Population and Habitat Viability Assessment for the African Wild Dog (*Lycaon pictus*) in Southern Africa

Final Report from the Workshop
Held 13-17 October 1997 in Pretoria, South Africa

Edited by
M.G.L. Mills, Susie Ellis, Rosie Woodroffe, Anthony Maddock
Philip Stander, Greg Rasmussen, Alistair Pole, Pat Fletcher, Mike Bruford
David Wildt, David Macdonald and Ulysses Seal

May1998

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Foreword

African wild dogs are thrilling, intriguing and endangered. Delight in their beauty is matched by anguish at their plight. In the fervent hope that our efforts will make some practical difference to their prospects for survival, the Canid Specialist Group has had a busy year regarding African wild dogs. The defining moment for us was the publication of the African Wild Dog Action Plan in 1997, a triumph for the scholarship and dedication of Rosie Woodroffe, Joshua Ginsberg and many contributors and correspondents. However, the end of the Plan is the start of the Action. One important conclusion of the Plan was that the situation of wild dogs in Southern Africa was significantly different to that anywhere else, and therefore merited a specialised, regional focus. It is therefore very gratifying that an immediate action has been the convening of the PVHA for African Wild Dog in Southern Africa.

The situation of wild dogs in southern Africa in general, and South Africa in particular, is special because the relatively big and secure population in Kruger National Park currently exists largely in isolation. No other substantial population of wild dogs exists in the country, although elsewhere in the region there are other strongholds, for example in the Okavango Delta of Botswana and Hwange National Park in Zimbabwe. Yet, in South Africa there is a will to promote wild dog conservation, and therefore thoughts have turned to reintroduction. That topic has been at the nub of the PVHA workshop held in Pretoria in October 1997. Because no huge national park suitable for such a reintroduction exists, thoughts turned increasingly to metapopulation management: a highly technical concept, and one at the forefront of theory but as yet largely untested in practice. In short, the notion would be to establish in a series of isolated reserves, small wild dog populations, which are freed from the genetic and populational penalties of isolation by active management: where dispersal and immigration could not happen naturally, they would be achieved by translocation. This is a very specialised topic, and an innovative idea especially, which is probably uniquely relevant to the South African situation. It was invigorating and fruitful to hear it debated in the PVHA.

The greatest strength of that debate was the inter-disciplinary mix of skills and experience brought to the meeting by the assembly of enthusiastic, well-informed and broad-minded participants. Their efforts shine through in the pages of this report, and the Canid Specialist Group is proud to have played a role in convening the meeting, and especially so in that this was a joint venture with the Conservation Breeding Specialist Group. We warmly acknowledge the skills of Ulie Seal's team, Dave Wildt and Susie Ellis and, in particular, Ulie's courage in attending the meeting at a time of personal sadness. All those concerned also thank the National Zoological Park of South Africa and the Endangered Wildlife Trust for their sponsorship of the meeting. Above all, however, my personal thanks and admiration go most fervently to Gus Mills, Co-ordinator of the CSG's *Lycaon* Working Party, whose tireless commitment both initiated and steered to fruition this excellent workshop.

Many of the ideas debated in these pages are complex, scientifically and socio-economically. We are eager to see action, but we are nervous of running before walking: several proposals considered by the workshop involve ideas that are as yet untested. The Canid Specialist Group's role is not merely to aid in the formulation of plans and to foster their implementation, but also to encourage a robust foundation for action. Much of the debate in the workshop served not to answer questions, but to insure that they were formulated correctly. The participants will have served wild dogs well in Southern Africa if their questions stimulate the methodical quest for answers.

David W. Macdonald
Chairman, Canid Specialist Group

African Wild Dog
Population and Habitat Viability Assessment
Executive Summary

There can be no doubt that African wild dogs (*Lycaon pictus*) have declined over the last century, accelerating in the last 30 years. Once distributed through much of sub-Saharan Africa, they have now been exterminated from most of their range. Wild dogs are extinct in most countries in West and Central Africa, and in the East and the South they are confined to a few areas where human population density remains low (Fanshawe *et al.* 1997). Today, Africa's wild dog population probably numbers between 3,000 and 5,000 (Woodroffe *et al.* 1997). Most populations, both outside and inside of protected areas, still may be declining.

Wild dogs are intensely social animals, spending almost all of their time in close association with one other. Hunting in packs, each member achieves a higher foraging success (measured as kg. killed per km chased) than it would if it hunted alone (Creel & Creel 1995). Packs may be as small as a pair, or number as many as 49 adults, yearlings and pups. In southern Africa, pups are born from late May to early June. In most packs, only the dominant female breeds, although up to five breeding females have been recorded.

All pack members help to care for the pups (Frame *et al.* 1979; Malcolm & Marten 1982). Pups are born in a den, where they remain for the first three months of life. Wild dog litters number 10-11 pups on average and may occasionally contain as many as 21 pups (Fuller *et al.* 1992a). The mother is confined to the den while nursing, and relies on other pack members to feed her at this time. They deliver food to her by regurgitation; later on, they regurgitate to the pups as well (Malcolm & Marten 1982). Some pack members also "baby-sit" the pups and chase predators from the den (Malcolm & Marten 1982). Pup mortality may still be high, however. Some evidence suggests that more pups survive in packs where there are more helpers to assist with their care, but this is certainly not always the case (S.R. Creel pers. comm., Burrows 1995; Fuller *et al.* 1992a; Malcolm & Marten 1982). Since wild dog females cannot successfully rear pups without assistance, in most cases the pack, rather than the individual, is considered the basic unit within the population.

Outside the denning period, wild dogs have enormous home ranges. For example, a pack in Kruger ranged over 80 km^2 when denning, but 885 km^2 after denning (Gorman *et al.* 1992). Similarly, wild dogs in Zimbabwe have been recorded to have home ranges during the denning period of up to 450 km^2 with a mean size of 250 km^2 (Rasmussen, pers. comm.). In comparison with other large predators, wild dogs live at extremely low population densities. Wild dog density is negatively correlated with the density of lions and hyenas across study sites in Africa (Creel & Creel 1996); lions are important predators of both adults and pups. Probably as a result, wild dogs avoid areas of high lion density, which often are those areas sustaining the highest biomass of prey (Mills & Gorman in press). Hyenas steal wild dog kills, especially in areas of open habitat.

Even when they live in well-protected habitats with abundant prey, wild dogs' low population densities make them unusually susceptible to habitat fragmentation. As large tracts of land have been taken over for livestock grazing and cultivation, growing human populations have caused wild dog habitat to become discontinuous. With more colonisation of land, wild dogs have been persecuted and their prey has been depleted. Wild dog populations have, therefore, become increasingly isolated in fragments of habitat with few human inhabitants. Because of the low densities at which wild dogs live, even the largest of these fragments could support only small populations, which are vulnerable to the risk of extinction (Soulé 1987). Worse still, until recently, wild dogs were persecuted in national parks and game reserves, which represented some of the best remaining habitat. This combination of habitat fragmentation, persecution and prey loss explains wild dogs' dramatic decline across most of Africa. As a result of this process, today wild dogs persist only in countries with relatively low human population densities – even in these areas, direct contact with humans is responsible for more than 50% of recorded adult mortality, even in the well-protected population in Kruger National Park (Ginsberg *et al.* 1995).

Persecution still remains the most serious threat to wild dog populations. Wild dogs are persecuted where they are perceived as a pest that kills livestock, or competes with people for wild ungulates in hunting areas (Bowler 1991). Their reputation as voracious stock-killers is has not been justified and whilst livestock occasionally are taken, losses to farmers seem to be relatively small, particularly when wild prey is available (Rasmussen 1998). The only systematic study of this problem found that, over a two-year period, wild dogs took just 26 cattle from a herd of 3,132 in the Nyamandhlovu region of Zimbabwe, and none of these were adult cattle (Rasmussen 1998). However, losses of small stock may be dramatic: one pack of wild dogs was reported to have killed 70 merino ewes and 67 lambs on a single ranch in Kenya in 1996 (M. Dyer pers. comm.). Furthermore, wild dogs frequently range outside the boundaries of protected areas, where they come into contact with people. Direct contact with human activity is responsible for over 50% of recorded adult mortality, even for the well-protected population in Kruger National Park (Ginsberg *et al.* 1995). For packs living on the borders of National Parks (e.g., living both inside and outside the Park), mortality can be as high as 92% (Rasmussen 1997).

Capture in snares is another important cause of mortality. In most places, wild dogs are caught unintentionally in snares set for ungulates, although occasionally snare capture is not accidental (Rasmussen 1997). Disease also is a serious threat to wild dogs, in particular, rabies and canine distemper. Since domestic dogs are the most likely source of both canine distemper and rabies infections in wild dogs, increased exposure to these diseases is also a direct result of human activity.

Although wild dog populations have declined markedly throughout their range, it is not too late to prevent their extinction. Viable populations remain in several countries in southern and eastern Africa, with the last viable wild dog populations left in the wild living in the Kruger and Hwange National Parks (South Africa), the Selous National Park (Tanzania), the Zambezi National Park (Zimbabwe) and the Okavango region (Botswana). With adequate protection and management, there is no reason why these populations should not endure.

To address these and other problems facing the African wild dog, a Population and

Habitat Viability Assessment (PHVA) Workshop for was held at the National Zoological Gardens in Pretoria, South Africa from 14-17 October 1997. Thirty-five people attended the workshop (Appendix I), which was a collaborative effort between the Canid Specialist Group of the IUCN Species Survival Commission (SSC) and the Carnivore Conservation Group of the Endangered Wildlife Trust. The workshop was generously hosted by Mr. Willie Labuschagne and the staff of the National Zoological Gardens, and was facilitated by the IUCN/SSC Conservation Breeding Specialist Group (CBSG). The primary aim of the PHVA was to develop a conservation action plan to improve the status of wild dogs in southern Africa. Of particular interest was the investigation of the possibility of using a metapopulation approach to management for the species. A second and linked priority was the identification of suitable conservation areas that could support an introduction program to establish additional populations of wild dogs, and the development of criteria for selecting such sites.

