CHAPTER 1

Conserving large carnivores outside state protected areas: an introduction

Large carnivores are predisposed to conflict with humans and are consequently more difficult to conserve than most other taxonomic groups (Linnell et al. 2001). In recent history, humans have been responsible for the extinction of some large carnivore species (e.g. Falkland Island wolf *Dusicyon australis*), and for substantial reductions in the distribution of many other species (e.g. brown bears *Ursus arctos*, lions *Panthera leo*, jaguars *Panthera onca,* and wolves *Canis lupus,* Johnson et al. 2001). Anthropogenic mortality continues to constitute the most significant threat to the persistence of many carnivore species (Woodroffe & Ginsberg 1998). Despite this, there are some positive trends in large carnivore conservation, particularly in North America and Europe. A combination of increased legal protection, limits to the use of poisons, expanding forests, recovering prey populations, and reintroduction programmes have resulted in increasing populations of wolves and cougars *Felis concolor* in the USA, and brown bears, wolves, and lynx *Lynx lynx* in parts of Europe (Breitenmoser 1998; Swenson et al. 1998; Linnell et al. 2001). In most other parts of the world, however, rapid expansion of human populations coupled with ineffective regulation of hunting is linked to continuing population declines and local extinction of large carnivores (Woodroffe 2000; Linnell et al. 2001).

1.1 Reasons for large carnivore / human conflict, and the difficulty associated with conserving remaining populations

1.1.1 Ranging behaviour and life history characteristics

Due to their position at the top of the food chain, large carnivores require large areas to exist (Macdonald & Sillero-Zubiri 2002). An estimated 10,000 kg of prey are required to support 90 kg of carnivore, and large predators are invariably much rarer than their prey (Carbone & Gittleman 2002). Large area requirements reduce the number of protected areas, or habitat fragments outside protected areas capable of effectively conserving large carnivore species. Species such as brown bears and wild dogs *Lycaon pictus* pose particularly acute problems for conservation as a result of their tendency to range far beyond the borders of protected areas (Woodroffe & Ginsberg 1998). Large carnivore species are also often characterized by a K-selected life history pattern, with delayed reproductive maturity and small litter sizes, reducing their capacity to tolerate persecution (Ferguson & Lariviere 2002).

1.1.2 Competition with humans for prey

Predation upon livestock is a source of conflict between large carnivores and humans virtually wherever they coexist - for example cougars killing goats in Argentina (Johnson et al. 2001), lions killing cattle and sheep in African savannas (e.g. Parry & Campbell 1992), and lynx killing sheep in the Swiss Alps (Breitenmoser 1998). The economic impact of predation by large carnivores upon livestock is variable. In some instances the impact is very high - for example predation by snow leopards *Panthera uncia* in Nepal results in losses equal in value to a quarter of the average per capita income for affected households (Oli et al. 1994). In other instances, the impact of large carnivores is small

relative to other causes – for example on a ranch in Kenya, carnivores killed 2.2% of sheep, compared to 7.8% killed by disease (Mizutani 1993). The impact of predators upon livestock is rarely evenly distributed among community members, and some farmers may suffer catastrophic losses, while the majority lose nothing (Archabald & Naughton-Treves 2001). In Gokwe communal land in Zimbabwe, for example, although the average annual cost per household due to predation upon livestock is US$ 13 per year, certain households suffer much greater losses due to occasional multiple killings of cattle by lions (Butler 2000). Carnivores also compete with humans for wild prey. Local hunters in the Canton Valais in Switzerland are opposed to the return of the wolf, because they perceive it as a competitor for the wild ungulates they hunt (Glenz et al. 2001). Conflict between humans and large carnivores due to losses of livestock and wildlife is often exacerbated by a lack of accurate information on the extent of, and true causes of mortality, and losses are often exaggerated. For example, wild dogs were responsible for only 2% of cattle losses in northwest Zimbabwe, contrary to exaggerated claims by ranchers (Rasmussen 1999).

