should be considered when choosing the release site :

- Sufficient distance from the boundary fence to reduce disturbance from humans and domestic dogs.
- A resident and preferred prey population (Moore & Smith 1990).
- Water in proximity.
- Easy accessibility for monitoring and managing during the reintroduction phase.
- A suitable and accessible site for the erection of a camp.

5.3.2.7 Post release monitoring

Without detailed monitoring the success of the operation cannot be determined, nor can important lessons be learnt for the future (Kleiman *et al.* 1986; Scott & Carpenter 1987; Kleiman 1989; Moore & Smith 1990; Chivers 1991). A full time study of the dogs should be implemented immediately prior to release to establish a data base which will assist with management of this and similar wild dog populations. The following should be monitored :

- Home range and habitat type utilisation. The size, location and percentage overlap of the home range areas and the use of available habitat by different packs will influence the capacity of HUP for wild dogs.
- Prey selection, hunting success rate and impact of hunting on prey populations. These factors determine the balance between predator - predator and predator - prey populations and associated management decisions.
- Interspecific carnivore competition. Lions and hyaenas are potential threats to wild dogs through predation and competition for prey.

- The effect of disease on the population and a complete post mortem on all mortalities when possible is required to implement timely disease management.
- Movements of the dogs outside the confines of the reserve and resulting conflict with human populations.
- Social organisation and stability of the group or pack and interaction with the existing population. The nature of social interaction between introduced and existing populations of dogs will influence the genetic composition and successful breeding in the population and therefore related management decisions.

It must be stressed that, based on this study, such a monitoring programme is extremely difficult to implement successfully in HUP. This is primarily due to difficult terrain and the vast movements of the dogs which makes daily observation at close quarters an enormous task. However, the data which are gained will be of vital importance to the success of the operation as it influences future management decisions.

5.4 LONG TERM

5.4.1 Monitoring

A full time intensive monitoring programme during the reintroduction programme has been suggested for the short term, i.e. next five years. This should be followed by less intensive monitoring over the long term by HUP staff. It is suggested that a record system be established specifically for the wild dog population to record the following where possible:

- Population numbers at least quarterly.
- All sightings by staff and tourists (including date, place, time, activity and number of dogs).
- Details of breeding biology (denning site, number of pups produced, pup mortality).
- Mortalities and cause of death.
- Sex ratios annually.
- Photographic record update annually.
- Predation by the dogs, i.e. records of kills and prey selected.

The actual collation of the records will be the responsibility of the research staff. All staff members will have to contribute by supplying the required information.

If possible, radio collars should be kept on two wild dogs at all times, renewing batteries as required. This will facilitate locating the dogs regularly. The research department in HUP has the necessary tracking equipment for this purpose, but not the staff.

5.4.2 Disease control and management

The threat posed by disease to wild dogs in HUP has been discussed (Chapter 4). In terms of active disease management two options exist. The first is to institute a vaccination programme for the wild dog population. There are a number of practical problems associated with such a programme (J. van Heerden 1994, pers. comm[32].; P. Rogers 1993, pers. comm.[33]):

- Physical constraints caused by the difficult terrain which the dogs frequent in HUP as well as their extremely nomadic habits make immobilisation for the purpose of vaccination extremely difficult and certainly impossible on a routine basis.
- High costs of immobilization and vaccination.
- All vaccines available are for domestic dogs, most of which have been shown to induce disease in wild dogs.
- Killed vaccines are more effective but are difficult to obtain and are very expensive.
- The immune system needs to be stimulated on a regular basis in order to be effective, making it a costly exercise.

It is suggested that any dogs reintroduced or translocated be vaccinated against rabies and canine distemper as a safety measure. Killed vaccines or vaccines which do not require regular follow up boosters, should be used. Vaccination on a periodic basis, i.e. annually is not proposed owing to constraints.

The problem of endemic diseases amongst domestic dogs in the vicinity of HUP is probably more important. All indications are that these dogs are the origin and reservoir of diseases affecting wild dogs in HUP (see Chapter 4), if only as a potential source of infection. The State Veterinary Department is currently conducting a vaccination programme in these areas, but are

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faced with an almost impossible task. Strict control of fences as a means of keeping domestic dogs out of HUP and an eradication of any such animals found within HUP, i.e. kill and destroy by NPB staff, is also necessary. The fence should be warthog proof since it is their holes under the fence through which domestic and wild dogs move.