The workshop process took an in-depth look at the species' life history, population history, status, and dynamics, and attempted to assess the threats putting the species at risk.
To obtain the entire picture concerning the situation facing African wild dog, all the information that could be gathered was discussed by the workshop participants with the aim of first reaching agreement on the state of current information. These data then were incorporated into a computer simulation model to determine: (1) risk of extinction under current conditions; (2) those factors that make the species vulnerable to extinction; and (3) which factors, if changed or manipulated, including the development of “new” populations, may have the greatest effect on preventing extinction. In this case, these analyses included the examination of the development of reintroduced populations using founder animals from the existing wild populations.

Complimentary to the modelling process was a communication, or deliberation, process. Workshop participants worked together to identify the key issues affecting the conservation of the species and then dispersed into small, self-selected groups to discuss components of key issues which included: Management; Reintroduction; Disease; Human Interactions; and Modelling/Life History.

Each working group was asked to:

- Examine the list of problems and issues affecting the conservation of the species as they fell out under each working group topic, and expand upon that list, if needed.
- Identify and amplify in text the 3-5 most important issues.
- Develop and elaborate between three and ten action strategies to address the key issues.
- Amplify and specify the actions or strategies that might improve each of the priority problems or issues in detail.
- Identify the resources that would be needed to implement these recommendations.

Each group presented the results of their work in three plenary sessions to make sure that everyone had an opportunity to contribute to the work of the other groups and to assure that issues were carefully reviewed and discussed by all workshop participants. The recommendations coming from the workshop were accepted by all participants, thus representing a consensus. Working group reports can be found in Section 2-of this document.

The **REINTRODUCTION WORKING GROUP** used the definitions of these terms as outlined in the IUCN Guidelines for Reintroductions (Appendix II). Hence, *reintroduction* was defined as “an attempt to establish a species in an area which was once part of its historical range, but from which it has become extirpated.” *Translocation* was defined as “the deliberate and mediated movement of wild individuals or populations to an existing population of conspecifics from one part of their range to another.” The group focused on reintroduction, keeping in mind that many of the items discussed also will pertain to translocation. The group worked together to identify factors to be considered both before and during reintroductions. These then were collapsed into three main issues affecting reintroduction: site selection; animal selection; and criteria for reintroduction.

For site selection, the highest priority solution/strategy to address the identified site selection factors included:

1. a) Initiating a communication awareness campaign utilising the media and especially targeting the local community.
   b) Setting up a working group, comprised of relevant people, to evaluate reintroductions and requests for reintroductions.
   c) Developing a national and international strategy to lobby for legislative assistant and/or support for reintroductions.
   d) Evaluating/modelling the prey base to ensure that there is a high probability of a sustained adequate food supply for dogs.

The Reintroduction Working Group developed 29 site selection criteria, which were subsequently used by the Management Working Group to compile information on various potential reintroduction sites and eventually will be used to evaluate sites for suitability.

The Working Group defined animal selection as the selection of the most suitable and available individuals to develop a founder population, in order to achieve specified reintroduction goals. The most important factor in animal selection concerns the founder population. The highest priority strategy to address the animal selection was to develop criteria for selection of individuals including factors such as:-age; immune status; genetic status (including regional genotype); established hunting skills; and previous exposure to litters.

A plenary discussion was held to discuss the wild population of African wild dogs as a source for the proposed reintroduction program. The reintroduction program planned for South Africa is aimed at establishing a metapopulation, with packs to be distributed across southern Africa with a minimum total of 9 packs over a 10- year period (as recommended by the Management Working Group – see below). Beginning with the assumption that founders for 9 packs are needed, and that the upper limit of founders needed for one pack is 6 animals, then 50-100 founders will be needed over the 10-year period.

Given the desire to have the potential wild founder source represent the southern African genetic "ecotype," founder stock over the 10-year period could come from Kruger National Park, Zimbabwe, or Namibia. Workshop participants agreed that there are enough source animals available from the wild to implement the reintroduction program without compromising the wild population**.**

This plenary discussion also included a consideration of the captive population as a potential source for reintroductions. Workshop participants agreed that this lower heterozygosity and uncertain provenance would limit the use of captive animals as a source for wild dog introductions. It also was agreed that there needs to be a better-defined structure of the South African captive population (as well as other captive populations) before it could be considered as a source of animals, given the extensive source of animals available from the wild.

Thus, there was general agreement among all workshop participants:

1. That the current metapopulation reintroduction program for next 5 years be designed to use wild animals as the source for founders. During that time, the captive community will have time to decide how they want to organise and manage that population, and to decide upon the design and some of the uses for that population over time.

2. The captive population needs to undertake organisation of its information to clarify provenance and genetic status and consider developing a research program to address some of the questions identified by this workshop.

A smaller subgroup comprised of Reintroduction Working Group members worked with the Veterinary and Management Working Groups to compile identified questions/problems that could be researched in captive populations. These priorities were:

- drug and vaccine testing
- genetic surveys
- research on basic reproductive biology
- research on optimal ages for reintroduction
- development of standards for optimal holding facilities and conditions.

Other priority functions included:

- Assisting in raising funds and linking with *in situ* projects
- Participation in repetition of the Madikwe experiment.
- Conducting basic behavioural studies, especially in conjunction with hormonal monitoring

The Reintroduction Working Group also identified a number of factors to be taken into account in determining criteria for reintroduction, with the highest priority solution to obtain and maintain information on previous reintroductions for possible publication. The Group also recommended that practical guidelines for reintroduction implementation are needed, and developed a set of factors to be considered in the development of such guidelines by the *Lycaon* Working Group.

The **MANAGEMENT WORKING GROUP** identified five primary factors affecting the management of African wild dog and prioritised them as follows: fragmentation; problem animals; monitoring; the need for a metadatabase; and the need for a uniform national wild dog policy.

High priority management issues associated with wild dog populations include the need to:

1. Map distribution, protection status and size of existing wild dog populations. To address this, Working Group participants used data from the Canid Action Plan combined with updated information to develop a table of latest information on wild dog and pack numbers (Table 1, Management Working Group Report).

2. Determine protection status of an area. To assess this, the Working Group recommended that each population be plotted on a simple bipolar axis that compares level of security (from secure to threatened) and level of legal protection (from protected to unprotected) (Fig. 1). In conjunction with this, a four-point category system was developed to indicate the level of security and level of protection.

3. Identify suitable areas for wild dog re-introduction (see below).

With the recognition that small populations are more likely to go extinct, the Working Group also identified the need for, and key factors to be considered in, the development of a set of guidelines that will be used to reduce the probability of extinction of extant or introduced populations. The Management Working Group also recommended high priorities for research including: genetics; disease; and metapopulation management.

The Working Group also set forth guidelines for the management of small populations of wild dogs, with the overall goal that within the next 10 years, a second viable population of wild dogs will be established, one in the Republic of South Africa and one in Namibia. Using the above goal, the Management Working Group then developed draft guidelines for managing small populations (i.e., more than eight packs) of extant wild dogs.

To begin an evaluation of the 29 potential reintroduction sites identified by the Working Group, the sites were cross-plotted on a matrix against the 29 criteria for site selection prepared by the Reintroduction Working Group (Table 2, Management Working Group report). A paired ranking test then was used by nine of the workshop participants to identify the highest-ranking selection criteria. Seven criteria clustered were determined to have the highest priority, based on the voting.

The Management Working Group had too little remaining time to use the top seven criteria to then rank the potential reintroduction sites using pair wise testing. However, these criteria were used in an experimental exercise by two of the participants to compare the seven identified site criteria across the potential reintroduction sites for Namibia and Zimbabwe. The Management Working Group recommended that this paired ranking approach (using the seven high priority criteria) be used for all relevant countries as a potential approach for selecting the highest priority reintroduction sites for wild dogs. It also was recommended that a high priority for the *Lycaon* Working

Party will be to use this approach on the 18 potential reintroduction sites identified in South Africa.

The aim of the **MODELING/LIFE HISTORY WORKING GROUP** was to develop a model to underpin practical recommendations for a managed meta-population in southern Africa. For adequate management, it is imperative to accurately understand the dynamics of very small populations of African wild dogs, and in some cases these small populations may comprise no more than one pack. Decisions will have to be made regarding the size and composition of founder stock, the imposition of a schedule of artificial immigration and emigration, the necessity for regulation of numbers, and any management action needed to contain the impact of catastrophes, such as disease.

To develop and validate the model, the Working Group selected Kruger National Park (KNP), with supplementary data from Moremi, in the Okavango Delta of Botswana. Eight packs, found south of the Sabie River, were modelled. In terms of metapopulation terminology, these represented the Group's meta- population, whereas each pack is a local or sub-population.

Based on the modelling, the Working Group tentatively recommended <u>for the managed metapopulation</u>:

1. The model reveals the importance of mortality schedules and therefore we recommend that a priority for research should be the quantification of mortality factors.

2. Metapopulations comprising only few packs are likely to require management. Putting a precise value on the number of packs below which such intervention is required is beyond the scope of the modelling that has taken place to date. However, the simulations using the model generated here emphatically emphasise the risk of metapopulation extinction as a consequence of even low frequencies (e.g. 8%) of catastrophic loss. Even populations as large as eight packs may require intervention.