1.1.3 Predation on humans

Globally, large carnivores cause hundreds of human fatalities every year, creating a highly emotive conflict scenario (Linnell 2002). Relative to the number of people coexisting with large carnivores however, the number of human deaths is remarkably low (Chakrabarty 1992). Attacks on humans typically result from injury to individual carnivores reducing their ability to catch natural prey, habituation and loss of fear of humans, the defence of kills by carnivores from prospective thieves, or the occurrence of

'problem animals' (Treves & Naughton 1999). An additional problem is the increasing encroachment by humans into wildlife areas and increasing contact between large carnivores and people as a result. For example, Yamazaki & Bwalya (1999) reported three fatal attacks by lions on people living in a wildlife management area in Zambia. Conversely, in North and South America, expanding populations of cougars have resulted in increasing numbers of attacks on humans (Johnson et al. 2001). Most human fatalities are caused by large felids, and most notably tigers *Panthera tigris* (Sillero-Zubiri & Laurenson 2001). In the Sundarbans mangrove forests in India, for example, between 36 and 100 people are killed annually by tigers (Chakrabarty 1992).

1.1.4 Exploitation of commercially valuable carnivore species

Historically, the exploitation of commercially valuable species has resulted in conservation problems for a variety of large mammals, including black *Diceros bicornis*, and white rhinoceros *Ceratotherium simum*, elephants *Loxodonta africana*, and several pinniped species. For example, northern elephant seals *Mirounga angustirostris* were over-exploited for their blubber in the 19th century, and reduced to a population size of 10 - 20 individuals as a result (Johnson et al. 2001). The fur trade is a problem specific to carnivores, and over exploitation has resulted in conservation problems for several species. For example, in the 1960s, 15,000 jaguar, and 80,000 ocelot *Leopardus pardalis* pelts were removed annually from the Amazon, resulting in population declines (Smith 1976). Changing fashions and increased legislation have, however, reduced exploitation levels and by the late 1980s jaguar pelt prices had dropped by ~ 95% (Swank & Teer 1987). Commercial exploitation continues to be a problem for some species, as evidenced

by the dramatic increase in tiger poaching to meet the growing demand for tiger bones and organs for traditional Asian medicine (Karanth & Stith 1999).

1.1.5 Human prejudice

Human perceptions and attitudes play an important role in determining which species are tolerated in a given area. For example, Kenyan ranchers tolerate large felids while persecuting spotted hyaenas *Crocuta crocuta,* despite the fact that the felids kill more livestock (Frank & Woodroffe 2001). Canids, in particular, appear to be the victims of irrational human prejudice. In North America, while bears are typically popular, wolves and coyotes *Canis latrans* are among the least liked of animals (Kellert 1985), perhaps due to negative childhood stories (Berg 2001). In several European languages, wolves are associated with negative expressions associated with danger and brutality (Dingwall 2001). Likewise, African wild dogs fare poorly in the public eye relative to other large carnivores, due to a reputation as wanton killers (Fanshawe et al. 1991). Overcoming human prejudices represents a major challenge in promoting coexistence between people and predators, and much research has been done on assessing the bases of attitudes towards large carnivores (e.g. Berg 2001; Dingwall 2001; Zimmerman 2001).

1.2 Approaches to the conservation of large carnivores

The best solution for large carnivore conservation is proclamation and maintenance of large protected areas (Terborgh & van Schaik 2002). However, due to increasing human populations and increasing competition for space, the scope for creating new protected

areas is dwindling. Furthermore, few protected areas are large enough to permit a full range of ecosystem processes, or adequate protection for viable populations of large carnivores (Miller et al. 1999). For example, lions ranging from the Kgalagadi Transfrontier Park in Botswana / South Africa are regularly persecuted by ranchers in response to occasional cattle losses (Castley et al. 2002). Existing parks systems currently leave 93% of the world's surface unprotected and many parks, particularly in the developing world, are under-protected 'paper parks' (Langholz et al. 2000). African protected areas are becoming increasingly insularised and wildlife reserves need to be substantially larger than those presently established to preserve current species assemblages (Burkey 1995). In light of these shortcomings, there is an increasing move towards conservation approaches based upon creation of incentives aimed at encouraging local people to coexist with wildlife outside of parks (Prins & Grootenhuis 2000). Conservation efforts outside protected areas increase the area available to wildlife, potentially create buffers for populations occurring within parks, and potentially protect habitat types not represented within parks systems. For example, vital habitat for the San Joaquin kit fox *Vulpes macrotis mutica* occurs on farmland in California (Innes et al. 1998). Conservation outside protected areas is difficult, however, and many of the problems associated with conserving large carnivores are exacerbated.