5.4.3 Establishment of a metapopulation

A management concept which is currently gaining popularity is that of the metapopulation which is described as a population of populations (Hanski & Gilpin 1991). This is due largely to the smaller more isolated nature of game and nature reserves today, and is aimed at populations which are separated or isolated as a result of this trend. Each of these smaller populations do not have the potential to be a viable self-sustaining population in terms of genetic variability and population size, and are ultimately doomed to extinction.

Metapopulation management focuses on the spatial distribution of the populations and how that influences both the genetic and demographic dynamics of the system (Gilpin 1987). Small, fragmented and isolated populations rapidly lose genetic diversity. However, with migration among sub-populations, gene flow can be increased and the effective size of the total metapopulation is significantly increased. In general, a population distributed over several sub-populations is more secure over the long term than a population located at a single site. This is particularly true if there is gene flow between populations (either natural or through management intervention) and the populations are not susceptible to the same catastrophic threats (Ballou 1992).

Metapopulation management has a number of potential advantages which should benefit the southern African population of wild dogs. Genetic variability is maintained at higher levels (Craig 1994) among the sub-populations rather than within each one (Wright 1931; Quinn & Hastings 1987; Craig 1991). Each small sub-population may lose variability, but the probability is small that the loss will occur to the same extent in each sub-population (Lacy 1987). Each small sub-population is predisposed to a higher chance of extinction by chance demographic changes within any time period (Craig 1994) but it is highly unlikely that all the sub-populations will suffer the same fate at the same time. Natural catastrophes such as floods, fires, droughts or other means of habitat destruction pose a minor threat to the total population if the sub-populations are spread geographically (Craig 1994). Environmentally linked factors such as parasites and diseases also pose less of a threat to the total population in such a management system.

The metapopulation approach has a number of practical management advantages as well (Craig 1994). Captive-bred populations can be managed as separate units and linked to selected wild populations though a long-term reintroduction program for the purpose of swopping genetic material. The establishment of small sub-populations as part of a metapopulation allows managers to effectively utilise smaller areas than are generally required for self-sustaining populations. This provides further opportunities for new conservation areas established on private land to actively participate in and contribute to the preservation of the species. Metapopulations allow managers to meet the seemingly contradictory demands of total protection and public involvement. Detailed evaluation of Metapopulations versus single large populations for rare species management is discussed in Craig (1994).

The remaining populations of wild dogs in southern Africa fit the profile for a species which should be managed as a metapopulation to prevent the ultimate extinction of the species. This primarily involves the swopping of genetic material in the form of individuals or groups of animals among the various sub-populations on a regular basis (possibly every 3 to 5 years) or as need be, in order to maintain genetic diversity and population numbers in each isolated population. Further study is required to draw up an effective swopping programme beneficial to the wild dog metapopulation.

Managing the HUP wild dog population as part of a metapopulation will require close cooperation among the conservation bodies and associations concerned. In South Africa, populations which could be included in a metapopulation are those in KNP, HUP, Madikwe Game Reserve, Kapama Game Reserve and DeWildt Breeding Centre. The Namibia, Botswana and Zimbabwe populations of wild dogs are all of the southern African sub-species and should be included in the metapopulation.

Certainly in the case of the HUP wild dog population, swopping or supplementation of new genetic material on a regular basis will be essential to the survival of the population. For such genetic supplementation to be successful the introduced individuals must reproduce in the new area. Therefore, in the case of managed swopping, it will be important to monitor the genetic and demographic performance of introduced dogs. A long-term swopping program must be prepared among the conservation bodies and private organisations involved, assisted by geneticists and ecologists. The first step towards the implementation of such a program will be the immediate supplementation of the present population in HUP with a reintroduction or translocation of dogs.