3. Insofar as the metapopulation analysis represents reality, it leads to the recommendation that metapopulations as large as eight packs require management to secure an acceptable level of persistence. This conclusion is in accord with the judgement of field biologists in our working group, and leads us to conclude that, in practice, it is likely that some intervention will often be required to achieve a satisfactory probability of persistence for metapopulations of eight packs or fewer.

4. Consistent, periodic managed gene flow (through tranlocations) is recommended to reduce damaging levels of inbreeding and the resulting risks of meta- and sub-population extinction. The model indicated that by using a frequency of exchange based on the natural reproductive life span of wild dogs (up to five years) inbreeding can be reduced by two thirds and population persistence can be assured.

5. Based on this understanding, the Working Group also recommended that any proposed creation of sub-populations includes a feasibility study to confirm that the necessary level of management to achieve gene transfer is practical.

6. Although the model did not definitively explore this, the results are compatible with the conclusion that annual anti-rabies vaccination is likely to increase the probability of persistence and to that extent we recommend that option. Vaccination programmes should be contingent upon further research, using captive animals, to establish vaccination protocols which are both safe and effective.

7. The single pack model also demonstrated that any founding group size from two to seven could persist but that a founding pack of 6 or more reduces the probability of extinction to acceptable levels.

8. Based on the initial eight-pack model which comprised one third of the KNP population, the Working Group concluded that an offtake (for the purposes of reintroduction) of six animals per years for the next eight years is sustainable, and that an additional six per year may be sustainable under relaxed mortality conditions.

The **THREATS AND DISEASES WORKING GROUP** defined two types of threats to wild dog: anthropogenic mortalities and those caused by disease.
Threats associated with anthropogenic mortalities included: direct persecution; road mortalities; snares; and researcher effect.

Primary disease threats, in decreasing order of importance, included: rabies; canine distemper; anthrax; Parvovirus-enteritis; Babesiosis; Ehrlichiosis; internal parasite infections; external parasites; sarcoptic mange; tuberculosis.

The Working Group addressed each of these threats in turn, developing solutions and strategies which might be used to lessen the effects of threat. Primary recommendations to lessen the identified threats included:

1. Carry out basic research into vaccination of wild dogs against rabies and canine distemper.

2. Compile guidelines for crises handling of wild dogs.

3. Establish a national / international strategy on education.

4. Establish a resource information network.

5. Insist on legislation granting special protection to wild dogs throughout the Southern African region.

Different Group members took responsibility for implementing certain tasks to be carried out immediately. These actions can be found in the Working Group report.

The **HUMAN FACTORS WORKING GROUP** defined factors which are important for the development of an effective management program for the species, including:

- Habitat
- Ownership and Legal Issues
- Education, Participation, and Interaction
- Funding and NGOs

- Ecotourism and Sustainable Utilization

For each of these identified factors, the Working Group developed an array of possible strategies and specific action steps that could be used to address the problems. From these, the Group selected those strategies and action steps of highest priority. The most important actions and strategies to address the identified factors included:

1. Organise meetings and workshops with representative community land owners and game farmers near the selected protected areas to engage them in the early stages of the development of a management plan for the wild dog in their region. These stakeholders must be able to have an early and active role in the development of the program.

2. Seek all potential contributors, including states and NGOs, to take the lead in these fund raising activities.

3. Prepare a user-friendly version of this report for distribution to land owners and game farms to inform and to assist in securing their participation in management programs for the wild dog.

4. Develop suitable pamphlets on the biology and conservation of the wild dog for general distribution.

6. Encourage the formation of larger land areas with the state and conservancies by private landowners and game farmers with removal of fencing. These should be of sufficient size to accommodate at least one pack of dogs throughout the seasonal cycle of pack size and prey availability. This might be accomplished by removal of fences from ten farms approximately 1,500 hectares in size to produce a 15,000-hectare conservancy unit.

At the end of the workshop, The Chairman of the IUCN/SSC Canid Specialist Group (CSG) Chairman, Dr. David Macdonald, proposed that the *Lycaon* Working Party be re-organised, noting that this workshop coincided with a watershed period in the development of the Canid Specialist Group in general and the Lycaon Working Party in particular. The CSG recently has published two major action plans, have others in the pipeline, and fruitfully look to a future with a greater emphasis on implementation of our plans. Dr. Macdonald therefore proposed that the LWP be restructured and fortified into a nested structure, with both geographical and topical responsibilities devolved to a network of participants under the co-ordination of Dr. MGL Mills. The structure of the Group will further be elucidated in a discussion paper generated by Drs. Macdonald and Mills. The initial intention is to appoint national and regional representatives who would report on status, with those data being co-ordinated by Dr. R.B. Woodroffe. Within the CSG website, a *Lycaon* page also will be developed; this currently can be accessed through http://users.ox.ac.uk/~wcruinfo.

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Section 1

PHVA for the African Wild Dog in Southern Africa: Introduction and Overview

Population and Habitat Viability Assessment for the African Wild Dog in Southern Africa Introduction and Overview

Introduction

Reduction and fragmentation of wildlife populations and habitat are occurring at an accelerating rate world-wide. For an increasing number of taxa, these factors result in small and isolated populations that are at risk of extinction. A rapidly expanding human population, now estimated at 5.77 billion, is expected to increase to 8.5 billion by the year 2025. This expansion and the resulting utilisation of resources has momentum that cannot be stopped, with the final result being a decreased capacity for all other species to exist simultaneously on the planet.

In southern Africa, as in the rest of the world, human activities increasingly threaten the survival of natural environments and wildlife populations. As these populations are diminished, their ecological roles in ensuring a well-balanced, regulated, and sustainable ecosystem also are reduced. Still, most conservation actions are directed toward habitat and reserve protection, rather than the conservation and management of the wildlife components that are critical to the long-term survival of individual ecosystems.

Single species management for threatened species can take a variety of forms:

- Protection from invasive organisms and pathogens
- Habitat modification and management (e.g., prescribed burning or provision of artificial watering sites)
- Reintroduction or translocation
- Assisted reproduction
- *Ex situ* breeding or propagation, either in-country or abroad

Species as the compositional unit of a community or ecosystem are a convenient and discrete unit of management, particularly when that taxon is threatened and requires species-specific management.

Wildlife managers realise that management strategies designed to reduce the risk of species depletion must be adopted to ensure viable ecosystem functions. These strategies will include increased communication and collaboration in: habitat preservation; intensified information gathering in the field; investigating the ecological roles of key species; improving biological monitoring techniques; and, occasionally, scientifically managing captive populations that can interact genetically and demographically with wild counterparts. Successful conservation of ecosystems and wild species necessitates developing and implementing active management programmes by people, governments, and non-government organisations (NGOs) that live alongside, and are responsible for, that ecosystem.

The African Wild Dog – *Rosie Woodroffe and M.G.L. Mills*

There can be no doubt that African wild dogs (*Lycaon pictus*) have declined over the last century, accelerating in the last 30 years. Once distributed through much of sub-Saharan Africa, they have now been exterminated from most of their range. Wild dogs are extinct in most countries in West and Central Africa, and in the East and the South they are confined to a few are as where human population density remains low (Fanshawe *et al.* 1997). The African Wild Dog Action Plan, prepared by the IUCN/SSC Canid Specialist Group (Woodroffe et al., 1997), estimates that today Africa's wild dog population probably numbers between 3,000 and 5,000. Some populations, both outside and insi

▲ The African Wild Dog.

Wild dogs are the only member of the genus *Lycaon*. Phylogenetic analyses indicate that they represent a unique lineage within the wolf-like canids (Girman *et al.* 1993). As a result of this phylogenetic distinctiveness, they have a high conservation value.

In southern Africa, wild dogs typically weigh around 25 kg. with males slightly larger than females. Wild dogs mostly hunt medium-sized antelope; in southern Africa, because of their abundance, impala are their principal prey (Woodroffe & Ginsberg 1997). Wild dogs living in farming areas will occasionally take livestock, and have been heavily persecuted for this reason. Wild dogs very rarely take cattle (Fanshawe 1989; Fuller & Kat 1990; Rasmussen 1998), but they occasionally can become a severe problem for smaller stock.

Wild dogs are intensely social animals, spending almost all of their time in close association with one other. Hunting in packs, each member achieves a higher foraging success (measured as kg killed per km chased) than it would if it hunted alone (Creel & Creel 1995). Larger packs are better able to defend their kills against scavenging hyaenas (Fanshawe & FitzGibbon 1993).

Packs may be as small as a pair, or number as many as 50 adults, yearlings and pups. Packs are formed when small same-sex subgroups (usually siblings) leave their natal groups and join up with subgroups lacking adults of their sex. Thus, in newly-formed packs the adult females are closely related to one another, but not to the adult males, and the adult males are closely related to one another, but not to the adult females (Burrows 1995; Frame *et al.* 1979; Fuller *et al.* 1992a; Girman *et al.* 1997). Young born into such packs may remain there, but most disperse as yearlings or young adults to form new packs. New packs also may be formed when particularly large packs fission.

Wild dogs are seasonal breeders. In southern Africa, pups are born from late May to early June. In most packs, only the dominant female breeds, although up to five breeding females have been recorded. Even when several females become pregnant, most of the surviving pups are the offspring of the dominant female. Both mating behaviour and genetic analysis indicate that the dominant male fathers most (but not all) of the pups (Girman *et al.* 1997).