1.2.1 Ecological approaches

Conserving carnivores outside protected areas can be achieved *in situ* by protecting intact habitat patches, through augmentation of existing populations by releasing additional animals, or through the reintroduction of species into areas from which they have been

removed as a result of human activity. For each of these methods, the design of an effective conservation strategy is dependent upon an understanding of the behavioural ecology of a given species. For example, the area requirements for effective conservation vary between species. Extinction is predicted for grizzly bears in reserves smaller than 3,981 km^2, whereas the critical reserve size for the persistence of black bears *Ursus americanus* is predicted to be as small as 36 km^2, due partly to differences in ranging behaviour (Woodroffe & Ginsberg 1998). Reintroduction programmes are often severely affected by post-release ranging by large carnivores, and release sites must be far enough away from source populations to prevent reintroduced animals returning to the site of capture (Linnell et al. 1997).

Life history and behavioural ecology also determine the amount and type of prey required to sustain carnivore populations, and affect the extent to which species can adapt to habitats modified by human activity. For example, whereas lynx are strictly carnivorous and cannot survive in the absence of wild ungulate prey, bears and wolves are more able to survive on alternative food sources such as human waste products (Meriggi & Lovari 1996). The presence of sufficient suitable wild prey in an area also affects the chances of conservation efforts involving a given carnivore species succeeding, by reducing roaming beyond the borders of conservation areas, and reducing livestock depredation (Miller et al 1999).

Finally, life history traits are important in determining sensitivity to adult and juvenile mortality, ability to tolerate habitat modification, and the size of founder populations

required for reintroductions. For example, conservation strategies for species such as neotropical cats, which are short lived and produce few large neonates following lengthy gestation, should be focused upon juvenile survival, whereas conservation strategies for K-selected competitors such as pinnipeds, should focus upon reducing adult mortality (Ferguson & Lariviere 2002). Variation in life history traits leads to a corresponding variation in necessary conservation strategies, ranging from complete protection and active management (e.g. the black footed ferret *Mustela nigripes*), to protection in conjunction with limited control of problem animals (e.g. tigers), to sustainable harvest of species with sufficient numbers, growth rates and economic value (e.g. cougars), and finally, to the control of species with no economic value (e.g. coyotes, Johnson et al. 2001).

1.2.2 Sociological approaches

The conservation predicament of most large carnivores is directly attributable to conflict with humans (Woodroffe 2000), and consequently involving communities in the development of conservation strategies is imperative. Socio-political and economic considerations become more important as carnivore conservation is extended beyond protected areas, as conflict with humans increases (Mech 1998; Glenz et al. 2001). In Europe, while expanding carnivore populations are frequently supported by urban populations, the views of people directly affected by carnivores are often less positive (Breitenmoser 1998; Ericsson & Heberlein 2003). A first step in conserving predators outside protected areas is to work with the communities most affected to determine the source and extent of conflict, and to identify ways in which conflict might be reduced.

Experience from Norway suggests that conflict between people and expanding large carnivore populations could have been reduced by implementing information campaigns prior to and during natural re-colonisation by large carnivores (Zimmerman et al. 2001). Effective public relations and education campaigns are also a vital prerequisite for carnivore reintroduction programmes (Reading et al. 1997). Outreach work done prior to and during the reintroduction of wild dogs into Venetia Limpopo Nature Reserve in South Africa, for example, yielded promises from ranchers not to shoot dogs if they escape from the reserve (Davies, pers. comm.). In some cases, attitudes towards conservation can be improved simply by acknowledging that people are adversely affected by the presence of large carnivores (Sillero-Zubiri & Laurenson 2001). In other cases, however, intensive educational programmes are required – as illustrated by an example from Namibia, where 95% of ranchers interviewed indicated that they had no knowledge of the conservation predicament of cheetahs *Acinonyx jubatus* (Marker-Kraus & Kraus 1997). However educating people with entrenched attitudes towards large carnivores is difficult (Ericsson & Heberlein 2003), and in intensive conflict scenarios, education and awareness campaigns are unlikely to succeed without addressing the economic bases of conflict.