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APPENDIX 1

NATAL PARKS BOARD

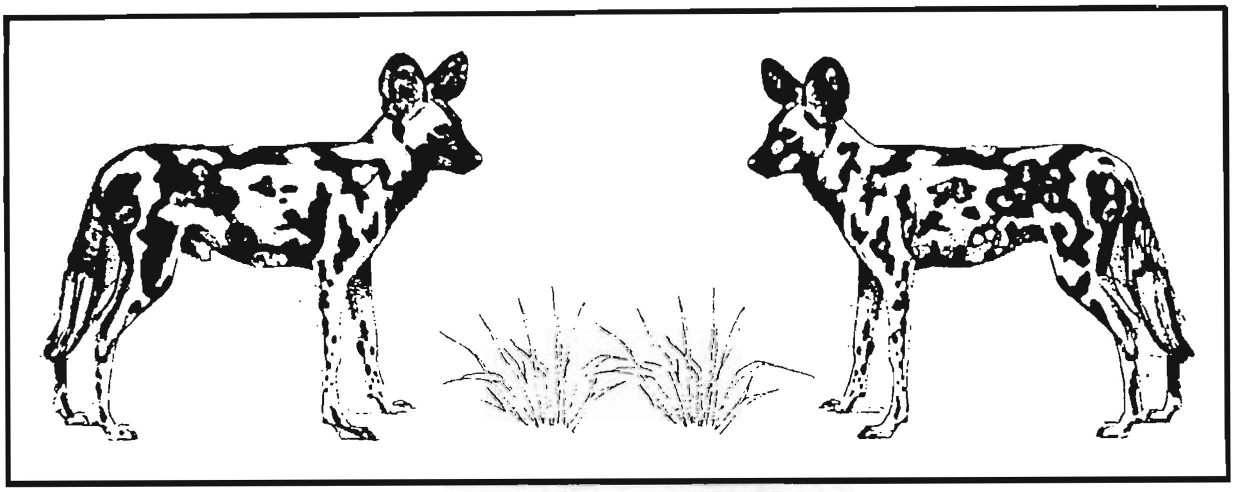
Established 1947 * 1947 gestig

ENDANGERED WILDLIFE TRUST

Licaone Fund

WILD DOGS

AFRICA'S MOST ENDANGERED CARNIVORE



HLUHLUWE - UMFOLOZI WILD DOG PROJECT

THIS PROJECT AIMS TO:-

- determine the movements and feeding biology of wild dogs in Hluhluwe-Umfolozi Park
- gather population demographic data on these wild dogs
- study the effects of disease and possible inbreeding on the Hluhluwe-Umfolozi population

HOW CAN YOU HELP?

- Should you see wild dogs in Hluhluwe-Umfolozi Park please report the location and number of dogs to the gates or camp offices *AS SOON AS POSSIBLE.*
- If you have photographs of wild dogs in Hluhluwe-Umfolozi Park and are willing to let us have copies with the relevant information, please post them to:

THE WILD DOG PROJECT
Hluhluwe Game Reserve.
P. O. Box 25
Mtubatuba. 3935

Your assistance in this regard will be greatly appreciated and will be invaluable to the success of the project.

APPENDIX 2

NATAL PARKS BOARD POLICY

SUBJECT: COMPENSATION CLAIMS IN RESPECT OF DAMAGE CAUSED BY LION, CHEETAH, WILD DOG AND ELEPHANT TO STOCK AND CROPS

POLICY FILE NO: 5-iv

DATE OF BOARD APPROVAL: 29 June 1984 BOARD MINUTE: 8(c)(i)

REVISED:	27 February 1987 :	BOARD MINUTE:	6(a)(iv)
	30 October 1987 :	BOARD MINUTE:	6(a)(iv)
	31 January 1992 :	BOARD MINUTE:	6(a)(i)(bb)
	28 January 1994 :	BOARD MINUTE:	6(b)

RECOGNISING that the Board has a responsibility to minimise any negative effect caused by introduced species that escape from NPB protected areas and realising the possibility of resultant losses to the neighbouring communities, the Board UNDERTAKES:

1. to consider all claims resulting from damage to livestock by lion, cheetah, wild dog and elephant, based on the merits of each claim, to pay compensation in an amount equivalent and to the Board's assessment of the loss suffered by that claimant, subject, however, to the following restrictions :

   (i) to pay compensation for stock killed 200 metres of the following river crossings subject to the proviso that the compensation will be reduced by one half in respect of stock killed during the hours of darkness :