All pack members help to care for the pups (Frame *et al.* 1979; Malcolm & Marten 1982). The denning period lasts about 12 weeks. The mother is confined to the den for the first three weeks after giving birth while pups are totally reliant on her milk. She relies on other pack members to feed her by regurgitation at this time. Once the pups emerge, they too receive regurgitated food and are weaned at about six weeks. Some pack members also "baby sit" the pups and chase predators away from the den (Malcolm & Marten 1982). Some pack members also "baby-sit" the pups and chase predators from the den (Malcolm & Marten 1982), allowing the mothers to go out hunting. Some evidence suggests that more pups survive in packs where there are more helpers to assist with their care, but this is certainly not always the case (S.R. Creel pers. comm., Burrows 1995; Fuller *et al.* 1992a; Malcolm & Marten 1982). Since wild dog females cannot successfully rear pups without assistance, in most cases the pack, rather than the individual, is considered the basic unit within the population.

Outside the denning period, wild dogs have enormous home ranges. For example, a pack in Kruger ranged over 80 km^2 when denning, but 885 km^2 after denning (Gorman *et al.* 1992). Similarly, wild dogs in Zimbabwe have been recorded to have home ranges during the denning period of up to 450 km^2 with a mean size of 250 km^2 (Rasmussen, pers. comm.). Wild dogs dispersing from their natal packs range even more widely -- they have been followed for hundreds of kilometres (Fuller *et al.* 1992b) and single wild dogs, or single-sex groups, are occasionally reported from Nigeria and Uganda, where there have been no resident wild dog populations for decades (Fanshawe *et al.* 1997).

In comparison with other large predators, wild dogs live at extremely low population densities. Lions typically occur at densities around three times as high as wild dogs where the two species coexist; spotted hyaenas may outnumber wild dogs by up to 10:1. Direct competition with lions and hyaenas probably explains this pattern. Wild dog density is negatively correlated with the density of lions and hyaenas across study sites in Africa (Creel & Creel 1996); lions are important predators of both adults and pups. Probably as a result, wild dogs avoid areas of high lion density, which often are those areas sustaining the highest biomass of prey (Mills & Gorman 1998). Hyaenas steal wild dog kills, especially in areas of open habitat. Because of the extremely high daily energy expenditure of wild dogs, even a small loss of food to kleptoparasites has a large impact on the time that dogs must hunt to achieve energy balance (Gorman *et al.* 1998).

Threats – *Rosie Woodroffe and M.G.L. Mills*

Even when they live in well-protected habitats with abundant prey, wild dogs' low population densities make them susceptible to habitat fragmentation. As large tracts of land have been taken over for livestock grazing and cultivation, growing human populations have caused wild dog habitat to become discontinuous. With more colonisation of land, wild dogs have been persecuted and their prey has been depleted. Wild dog populations have, therefore, become increasingly isolated in fragments of habitat with few human inhabitants. Worse still, until 30-40 years ago, wild dogs were persecuted in protected areas, which represented some of the best remaining habitat. This combination of habitat fragmentation, persecution and prey loss explains wild dogs' dramatic decline across most of Africa. As a result of this process, today wild dogs persist only in countries or regions with relatively low human population densities, or where there are large, well-managed protected areas.

Although more so in the past, factors such as habitat fragmentation, persecution and loss of prey still represent the principal threats to the species today. Since wild dogs live at such low density, even the largest habitat fragments contain populations that are small in absolute terms, and are vulnerable to the risk of extinction (Soulé 1987).

Persecution still remains the most serious threat to wild dog populations. Wild dogs are persecuted where they are perceived as a pest that kills livestock, or competes with people for wild ungulates in hunting areas (Bowler 1991). Their reputation as voracious stock-killers has not been justified and whilst livestock occasionally are taken, losses to farmers seem to be relatively small, particularly when wild prey is available (Rasmussen 1998). The only systematic study of this problem found that, over a two-year period, wild dogs took just 26 cattle from a herd of 3,132 in the Nyamandhlovu region of Zimbabwe, and none of these were adult cattle (Rasmussen 1998). However, losses of small stock may be dramatic: one pack of wild dogs was reported to have killed 70 merino ewes and 67 lambs on a single ranch in Kenya in 1996 (M. Dyer pers. comm.). Furthermore, wild dogs frequently range outside the boundaries of protected areas, where they come into contact with people. Direct contact with human activity is responsible for over 50% of recorded adult mortality, even for the well-protected population in Kruger National Park (Ginsberg *et al.* 1995). For packs living on the borders of National Parks (e.g., living both inside and outside the Park), mortality can be as high as 92% (Rasmussen 1997).

Capture in snares is another important cause of mortality. In most places, wild dogs are caught unintentionally in snares set for ungulates, although occasionally snare capture is not accidental (Rasmussen 1997). Thus, wild dog mortality is an incidental effect of subsistence hunting outside protected areas, and poaching inside them. Wild dogs living in protected areas often encounter snare lines as they move out into unprotected areas. This is confounded by the large areas over which wild dog populations range.

Road traffic accidents also cause substantial mortality. Where wild dogs occupy areas with good roads used by fast-moving traffic, the effect may be dramatic. The most recent data from Hwange National Park, Zimbabwe reports that road mortalities account for 30% of all dead dogs encountered in marginal areas (e.g., on the borders of National Parks). Outside protected areas, road casualties may cause relatively more wild dog deaths than inside them. Where roads are available, wild dogs use them to move and hunt.

Disease also is a serious threat to wild dogs. Rabies contributed to the extinction of the wild dog population in the Serengeti-Mara area on the Kenya-Tanzania border (Gascoyne *et al.* 1993; Kat *et al.* 1995). Canine distemper caused the death of at least one whole pack in Northern Botswana (Alexander *et al.* 1996), and is a likely cause of the simultaneous deaths of a further five packs elsewhere in the same ecosystem. The mortality caused by distemper is not well characterised, however: in other populations a high proportion of wild dogs may carry antibodies, indicating that they have survived exposure to canine distemper virus. Anthrax may be another important threat: dramatic decline of wild dogs in the Luangwa Valley, Zambia, coincided with an outbreak of anthrax in wild herbivores, although wild dogs in other areas appear relatively resistant to anthrax (Woodroffe & Ginsberg 1997). Since domestic dogs could be a source of both canine distemper and rabies infections in wild dogs, increased exposure to these diseases also is a direct result of human activity. It also must be recognised, however, that rabies also is carried by many other wild animals and is an indigenous disease in southern Africa.

Although wild dog populations have declined markedly, it is not too late to prevent their extinction. Viable populations remain in several countries in southern and eastern Africa, with the last viable wild dog populations left in the wild living in the Kruger National Park in the Republic of South Africa, the Okavango region, Selous National Park in Tanzania, the Zambezi and Hwange National Parks in Zimbabwe (Rasmussen 1997), and in the Kaudom Game Reserve and Tsumkwe District in Namibia (Stander 1998). With adequate protection and management, there is no reason why these populations should not endure and with some innovative programmes why new populations should not be established.

Initiation of the PHVA Process for the African Wild Dog in Southern Africa

To address these and other problems facing the African wild dog in southern Africa, a Population and Habitat Viability Assessment (PHVA) Workshop was held at the National Zoological Gardens in Pretoria, South Africa from 14-17 October 1997. Thirty-five people attended the workshop (Appendix I), which was a collaborative effort between the Canid Specialist Group of the IUCN Species Survival Commission (SSC) and the Carnivore Conservation Group of the Endangered Wildlife Trust. The workshop was generously hosted by Mr. Willie Labuschagne and the staff of the National Zoological Gardens, and was facilitated by the IUCN/SSC Conservation Breeding Specialist Group (CBSG). The primary aim of the PHVA was to develop a conservation action plan to improve the status of wild dogs in southern Africa. Of particular interest was the investigation of the possibility of using a metapopulation approach to management for the species. A second and linked priority was the identification of suitable conservation areas that could support an introduction programme to establish additional populations of wild dogs, and the development of criteria for selecting such sites.

The PHVA Process

At the beginning of each PHVA workshop, there is agreement among the participants that the general desired outcome is to prevent the extinction of the species and to maintain a viable population(s). The workshop process takes an in-depth look at the species' life history, population history, status, and dynamics, and assesses the threats putting the species at risk.

One crucial by-product of a PHVA workshop is that an enormous amount of information can be gathered and considered, that, to date, has not been published. This information can be from many sources; the contributions of <u>all</u> people with a stake in the future of the species are considered. Information contributed by farmers, ranchers, game wardens, scientists, field biologists, and zoo managers all carry equal importance.

To obtain the entire picture concerning a species, all the information that can be gathered is discussed by the workshop participants with the aim of first reaching agreement on the state of current information. These data then are incorporated into a computer simulation model to determine: (1) risk of local extinction under current conditions; (2) those factors that make the species vulnerable to extinction; and (3) which factors, if changed or manipulated, may have the greatest effect on preventing local extinction. In essence, these computer-modelling activities provide a neutral way to examine the current situation and what needs to be changed to prevent local extinction.

Complimentary to the modelling process is a communication process, or deliberation, that takes place during a PHVA. Workshop participants work together to identify the key issues affecting the conservation of the species. During the PHVA process, participants work in small groups to discuss key identified issues, whether predator management, disease, human-animal interactions, or other emerging topics. Each working group produces a brief report on their topic, which is included in the PHVA document resulting from the meeting. A successful PHVA workshop depends on determining an outcome where all participants, coming to the workshop with different interests and needs, "win" in developing a management strategy for the species in question. Local solutions take priority. Workshop report recommendations are developed by, and are the property of, the local participants.

At the beginning of the workshop, the 35 participants worked together in plenary to identify the major issues and concerns affecting the conservation of the African wild dog in southern Africa. These identified issues centred around four main topics, which then became the focus of five working groups: Management; Reintroduction; Disease; Human Interactions; and Modelling/Life History.

Each working group was asked to:

- Examine the list of problems and issues affecting the conservation of the species as they fell out under each working group topic, and expand upon that list, if needed.
- Identify and amplify in text the 3-5 most important issues.
- Develop and elaborate between three and ten action strategies to address the key issues.
- Amplify and specify the actions or strategies that might improve each of the priority problems or issues in detail.
- Identify the resources that would be needed to implement these recommendations.