1.2.3 Economic approaches

The emerging discipline of ecological economics has a vital role in strengthening the case for conservation, by highlighting the economic value of wildlife, and identifying the economic pressures threatening species (Edwards & Abavardi 1998). Recent studies have identified three related economic reasons for continued habitat conversion and species

losses: a) the lack of information on the true value of ecosystem goods and services; b) the failure of markets to capture the benefits provided by nature to human welfare, and c) the use of perverse subsidies by governments to promote environmentally harmful agricultural activities (Constanza et al. 1998; James et al. 1999; Balmford et al. 2002). For example, unprofitable sheep farming in the Swiss Alps is heavily subsidised, creating conditions conducive to conflict with large carnivores (Breitenmoser 1998). Ultimately, wildlife will only persist in the long term if the value of its conservation outweighs these costs, and out-competes alternative land uses that contribute to human welfare (Child 1995). It is imperative that conservation strategies are designed to reduce costs incurred by local communities, and to promote exploitation of the use values of large carnivores that can be captured by conventional markets, to create financial incentives for conservation. Attempts to reduce the costs associated with the conservation of large carnivores have included the following:

a) Improved livestock husbandry. For example, livestock losses in Kenya can be reduced by constructing bomas strong enough to prevent cattle from panicking and breaking out when they become aware of the presence of lions outside (Frank & Woodroffe 2002).

b) Problem animal control. Livestock losses are sometimes attributable to single individuals, in which case an appropriate solution is the removal of that individual. For example, some British gamekeepers selectively remove individual foxes *Vulpes vulpes* responsible for losses of lambs (Sillero-Zubiri & Laurenson 2001).

c) Compensation schemes. Compensation schemes aim to promote coexistence between large carnivores and people through the reimbursement of livestock losses. For example, 12 states in the USA have compensation schemes for bears, five states for wolves, and four states for cougars (Wagner et al. 1997).

d) Removing perverse subsidies. The removal of price distortions which previously disadvantaged wildlife relative to livestock-based land uses has resulted in a proliferation of wildlife in southern Africa, in the form of game ranching on private land, and community based wildlife management schemes on communal land (Child 2000). These land use changes have had positive benefits for large carnivores in some areas – for example, in southeastern Zimbabwe, game ranching has led to population increases of cheetahs and wild dogs (Pole 1999).

Potential benefits associated with conserving large predators can be categorised as consumptive or non consumptive:

a) Consumptive utilisation involves hunting for sport or for animal products, or capture and live sale. The trophy fee for lions in Africa ranges from $3,000 - $15,000 (Loveridge & Macdonald 2002), and large carnivores are critically important for the trophy hunting industry in Africa (e.g. Creel & Creel 1997). The CAMPFIRE and ADMADE programmes in Zimbabwe and Zambia represent attempts to promote conservation outside protected areas through the generation of income from safari hunting (Balakrishnan & Ndhlovu 1992; Child 1996).

b) The most widespread form of non-consumptive utilisation is ecotourism. Global ecotourism, defined as "tourism compatible with conservation and posing minimum threat to local culture and society", is growing at rates of up to 15% per year, and has increasing potential to contribute to safeguarding biodiversity (Gossling 1999). Visitors to protected areas are willing to pay substantial sums to view certain wildlife species – in Kenya, for example, the net returns through ecotourism from the wildebeest *Connochaetes taurinus* migration are estimated at US$ 125 - 150 / animal / year (Earnshaw & Emerton 2000). Carnivores are especially popular among tourists (Davies 1998), and exploitation of their tourism value outside protected areas has potential to offset costs and promote coexistence between people and carnivores. The International Wolf Centre in Minnesota, for example generates an estimated US$ 3 million annually for the local economy (Mech 1998).

1.3 Carnivore conservation outside state protected areas: wild dogs in South Africa as a case study

The conservation predicament of wild dogs in South Africa is the result of a variety of ecological, sociological and economic factors. Consequently, wild dogs represent a useful model species with which to investigate the determinants of success in the conservation of a large carnivore species outside state protected areas.