   Siyembeni, Nqolothi, Mhlolokazana, Nhlungwane, Nqutsheni, Mona, Nzimane, Hluhluwe and Nyalazi;

   (ii) not to consider compensation if the loss is reported to the Board's staff more than thirty-six hours after the discovery of the kill;

   (iii) that no compensation will be paid out where the killed animal has not been protected from scavengers, or where meat has been removed before the Board's Investigating Officer arrives;

2. to issue Officers-in-Charge of NPB protected areas with special stock sale measuring tapes, which give an estimated live weight based on girth measurement. This measurement will be recorded on stock-loss forms which will be sent to veterinarians for valuation purposes, in order for the Board to assess the loss.

3. to issue all NPB protected areas with a stock/crop loss claim book, and to issue to each claimant a copy of the claim as recorded in the claim book. The issue of such a form will not convey, infer, or guarantee that the claimant will be paid compensation. The forms will be printed in English, Afrikaans and Zulu.

4. to consider claims for compensation for crop losses caused by elephant which have escaped from an NPB protected area. Compensation is to be based on ruling market prices of the crops so damaged, and the monetary value of such loss is to be assessed jointly by :

(a) an officer of the Board, and

(b) either (i) an Extension Officer of the KwaZulu Department of Agriculture,

or (ii) an officer of the KwaZulu Bureau of Natural Resources,

or (iii) an Agricultural Extension Officer of the Department of Agriculture.

5. to process all claims approved by the Board for compensation as soon as possible, and to include the full names and identity number of claimants (to avoid identification difficulties) on all compensation cheques.

Payments of compensation will be *ex gratia* and without prejudice or admission of liability.

APPENDIX 3

NATAL PARKS BOARD POLICY

SUBJECT: PROBLEM ANIMAL CONTROL POLICY FILE NO: 3-iv

DATE OF BOARD APPROVAL: 24 February 1989 BOARD MINUTE: 6(b)

REVISED: 31 January 1992 6(a)(i)(aa)

The Natal Parks Board **RECOGNISING** that:

1. Wild animals may prey on livestock and cause damage to crops;

2. Rural communities rely on the Natal Parks Board (NPB) for advice and help in combating such problems;

3. The techniques for the prevention and control of such predation and damage are not always successful in practice and require special expertise to implement;

4. Environmentally dangerous and ecologically harmful methods are sometimes employed by livestock owners and crop farmers in attempts to destroy problem wild animals;

5. There are occasions when problem wild animals come from NPB protected areas;

and **REALISING** that:

6. Caracal and black-backed jackal alone are declared problem animal species in terms of Natal Ordinance No 14 of 1978 (Problem Animals Control Ordinance);

7. The Natal Provincial Administration is the body charged with the administration of the legislation referred to in 6 above, and that

8. Provision is made in Section 40(1) of the Natal Nature Conservation Ordinance 15/1974, relating to specially protected game and in Section 48(1) relating to game and the use of prohibited methods for the destruction of specially protected game;

9. It is not appropriate for the Board to attempt to provide a complete problem animal control service;

10. It is in the interests of effective conservation extension work that the Board continues to promote investigation into both the ecological and the practical control aspects of animals causing damage to livestock and crops;

UNDERTAKES to:

1. Investigate whenever possible through its staff all incidents of predator and other damage brought to its attention; to identify the species responsible, and to recommend the appropriate control method;

2. Encourage research into predation and crop damage and thereby maintain an up-to-date extension service in this field;

3. Promote the use of humane and ecologically acceptable capture and control methods;

4. Facilitate training courses on control methods;

5. Conduct limited control operations where prudent, especially along the boundaries of NPB protected areas;

6. Destroy or capture, in the case of lion in the Hluhluwe-Umfolozi Park, all lions that have left the park or are attempting to leave, as evidenced by their proximity to the boundary fence;

7. Maintain liaison with neighbouring communities;

8. Continue to be represented on the Problem Animals Advisory Committee of the Natal Provincial Administration and the National Problem Animals Policy Committee.

<u>Note</u>:

(i) In the case of damage to stock and crops by lion, cheetah, wild dog and elephant, refer to Policy No 5-iv.

(ii) In the case of quelea control, refer to Policy No 4-vii.