Each group presented the results of their work in three plenary sessions to make sure that everyone had an opportunity to contribute to the work of the other groups and to assure that issues were carefully reviewed and discussed by all workshop participants. The recommendations coming from the workshop were accepted by all participants, thus representing a consensus. Working group reports can be found in Section 2-of this document.

HUMAN FACTORS WORKING GROUP

The Human Factors Working Group defined factors which are important for the development of an effective management programme for the species in southern Africa. These include:

- Habitat
- Ownership and Legal Issues
- Education, Participation, and Interaction
- Funding and non-governmental organisations (NGOs)
- Ecotourism and Sustainable Utilization

With respect to **HABITAT ISSUES**, wild dogs on private lands often are considered vermin to be exterminated because historically they have been perceived to prey on valuable game animals and livestock. At present, wild dogs do not have compensatory economic value. They are still often considered to be particularly ruthless and vicious killers that will kill animals beyond their need for food. Many potentially suitable private lands in southern Africa are highly fragmented by fencing into parcels averaging 1,500 hectares.

OWNERSHIP AND LEGAL ISSUES are complex because wild game species and livestock on fenced lands are considered the property of the landowner in most southern African countries. Because each prey animal, whether livestock or game, has a defined commercial value, each animal killed by wild dogs represents a loss of potential revenue and income for the farm. Confounding this, wild dogs currently have no commercial value as hunting trophies or on the open market for other uses and enforcement of the regulations protecting the species is minimal and fines are nominal.

Among landowners and the general public, there is a general lack of knowledge about the status and biology of wild dogs in southern Africa. Hence there is a great need for **EDUCATION, PARTICIPATION, AND INTERACTION** involving the general public. There also is not an integrated conservation management plan for the wild dog and its habitat in southern Africa. Such an action plan needs to include a strong education component directed at the general public and landowners, with a primary objective of developing a positive image, positive attitudes and support for the wild dog.

The Working Group recognised that **FUND RAISING AND RELATIONSHIPS WITH NGOs** will be particularly important as each of the activities recommended in this workshop report will need financial support and ongoing funding. It will be essential to develop budgets for each project. Solicitation of funds for wild dog projects in southern Africa will benefit from co-ordination through a group such as the *Lycaon* Working Party.

ECOTOURISM AND SUSTAINABLE UTILIZATION currently are not contributing proportionately to the preservation of the wild dog. Throughout southern Africa, the wild dog has no significant economic value as a trophy or as a species for hunting and conserving.

For each of these identified factors, the Working Group developed an array of possible strategies and specific actions that could be used to address the problems. From these, the Group selected those strategies and actions of highest priority. In descending order, the most important actions and strategies to address the identified factors include:

1. Organising meetings and workshops with representative community land owners and game farmers near the selected protected areas to engage them in the early stages of the development of a management plan for the wild dog in their region. These stakeholders must be able to have an early and active role in the development of the southern African programme.

2. Seeking all potential contributors, including States and NGOs, to take the lead in these fund raising activities.

3. Preparing a user-friendly version of this report for distribution to land owners and game farms to inform and to assist in securing their participation in management programmes for the wild dog.

4. Developing suitable pamphlets on the biology and conservation of the wild dog for general distribution in southern Africa.

5. Encouraging the formation of larger land areas with the States and conservancies by private landowners and game farmers with removal of fencing. These should be of sufficient size to accommodate at least one pack of dogs throughout the seasonal cycle of pack size and prey availability. This might be accomplished by removal of fences from ten farms approximately 1,500 hectares in size to produce a 15,000-hectare conservancy unit.

6. Developing a means of raising the perception and acceptability of the status of the wild dog and its ecological value in southern Africa.

7. Initiating a specific study to determine the actual impact of wild dogs on livestock as a basis for an objective public education programme throughout southern Africa.

8. Forming and training reaction teams to respond promptly to landowner's claims concerning wild dogs.

9. Establishing protocols for actions to be taken by the reaction teams including providing information on co-operative conservation programmes, providing information on the biology and status of the species, verification of kills, determination of need for removal of problem animals.

10. Preparing legislation for protection of animals in trans-frontier parks and reserves in southern Africa. Initiate the preparation of international agreements for protection of the animals.

REINTRODUCTION WORKING GROUP

The Reintroduction Working Group began their discussions with clarifying definitions for reintroduction and translocation. It was agreed to use the definitions of these terms as outlined in the IUCN Guidelines for Reintroductions (Appendix II). Hence, *reintroduction* was defined as "an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct." *Translocation* was defined as "the deliberate and mediated movement of wild individuals or populations to an existing population of conspecifics from one part of their range to another."

The group decided to focus on reintroduction, keeping in mind that many of the items discussed also will pertain to translocation. The group worked together to identify factors to be considered both before and during reintroductions in southern Africa. These then were collapsed into three main issues affecting reintroduction: site selection; animal selection; and criteria for reintroduction.

SITE SELECTION is an important consideration for reintroduction to ensure the successful establishment of a founder wild dog population. For southern Africa, the highest priority solutions and strategies to address the identified site selection factors include (details can be found in the Working Group report):

1. a) Initiating a communication awareness campaign utilising the media and especially targeting the local community.
   b) Setting up a working group to evaluate reintroductions and requests for reintroductions in southern Africa.
   c) Developing a national and international strategy to lobby for legislative assistance and/or support for reintroductions in southern Africa.
   d) Evaluating/modelling the prey base to ensure that there is a high probability of a sustained adequate food supply for dogs.

2. Censusing suitable areas in southern Africa under consideration for reintroductions for existing and potential disease threat.

3. Providing a full literature study compiled in one document. This document would contain a full literature study on wild dogs (see Woodroffe *et al.*, 1997) and examine the history of various sites, preferred habitat type, as well as predator/prey studies.

Considering the above as well as many other factors, the Reintroduction Working Group developed 29 site selection criteria, which were subsequently used by the Management Working Group to compile information on various potential reintroduction sites in southern Africa and eventually will be used to evaluate sites for suitability.

The Working Group defined **ANIMAL SELECTION** as the selection of the most suitable and available individuals to develop a founder population to achieve specified reintroduction goals. The most important factor in animal selection concerns the founder population. The highest priority solutions and strategies to address the animal selection include:

1. Developing criteria for selection of individuals including factors such as:-age; immune status; genetic status (including regional genotype); established hunting skills; and previous exposure to litters.

2. Collecting and collating all information on wild dog distribution and numbers internationally (wild and captive populations).

3. Determining and prioritising suitable source populations.

4. Evaluating the effect of the off-take of the population on the existing populations of wild dogs.

5. Evaluating the feasibility of managing the new population as part of a metapopulation.

A plenary discussion was held to discuss the wild population of African wild dogs as a source for the proposed reintroduction programme in southern Africa. The reintroduction programme planned for South Africa and Namibia is aimed at establishing a second, additional viable population (other than Kruger Park). This population would be part of a metapopulation, with packs to be distributed across southern Africa with a minimum total of 8 packs over a 10- year period (as recommended by the Management Working Group – see below). Beginning with the assumption that founders for 8 packs are needed, and that the upper limit of founders needed for one pack is 6 animals, then 50-100 founders will be needed over the 10-year period.

Given the desire to have the potential wild founder source represent the southern African genetic "ecotype," founder stock over the 10-year period could come from Kruger National Park, Zimbabwe, or Namibia. The size of combined gene pool from these three countries is more than adequate to provide enough founders so that the wild population would not be negatively affected. Given the distinctiveness of the genetic material in the populations of wild dog in South Africa, Zimbabwe, and Namibia, at present the cautionary approach would be to exclude animals from Botswana from the introduction effort. Workshop participants agreed that there are enough source animals available from the wild to implement the reintroduction programme without compromising the wild population**.**

This plenary discussion also included a consideration of the captive population as a potential source for reintroductions. There is a good quantity of information on the South African captive populations that was not available for this workshop. Although there is a studbook for South Africa, not all the data have been assembled that are needed to understand the history, genealogy and current status of the captive population. Studies carried out by Girman (1996) indicated that the average heterozygosity is lower in the South African captive population than the current wild population. Workshop participants agreed that this lower heterozygosity and uncertain provenance would limit the use of captive animals as a source for wild dog introductions, and that there needs to be a better-defined structure of the South African captive population (as well as other captive populations) before it could be considered as a source of animals, given the extensive source of animals available from the wild.

There was general agreement among all workshop participants that:

3. The current southern African metapopulation reintroduction programme should be designed to use wild animals as the source for founders for the next 5 years. During that time, the captive community will have time to decide how they want to organise

and manage that population, and to decide upon the design and some of the uses for that population over time.

4. The managers of the captive population in southern Africa need to undertake organisation of their information to clarify provenance and genetic status and consider developing a research programme to address some of the questions identified by this workshop.

The general intention of the workshop recommendations is that reintroduction should be based on wild-caught animals but it is not intended that this generalisation should preclude the option of occasionally using captive-bred animals if circumstances lead to a consensus that it could be advantageous to do so.

A smaller subgroup of Reintroduction Working Group members worked with the Veterinary and Management Working Groups to compile identified questions/problems that could be researched in captive populations. These priorities were:

- Drug and vaccine testing
- Genetic surveys
- Research on basic reproductive biology
- Research on possible optimal ages for reintroduction
- Development of standards for optimal holding facilities and conditions.