1.3.1 Current conservation status of wild dogs

Historically, wild dogs occurred throughout sub-Saharan Africa, with the exception of true rainforest and desert (Creel & Creel 2002). There has been a dramatic reduction in numbers and geographic range over the last 30 years, with latest estimates suggesting that as few as 3000 - 5500 individuals remain (Fanshawe et al. 1997). Wild dogs have fared especially poorly in north and west Africa (Fanshawe et al. 1997) and viable populations are now restricted to southern (Botswana, Namibia, South Africa, and Zimbabwe), central (Zambia), and east Africa (Tanzania).

The ecological requirements of wild dogs predispose them, arguably more than most large carnivore species, to conservation difficulties. Large area requirements and naturally low population densities are the basis for their conservation predicament (Creel & Creel 2002). Wild dogs inhabit larger home ranges than expected for their body size (Gittleman & Harvey 1982), and utilise larger areas than other canids, or ecologically similar African carnivores (Creel & Creel 2002). Mean annual home range areas vary from 379 km^2 in Selous (Creel & Creel 2002) to 2,460 km^2 in the Serengeti (Burrows 1992). Correspondingly, wild dogs occur at densities much lower than those of competing carnivore species (Woodroffe et al. 1997a), ranging from a maximum of 4 dogs / 100 km^2 in Aitong in Kenya (Fuller & Kat 1990) to a minimum of 0.67 dogs / 100 km^2 in Serengeti (Creel & Creel 1996). The largest protected areas contain relatively few wild dogs, for example the 43,600 km^2 Selous Game Reserve contains an estimated 880 adult wild dogs (Creel & Creel 2002), and most protected areas contain much smaller populations (Woodroffe & Ginsberg 1999). Furthermore, ranging behaviour renders wild

dogs highly susceptible to edge effects, and local extinction is predicted in reserves smaller than ~ 3,600 km^2 (Woodroffe & Ginsberg 1998).

Wild dogs have an obligatorily cooperative breeding system, which results in inverse density dependence, and renders them highly sensitive to adult mortality (Courchamp et al. 2000). Correspondingly, the threshold human density above which wild dog extinction is predicted (0.7 - 6.3 people / km^2) is far lower than that for most other carnivore species (Woodroffe 2000). Persecution by humans, in conjunction with habitat loss, is the most important reason for the decline in numbers of African wild dogs (Woodroffe & Ginsberg 1999). Persecution appears to be based upon both perceived and real economic costs, and human prejudice. Wildlife managers actively persecuted wild dogs in several countries throughout much of the 20^{th} century (Creel & Creel 2002), and today, an estimated 27% of mortality in protected areas is attributable to human persecution (Woodroffe et al. 1997b). Large areas of natural habitat in Africa have been transformed by human activities, and the reduction or removal of populations of wild ungulates has contributed to the wild dogs' decline. Traffic and snares are responsible for significant additional sources of human related mortality in some parts of Africa (Woodroffe et al. 1997b).

Competing carnivores contribute to the enormous area requirements of wild dogs, and indirectly contribute to their conservation predicament. Lions are a significant source of mortality for wild dogs (up to 50% of adult deaths, Ginsberg et al. 1995) and limit access to habitats with high prey densities (Mills & Gorman 1997; Creel & Creel 2002). By virtue of their high metabolic requirements, wild dogs are highly susceptible to

kleptoparasitism (Gorman et al. 1998), and in open habitats, spotted hyaenas limit wild dog populations through interference competition (Woodroffe et al. 1997b). Increasing populations of hyaenas and lions are believed to have been responsible for the decline in wild dog numbers in the Serengeti (Creel & Creel 1996), and the local extinction of wild dogs in Ngorongoro crater was probably due to direct competition with other carnivores (Creel & Creel 2002). Rabies and canine distemper are believed to have caused the final extinction of wild dogs in the Serengeti (Gascoyne et al. 1993), and disease is reported to have a limiting effect upon some populations of wild dogs. In South Africa, a rabies outbreak was responsible for the failure of the first attempt to reintroduce wild dogs into Madikwe Game Reserve (Hofmeyr et al. 2000). Across most populations of wild dogs, however, disease is not a major cause of mortality (van Heerden et al. 1995; Creel & Creel 1996).

1.3.2 Current conservation efforts

Although wild dogs are listed as 'Endangered' by the IUCN, the degree of protection afforded to the species varies greatly between range states, from total to non-existent (Woodroffe et al. 1997c). Within South Africa, the legal status of wild dogs varies between provinces, and in all areas the shooting of 'problem animals' in the defence of livestock is permitted. Across Africa, the most important strategy for the conservation of wild dogs in the long term is the maintenance of large protected areas (Woodroffe et al. 1997c), and the creation of 'trans-frontier parks' through the linking of neighbouring protected areas across national boundaries has significant potential for improving conservation status.

In South Africa, high human population densities, widespread habitat transformation and a shortage of suitable large protected areas limit scope for improving the conservation status of wild dogs. Land tenure conditions in South Africa create unique problems for the conservation of large carnivores: private farmland constitutes 73.4% of the national land area, compared to 45% in Namibia, 6% in Botswana and 0% in Tanzania (Cumming 1991), and the expansion of commercial agriculture resulted in the rapid extirpation of wild dogs from ~ 98% of South Africa's land surface. Historically, wild dogs were distributed from the south coast, throughout the former Cape Province, to the northern borders (Skinner & Smithers 1990). At present, only one viable population of wild dogs exists in South Africa, in the Kruger National Park (henceforth referred to as "Kruger") in the extreme northeast of the country.

Current efforts to improve the conservation status of wild dogs in South Africa have focused upon the creation of a meta-population through the reintroduction of wild dogs into geographically isolated reserves, linked by management (Mills et al. 1998). This strategy has achieved some success, and to date, six sub-populations have been established. Due to the limited number of suitable state-owned protected areas, the expansion of the meta-population is likely to depend increasingly upon private nature reserves.

In recent years, there has been a widespread shift from traditional cattle ranching to game ranching, whereby wild ungulates are utilised consumptively through hunting, and non-consumptively through ecotourism (Falkena 2000; van der Waal & Dekker 2000). A

result of this has been a dramatic increase in the number of wild ungulates on private land, and conditions for the conservation of large carnivores have improved accordingly. In many areas, neighbouring game ranchers have cooperated through the removal of interior fencing to create private collaborative nature reserves or conservancies. The effect of these changing land use conditions is to provide scope for the expansion of the South African wild dog distribution outside protected areas onto private land.

1.4 This study

1.4.1 Objective

An understanding of the ecological, sociological and economic determinants of conservation success with regard to wild dogs outside state protected areas in South Africa.

1.4.2 Rationale

Wild dogs are South Africa's most endangered carnivore, and are limited to a single viable population, comprising <2% of their former range. Urgent conservation measures are required to increase the number and geographic range of wild dogs, and ultimately to improve their conservation status. As a result of changing land use patterns, conditions for conserving wild dogs outside state-protected areas are improving. Land outside state protected areas can be utilised to improve the status of wild dogs in two ways: through reintroductions into private nature reserves, and through the conservation of naturally occurring packs *in situ* on private livestock / game ranchland. These two scenarios are referred to repeatedly throughout the thesis, and are defined in the following sentences. a)

Reintroduction into private nature reserves is assumed to occur where wild dogs were absent, and into reserves from which they are prevented from leaving after release by the presence of predator proof fencing. Within this scenario, there is a range of private nature reserve types, from 'ecotourism' reserves in which predation by wild dogs is likely to result in no cost to the reserve owner, to reserves in which land use involves some consumptive utilisation of wildlife and predation is perceived to result in a direct cost to the reserve owner. b) Private nature reserves may occur within game / livestock ranchland, but the conservation of wild dogs *in situ* on ranchland is defined as occurring where wild dogs have re-colonised the area naturally, and where packs are largely able to pass between neighbouring ranches due to the absence of predator-proof fencing. Prior to the initiation of conservation efforts involving wild dogs outside state protected areas within either of the two scenarios, several feasibility aspects must be considered.