It was agreed that the captive community and the captive population could also serve other priority functions including:

- Assisting in raising funds and linking with *in situ* projects
- Participation in repetition of the Madikwe experiment.
- Conducting basic behavioural studies, especially in conjunction with hormonal monitoring

Other recommendations made by the subgroup included:

- Appointing a neutral party to serve as the African Preservation Programme (APP) wild dog co-ordinator.
- Re-evaluating the Pan African Association of Zoos, Aquariums and Botanic Gardens' (PAAZAB) APP guidelines and Memorandum of Participation for participation in the breeding programme by local stakeholders.
- Examining the feasibility and value of reinforcing the captive population genetically.

The Reintroduction Working Group also recommended that in order to plan co-ordinated, effective, successful reintroduction programmes in southern Africa, **CRITERIA FOR REINTRODUCTION** need to be established according to specified objectives and goals of the specified programme. (These criteria would be finalised by the *Lycaon* Working Party.) The Working Group identified a number of factors to be taken into account in determining criteria for reintroduction, including: time of year considerations, the need for a thorough review of previous case histories to avoid/predict possible problems; investigation as to the availability of financing, including definitions of potential income and expenses; and ensuring that specific criteria and goals are in place to guide decision making during the reintroduction effort.
The highest priority solutions and strategies to address the identified criteria for reintroduction in southern Africa include:

1. Obtaining and maintaining information on previous reintroductions for possible publication.

2. Determining funding needs.

3. Identifying specific objective/goals to guide decision-making during reintroductions.

4. Modelling potential reintroduction scenarios in the area.

5. Determining availability of funding for reintroduction programmes including sponsorship, fund raising and NGOs.

The Reintroduction and Translocation Working Group also recommended that PRACTICAL QUIDELINES FOR REINTRODUCTION IMPLIMENTATION are needed, and developed a set of factors to be considered in the development of such guidelines by the *Lycaon* Working Party.

MANAGEMENT WORKING GROUP

The Management Working Group identified five primary factors affecting the management of African wild dog in southern Africa and prioritised them as follows:

1. **HABITAT FRAGMENTATION:** Because of the wide-ranging habits of wild dogs and low densities, fragmentation of suitable habitat for populations is a problem.

2. **PROBLEM ANIMALS**: Wild dogs can be classed as "problem animals" because they are perceived to be incompatible with other land uses. Management issues associated with "problem animal" status include the need to:
    a) determine why the wild dog is a problem animal, to enable one to take appropriate action;
    b) develop appropriate action guidelines for short- and long-term solutions to problems with wild dogs.

3. **MONITORING:** Monitoring wild dogs is necessary to provide information on long-term conservation plans. Therefore, there is a need to develop a standardised procedure for gathering information on:
    a) basic distribution and numbers.
    b) detailed demographics to enable modelling of populations.
    c) threats to wild dog survival, including conflicts with people and other large carnivores (interspecific competition), disease and genetics.

4. **METADATABASE:** A central meta-database would be beneficial for swift and convenient exchange of information on all aspects of wild dog conservation. Therefore, there is a need to establish such a mechanism.

5. **UNIFORM NATIONAL/INTERNATIONAL POLICY**: Currently, wild dog policies differ provincially and internationally which limits conservation efforts in southern Africa. There is a need for standardisation of these policies.

Management issues associated with wild dog populations in southern Africa include the need for:

4. Mapping distribution, protection status and size of existing wild dog populations. To address this, Working Group participants used data from the Canid Action Plan, combined with upgraded information, to develop a table of latest information on wild dog and pack numbers (Table 1, Management Working Group Report).

5. Determining protection status of an area. To assess this, the Working Group recommended that each population be plotted on a simple bipolar axis that compares level of security (from secure to threatened) and level of legal protection (from protected to unprotected) (Fig. 1). In conjunction, a four-point category system was developed to indicate the level of security and level of protection.

6. Identifying suitable areas for wild dog re-introduction (see below).

With the recognition that small populations are more likely to go extinct, the Working Group identified the need for, and key factors to be considered in, the development of a set of guidelines that will be used to reduce the probability extinction of extant or introduced local populations in southern Africa.

The Management Working Group recommended high priorities for research in southern Africa including: genetics; disease; and metapopulation management. (Specific research questions are outlined in more detail in the Working Group report.)

The Working Group also set forth guidelines for the management of small populations of wild dogs in southern Africa, with the overall goal that **within the next 10 years, two second viable populations of wild dogs will be established, one in the Republic of South Africa and one in Namibia.**

Using the above goal, the Management Working Group then developed first draft guidelines for managing small populations (i.e., more than eight packs) of extant wild dogs in southern Africa. These guidelines include:

1. Ensuring systematic monitoring of demographic data, including: photographs; telemetry; sightings; and questionnaires.

2. Evaluating the carrying capacity of the area to determine the number of packs that can be maintained.

3. Linking this population to a metapopulation plan that is based on genetic and demographic information.

4. Controlling for rabies and canine distemper. Approaches for control will vary depending upon situations.

5. Maintaining the integrity of the area in which the population is living, including securing fences and eliminating snares and other human threats.

6. Enacting an education programme with local communities and area visitors.

7. Identifying a person to be ultimately responsible for the wild dog project in each particular area.

8. Generating an annual report that is submitted for periodic review and discussion by the Lycaon Working Party.

To begin an evaluation of the 29 potential reintroduction sites identified by the Working Group, the sites were cross-plotted on a matrix against the 29 criteria for site selection prepared by the Reintroduction Working Group (Table 2, Management Working Group report). A paired ranking test then was used by nine of the workshop participants to identify the highest-ranking selection criteria. Seven criteria clustered were determined to have the highest priority, based on the voting. These were:

1. Total biomass of potential prey per km^2.
2. Vulnerability of wild dogs to disease, i.e., canine distemper virus and rabies.
3. Potential expansion of area.
4. Density of the human population inside the area.
5. Potential linkage to other areas by corridors.
6. Habitat size available in terms of actual km^2
7. Density of other competing predators in area per km^2 .

The Management Working Group had too little remaining time to use the top seven criteria to then rank the potential reintroduction sites using pair-wise testing.

However, these criteria were used in an experimental exercise by two of the participants to compare the seven identified site criteria across the potential reintroduction sites for Namibia and Zimbabwe. The Management Working Group recommended that this paired ranking approach (using the seven high priority criteria) be used for all relevant countries as a potential approach for selecting the highest priority reintroduction sites for wild dogs in southern Africa. It also was recommended that a high priority for the *Lycaon* Working Party will be to use this approach on the 18 potential reintroduction sites identified in South Africa.

MODELING/LIFE HISTORY WORKING GROUP

The aim of the Modelling/Life History Working Group was to develop a model to underpin practical recommendations for a managed meta-population in southern Africa. For adequate management, it is imperative to accurately understand the dynamics of very small populations of African wild dogs, and in some cases these small populations may comprise no more than one pack. First, many surviving wild dogs exist in scattered pockets. Second, the opportunity may exist to create, by translocation and reintroduction, new pockets. In both cases these constellations of pockets may function as metapopulations. Some of these pockets, and possibly the majority of them, may be created in fenced areas. In this case, with areas too small to sustain a viable population indefinitely, and with immigration and emigration forestalled, there will be a need for management as a metapopulation. Decisions will have to be made regarding the size and composition of founder stock, the imposition of a schedule of artificial immigration and emigration, the necessity for regulation of numbers, and any management action needed to contain the impact of catastrophes, such as disease. Until recently, it has not been possible to provide practical guidelines to questions regarding the consequences of various combinations of these options. However, data do exist for southern African wild dogs that can be used to develop a model to provide such answers.

To develop and validate the model, the Working Group selected Kruger National Park (KNP), with supplementary data from Moremi, in the Okavango Delta of Botswana. Eight packs, found south of the Sabie River, were modelled. In terms of metapopulation terminology, these represented the Group's meta- population, whereas each pack is a local or sub-population.

Based on the modelling, the Working Group tentatively recommended for the managed metapopulation:

9. The model revealed the importance of mortality schedules and therefore it was recommended that a priority for research should be the quantification of mortality factors.

10. Metapopulations comprising only few packs are likely to require management. Putting a precise value on the number of packs below which such intervention is required is beyond the scope of the modelling that has taken place to date. However, the simulations using the model generated here emphatically emphasise the risk of metapopulation extinction as a consequence of even low frequencies (e.g. 8%) of catastrophic loss. Even populations as large as eight packs may require intervention.

11. Insofar as the metapopulation analysis represents reality, it leads to the recommendation that metapopulations as large as eight packs require management to secure an acceptable level of persistence. This conclusion is in accord with the judgement of field biologists in our working group, and leads us to conclude that, in practice, it is likely that some intervention will often be required to achieve a satisfactory probability of persistence for metapopulations of eight packs or fewer.

12. Consistent, periodic managed gene flow (through tranlocations) is recommended to reduce damaging levels of inbreeding and the resulting risks of meta- and sub-population extinction. The model indicated that by using a frequency of exchange based on the natural reproductive life span of wild dogs (up to five years) inbreeding can be reduced by two thirds and population persistence can be assured.

13. Based on this understanding, the Working Group also recommended that any proposed creation of sub-populations in southern Africa include a feasibility study to confirm that the necessary level of management to achieve gene transfer is practical.
14. Although the model did not definitively explore this, the results are compatible with the conclusion that annual anti-rabies vaccination is likely to increase the probability of persistence and to that extent recommend that option.

15. The single pack model also demonstrated that any founding group size from two to seven could persist but that a founding pack of 6 or more reduces the probability of extinction to acceptable levels.

16. Based on the initial eight-pack model which comprised one third of the KNP population, the Working Group concluded that an offtake of six animals per years for the next eight years is sustainable, and that an additional six per year may be sustainable under relaxed mortality conditions.