My study addressed two ecological issues relevant to the conservation of wild dogs outside state protected areas: First, I assessed the current status of wild dogs outside state protected areas, to determine what is left to conserve, and to identify the conditions in which wild dogs are persisting. Second, I determined the minimum ecological requirements for a pack of wild dogs to identify the minimum reserve sizes required for reintroductions, and the minimum habitat patch sizes required for *in situ* conservation efforts outside protected areas, assuming that genetic aspects are incorporated into conservation management, and that a pack is the demographic unit for wild dogs.

The success of conservation efforts outside protected areas is entirely dependent upon the cooperation of landowners, and their willingness to tolerate wild dogs on their land. I assessed the attitudes of landowners towards wild dogs, and identified the land tenure conditions under which conservation efforts are most likely to succeed.

The basis for the eradication of wild dogs from much of their former range is likely to have been real and perceived economic costs associated with livestock losses (Woodroffe & Ginsberg 1999). Economics form the basis for a substantial proportion of human behaviour (Shogrun et al. 1999), and consequently, an understanding of the economics associated with the conservation of wild dogs is a vital prerequisite for the design and implementation of conservation programmes. I assessed the economic costs associated with conserving wild dogs, and determined the extent to which costs can be offset by ecotourism related benefits. In this way, I identified the conditions under which wild dogs might effectively pay for their own conservation, and the conditions under which conservation efforts are likely to depend upon donor subsidies. In addition, I quantified the present subsidy to wild dog conservation from donor agencies, and utilised a cost efficiency approach to help design future conservation strategies.

1.4.3 Key questions

Specifically, my study aimed to answer the following key questions:

a) What is the present distribution and population status of wild dogs outside state-protected areas in South Africa?

b) What are the minimum area and prey requirements for a pack in the areas in which wild dogs occur in South Africa?

c) What are the attitudes of landowners towards wild dogs, and the reasons for these attitudes in the areas in which wild dogs occur on private land in South Africa?

d) What are the costs and potential benefits associated with conserving wild dogs within a viable population, through reintroduction into a reserve, and *in situ*, on ranchland?

e) To what extent has donor funding subsidised wild dog conservation in South Africa in recent years?

f) What is the most cost efficient strategy for improving the status of wild dogs in South Africa?

1.5 Overview of the thesis

The order of the chapters reflects the order of the key questions, outlined above. The thesis begins with an assessment of the distribution and status of wild dogs outside state protected areas in South Africa. Wild dog sightings were collected from a variety of sources from a period of six years, from January 1996 to June 2002. Geographic Information Systems technology enabled the analysis of wild dog distribution relative to environmental variables such as land cover, human population density and distance from source populations of wild dogs, and the identification of focal areas with the greatest potential for range expansion.

In Chapter 3, an attempt is made to identify the minimum areas required to support predation by an average pack of wild dogs. This method provided minimum area requirement estimates for wild dogs, and identified lower bound reserve sizes required for wild dog reintroductions. The utility of this approach is to assist in the selection of reintroduction sites for the expansion of the meta-population.

In Chapter 4, the results of interviews concerning rancher's attitudes towards wild dogs are presented. More than two hundred ranchers were interviewed from three parts of South Africa, and three parts of Zimbabwe. Results were used to identify the conditions under which conservation efforts are most likely to succeed.

In Chapter 5, the costs of conserving a pack of wild dogs within three scenarios were estimated: a) within a viable population, 2) through reintroduction into a private nature reserve as part of the expansion of the meta-population, and 3) the conservation of a naturally occurring pack *in situ*, on ranchland. A contingent valuation approach was used to determine the willingness of tourists to pay to see wild dogs. Estimates of the potential annual revenue from wild dog-based ecotourism were compared with costs under each conservation scenario, and the findings used to guide conservation and funding priorities.

Finally, in Chapter 6, donor-funding expenditure over the last five years was gauged with a survey of wild dog stakeholders. The way in which donor funds have been utilised was assessed relative to three sectors of the South African wild dog population: the Kruger population; the meta-population; and wild dogs occurring on ranchland. The efficacy of

current conservation efforts was assessed, and potential future strategies suggested. A cost efficiency approach was employed to help determine which future strategy is likely to represent the best 'value for money'.

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