THREATS AND DISEASES WORKING GROUP

The Threats and Diseases Working Group defined two types of threats to wild dog in southern Africa: anthropogenic mortalities and those caused by disease.

Threats associated with anthropogenic mortalities included:

1. Direct persecution
2. Road mortalities
3. Snares
4. Researcher effect

Primary disease threats, in decreasing order of importance, included:

1. Rabies
2. Canine distemper
3. Anthrax
4. Parvovirus-enteritis
5. Babesiosis
6. Ehrlichiosis
7. Internal parasite infections
8. External parasites
9. Sarcoptic mange
10. Tuberculosis

The Working Group addressed each of these threats in turn, developing solutions and strategies which might be used to lessen the effects of threat.

1. **Direct persecution** as a result of poisoning and or shooting stem from negative attitudes of people towards wild dogs, stock losses from wild dogs and the fact that some people even derive pleasure from shooting / killing wild dogs. Because of a lack of suitable habitat or simply sufficient habitat, dogs are forced into land inhabited by people, which results in conflict. The Working Group recommended the following strategies to deal with this threat:
   a) Developing community education programmes with local people in the immediate vicinity of the area, children, and nationals as priority targets.
   b) Developing innovative strategies to compensate ranchers for loss of stock to predators or for adopting active herd management strategies, particularly in buffer zones surrounding protected areas.

c) Legal protection of wild dogs must be increased throughout the region, assisted by the development of a national register.
d) Increasing measures to decrease the predation of livestock including promoting: farming with indigenous breeds and acclimatised animals; the use of a "visually closed" kraal; "kraaling" at night and herding of stock during the daytime.
e) Creating a value for wild dogs by promoting co-ownership of dogs and participation in conservation programmes by local communities/individuals.

2. To reduce **Road Mortalities**, measures recommended for implementation in southern Africa included:
   a) Identification of "hot spots" and action to be taken at these sites.
   b) Fitting dogs with reflective collars in "hot spot" areas.*****
   c) Education of local authorities (police).

   [***Note**: Dr. R.B. Woodroffe, one of the workshop participants and report editors, voiced a strong objection to this recommendation. Woodroffe requested that a note be added here that the efficacy of these devices should be tested prior to use, with the design of a proper experiment including a control group to which no collars are fitted. Such a study also should include a cost-benefit analysis of the benefits of fitting snare collars vs. controlling the snaring itself. The *Wild Dog Action Plan* (Woodroffe *et al.* 1997) notes that handling wild dogs is a difficult, expensive, controversial and potentially dangerous procedure and that it should be kept to a minimum.]

3. Similarly, the effects of snares could be minimised by education programmes, anti-poaching patrols, and fitting of "special" collars.

4. Researcher effect can be divided into direct and indirect effects.
   a) Direct problems primarily have to do with problems encountered during immobilisation of animals. The Working Group recommends that wild dogs only be immobilised/anaesthetised under the supervision of a veterinarian and as part of an approved research or management project.
   b) Indirect effects can be ameliorated somewhat by researchers having full understanding of the effects of their activities on the pack. Comportment of researchers around dens should be respectful and sensitive to potential effects on the dogs. Only drugs known to be safe for dogs should be used on wild dogs. Collar design must be appropriate for the species. If dogs are immobilised, the Working Group recommends that, minimally:
      - an "identikit" be compiled with left and right side photographs
      - clinical examination, noting any abnormalities
      - serum, blood, faecal, and ectoparasite samples be taken
      - complete necropsies should be performed on all dead animals

With respect to Disease threats, the Group noted that there currently is no strategy for the control of diseases in wild dogs in southern Africa. For both large, naturally occurring populations and introduced populations managed as part of a metapopulation, effective and ongoing monitoring of wild dog health status needs to be in place.

The Threats and Disease Working Group identified the following recommendations to lessen the identified threats in southern Africa:

7. Carrying out basic research into vaccination of wild dogs against rabies and canine distemper.
8. Compiling guidelines for crises handling of wild dogs.
9. Establishing a national / international strategy on education.
10. Establishing a resource information network.
11. Insisting on legislation granting special protection to wild dogs throughout the southern African region.
12. Establishing a national register of wild dogs.
13. Compiling guidelines for the immobilisation of wild dogs.
14. Compiling guidelines on collars for dogs.
15. Promoting wild dog-friendly stock and management practices.
16. Compiling proposals on traffic signs aimed at protecting wild dogs.

Different Group members took responsibility for implementing certain tasks to be carried out immediately. These included:

1. Setting up a research project on vaccination protocols for rabies and distemper in wild dogs.
2. Developing guidelines on crisis handling of disease outbreaks in wild dogs.
3. Developing guidelines for immobilisation.
4. Developing guidelines for the use of collars.

Lycaon Working Party

At the end of the workshop, in plenary, the Canid Specialist Group (CSG) Chairman, Dr. David Macdonald, noted that the workshop coincides with a watershed period in the development of the Canid Specialist Group in general and the enhancement of the *Lycaon* Working Party in particular. This watershed arises largely because of the recent publication of two major action plans, and others in the pipeline. The CSG therefore will look to a future with a greater emphasis on implementation of its plans. Dr. Macdonald proposed that the *Lycaon* Working Party be restructured and fortified into a nested structure, with both geographical and topical responsibilities devolved to a network of participants under the co-ordination of Dr. M.G.L. Mills. The initial intention will be to appoint national and regional representatives who would report on status, with those data co-ordinated by Dr. R.B. Woodroffe. Other ad hoc working groups would then explore issues such as disease, farmer liaison, and metapopulation management. During the coming weeks Drs. Mills and Macdonald will circulate a paper in which this proposed *modus operandi* is refined, and will seek volunteers to participate. In particular, amongst our priorities will be the quest for sponsorship to facilitate Dr. C. Sillero's work in initiating new surveys in regions where these have been identified as priority. Within the CSG website a *Lycaon* page also will be developed; this currently can be accessed through http://users.ox.ac.uk/~wcruinfo. The functioning of this web-site will also be elaborated in the discussion paper.

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Population and Habitat Viability Assessment for the African Wild Dog *(Lycaon pictus)* in Southern Africa

Final Report from the Workshop
Held 13-17 October 1997 in Pretoria, South Africa

May 1998

Edited by

M.G.L. Mills, Susie Ellis, Rosie Woodroffe, Anthony Maddock, Phillip Stander, Alistair Pole, Greg Rasmussen, Pat Fletcher, Mike Bruford, David Wildt, David Macdonald and Ulysses Seal

Section 2

Working Group Reports

Human Factors Working Group Report

Participants: Vincent Barkas, Karin Dougherty, Reardon Olubayo, Bert Velthuis, Pat Fletcher and Ulie Seal (facilitators)

The wild dog (*Lycaon pictus*) is endangered throughout Africa and in southern Africa because of habitat fragmentation, reduced habitat availability, declining population numbers, disease, conflicts with people, and persecution. Survival and conservation of viable wild populations of this highly mobile carnivore will require changes in public attitudes towards the species, active management of the fragmented populations of the species, and the involvement of private landowners. In South Africa the significant population of *Lycaon* occurs in Kruger National Park, with other, scattered populations on public and private lands and conservancies. Long-term survival of the species in southern Africa will require active public support and the participation of private landowners in an integrated conservation program. Therefore, there is an urgent and vital need to recruit other stakeholders, including game farmers and landowners, from the private sector as collaborators into the development of an adaptive conservation management program for viable populations of the wild dog in its habitat.

Human factors defined by the Working Group which are important for the development of an effective management program for the species in southern Africa include:

- Habitat,
- Ownership and Legal Issues
- Education, Participation, and Interaction
- Funding and Non-Governmental Organisations (NGOs)
- Ecotourism and Sustainable Utilization

Descriptions of the problems associated with each factor are summarised below.

Habitat

In southern Africa, wild dogs on private lands still often are considered vermin to be exterminated because they historically have been perceived to prey on valuable game animals and livestock. At present, wild dogs do not have compensatory economic value. They are considered by many people to be particularly ruthless and vicious killers that will kill animals beyond their need for food. Many of the private lands in southern Africa, potentially suitable as habitat for wild game and carnivore species, are highly fragmented by fencing into parcels averaging 1,500 hectares.

Ownership and Legal Issues

Wild game species and livestock on fenced lands are considered the property of the landowner in most countries in southern Africa. Breeding stock for desirable wild species may have been purchased to establish a free ranging population on the game farm. Revenue on the game farms comes principally from hunting fees and, to a lesser extent, from ecotourism. Each prey animal has a defined commercial value. Each animal killed by wild dogs represents a loss of potential revenue and income for the farm. In contrast, the wild dogs currently have no commercial value as hunting trophies or on the open market for other uses. Potential values from ecotourism have not been developed for the wild dog; thus, they are viewed as a threat to be removed by game farmers and cattle ranchers. However, while wild dogs are a nationally protected species in South Africa and are classified as Endangered on the IUCN Red List, enforcement of the regulations protecting the species is minimal and fines are nominal.

Education, Participation, and Interaction

Among landowners and the general public, there is a general lack of knowledge about the status and biology of the wild dogs in southern Africa. There also are no integrated conservation management plans for the wild dog and its habitat in southern Africa. Such an action plan needs to include a strong education component directed at the general public and landowners, with a primary objective of developing a positive image, positive attitudes and support for the wild dog. The wild dog needs to be recognised as a flagship carnivore species for the ecosystems in which it occurs. There also is a need for a publicly accessible database on the distribution and biology of the wild dog.

Fund Raising and NGOs

Each of the activities recommended in this workshop report will need financial support and ongoing funding. It will be essential to develop budgets for each project. Solicitation of funds for wild dog projects in southern Africa will benefit from co-ordination through a group such as the *Lycaon Working Party*.

Ecotourism and Sustainable Utilisation

Ecotourism and sustainable utilisation currently are not contributing proportionately to the preservation of the wild dog in southern Africa. The wild dog has no significant economic value as a trophy or as a species for hunting and conserving.

For each of these identified factors, the Working Group developed an array of possible strategies and specific action steps that could be used to address the problems. From these, the Group selected those strategies and action steps of highest priority. In descending order, the most important actions and strategies to address the identified factors include:

1. Organising meetings and workshops with representative community land owners and game farmers near the selected protected areas to engage them in the early stages of the development of a management plan for the wild dog in their region. These stakeholders must be able to have an early and active role in the development of the program.

2. Seeking all potential contributors including state and NGO to take the lead in these fund raising activities.

3. Preparing a user-friendly version of this report for distribution to land owners and game farms throughout southern Africa to inform and to assist in securing their participation in management programs for the wild dog.

4. Developing suitable pamphlets and posters on the biology and conservation of the wild dog for general distribution.

5. Encouraging the formation of larger land areas with the state and conservancies in southern Africa by private landowners and game farmers with removal of fencing.

6. Developing means of raising the perception and acceptability of the status of the wild dog and its ecological value.

7. Initiating a specific study to determine the actual impact of wild dogs on livestock as a basis for an objective public education program.

8. Forming and training reaction teams to respond promptly to requests for assistance from southern African landowners.

9. Establishing protocols for actions to be taken by the reaction teams including providing information on co-operative conservation programs, providing information on the biology and status of the species, verification of kills, determination of need for removal of problem animals.

10. Preparing legislation for protection of animals in trans-frontier parks and reserves in southern Africa. Initiate the preparation of international agreements for protection of the animals.

The above strategies and actions were extracted and prioritised from a broader list of strategies and solutions developed by the Group for each of the factors identified. These were:

HABITAT

Strategies and Proposed Actions

1. Form larger wildlife areas in southern Africa by including private, conservancy, and state-owned lands and reduce fragmentation of the habitat by removal of fences.

   Proposed Action
   Encourage the formation of larger land areas with the state and conservancies by private landowners and game farmers with removal of fencing. These areas should be of sufficient size to accommodate at least one pack of dogs throughout the seasonal cycle of pack size and prey availability. This might be accomplished by removal of fences from ten farms approximately 1,500 hectares in size to produce a 15,000-hectare conservancy unit.

2. Develop commercial value for the wild dog on all available lands in southern Africa.

   Proposed Action
   Support the development of economic value for the wild dogs through ecotourism in an ecological context.

3. Bring private landowners and game farmers into the process for the development of a conservation management plan for the species that includes private lands as part of the southern African program.

   Proposed Actions
   a) Organise meetings and workshops with representative community land owners and game farmers near the selected protected areas to engage them in the early stages of the development of a management plan for the wild dog in their region These stakeholders must be able to have an early and active role in the development of the program.

   b) Formulate a standardised training program in effective techniques for small group meetings and conflict management for the personnel who will conduct these workshops. It will be essential that the offers for participation in the development of the management plans be real and responsive.

4. Acquire additional lands for the management of wildlife populations including the wild dog.

   Proposed Actions
   a) Purchase or obtain long term conservation management leases on lands around selected protected areas in southern Africa to expand available habitat managed as state and private lands. Secure ongoing participation of non-governmental organisations (NGOs) in this process.

   b) Encourage acquisition of additional lands for the formation of trans-frontier national parks in southern Africa.

   c) Secure co-operation of owners of large game areas in allowing packs of dogs within their boundaries.

5. Use effectively-designed fencing to keep wild dogs on lands that are part of a management program.

   Proposed Action
   Encourage effectively designed and maintained fencing on smaller areas used in the southern African metapopulation management program to keep the packs within the protected area.

6. Impress on the landowners the ecological value of the wild dog.

   Proposed Action
   Initiate a specific study to determine the actual impact of wild dogs on livestock as a basis for an objective public education program in southern Africa.

OWNERSHIP AND LEGAL ISSUES

Strategies and Proposed Actions

1. Develop legislation and regulations that will provide more adequate protection and law enforcement for the wild dog.

   Proposed Actions
   a) Lobby for additional new legislation and increased penalties for violations in southern African countries.

   b) Secure increased enforcement of existing regulations.

   c) Establish a database for the information on animals sighted or killed on private lands.

2. Develop methods for rapid responses to landowner problems and complaints and queries.

   Proposed Actions
   a) Form and train reaction teams to respond promptly to landowners in southern Africa.

   b) Establish protocols for actions to be taken by the reaction teams including providing information on co-operative conservation programs, providing information on the biology and status of the species, verification of kills, and determination of the need for removal of problem animals.

   c) Secure funding for support of the reaction teams. Perhaps NGOs could support an experimental program to develop the techniques and procedures.

3. Actively promote and lobby international agreements to protect the wild dogs in southern African trans-frontier parks.

   Proposed Action
   Prepare legislation for protection of animals in trans-frontier parks and reserves in southern Africa. Initiate the preparation of international agreements for protection of the animals.

4. Develop methods for owner compensation by insurance for game loss to wild dog predation on private lands in southern Africa.

   Proposed Action
   Encourage insurance companies to initiate a scheme for compensation of private landowners for losses of game animals to uncontrolled wild dog predation.

EDUCATION, PARTICIPATION, AND INTERACTION

Strategies and Proposed Actions

1. Develop educational methods for broad-based participation in preparation of the management action plan by southern African stakeholders.

   Proposed Action
   Prepare a user-friendly version of this report for distribution to landowners and game farms to inform and to assist in securing their participation in management programs for the wild dog.

2. Develop an education program targeted at southern African game farmers, landowners, schools, the general public, law enforcement agencies, and communities.

   Proposed Action
   Develop suitable pamphlets on the biology and conservation of the wild dog for general distribution.

3. Develop a database on distribution, sightings, movements, and identification of southern African wild dogs and all other pertinent information.

   Proposed Action
   Develop plaques and citations to be awarded for recognition of game farms, landowners, and/or communities contributing to the conservation of the wild dog in southern Africa.

4. Develop a recognition system for landowners and farms participating in conservation programs for the wild dog in southern Africa.

FUND RAISING and NGOs

Strategies and Proposed Actions

1. Establish a budget for each wild dog project, particularly if funds are to be solicited from NGOs, companies, from private sources or with state assistance.

   Proposed Action
   Develop a specific budget for a high priority release program identified in the meta-population, including selection of animals, their transport, release, monitoring after release, and a local public education component to prepare for the releases.

2. Develop an ongoing fund-raising strategy and capability to support continuation of the southern African management activities.

   Proposed Action
   Secure funding for the prototype release program based upon the budget developed through public and private sources.

3. Secure dedicated government support from southern African countries to facilitate these actions.

   Proposed Action
   Add the budget for these activities to ongoing NGO and private projects for the conservation of the wild dog.

4. Identify organisations that can participate in these fund-raising activities.

   Proposed Action
   Seek all potential contributors including state and NGO to take the lead in these fund raising activities.

ECOTOURISM / UTILISATION

Strategies

1. Develop the techniques and opportunities for making wild dogs part of a satisfactory southern African ecotourism experience.

2. Develop a means of raising the acceptability of and perception about the status of the wild dog and its ecological value in southern Africa.

3. Develop continuing publicity programs for conservation of the wild dog and its ecological values.

4. Identify criteria for relocation of problem dogs in southern Africa

5. Establish education programs for zoos concerning wild dog conservation.

6. Develop a public participation program to report sightings and to submit photographs of wild dogs.

Reintroduction and Translocation Working Group Report

Participants: Gus van Dyk, Ferdi Schoeman, Michael Somers, Piet van Staden, Kobus du Toit, Wim Verberkmoes, John Wambua, Susie Ellis (facilitator)

The working group began the discussion with attempting to define reintroduction and translocation. It was agreed to use the definitions of these terms as outlined in the IUCN Guidelines for Reintroductions (Appendix II). Hence, *reintroduction* was defined as "an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct (using the CITES criterion of "extinct": species not definitely located in the wild during the past 50 years)." *Translocation* was defined as "the deliberate and mediated movement of wild individuals or populations to an existing population of conspecifics from one part of their range to another."

The group decided to focus on reintroduction, keeping in mind that many of the items discussed also will pertain to translocation.

The group worked together to identify factors to be considered <u>before</u> reintroductions occur in southern Africa. These factors (not listed in order of importance) included:

1. Suitable area/ size?
   - What led the dogs to local extinction in the first place?
   - What has changed in the area?
2. Are resources for monitoring & implementation available (people, money)?
3. Is there community support or awareness?
4. Are the dogs going to be secure in the new area?
5. What is the founder population size, composition, and origin?
6. Is there competition with other predators?
7. Is there enough potential prey for the dogs?
8. What is the predicted viability and what future reintroductions are anticipated?
9. What is the feasibility of managing population as part of a future metapopulation?
10. What are the dogs' habitat requirements (vegetation type)?
11. Is there potential economic income?
12. What is the presence of endemic disease?
13. Are there local legislation and constraints?
14. What is the status of ownership of animals?
15. Are there existing monitoring/ research protocol/contingency plans?
16. Is insurance available for compensation for neighbours for any stock or game loss?
17. A priority sequence for species as part of a reintroduction plan must be considered.
18. Is there a protocol for reintroduction?
19. Is it possible to have media involvement in the area?

20. Other areas larger than some prescribed size (in km2) should be considered and evaluated in order of size. Larger areas might be evaluated first, and then if they are not suitable, the evaluation can move to smaller areas.
21. Is there potential for corridor connection to other conservation areas? Or, is there a possibility for expansion of the area under conservation (reserve or conservancy)?
22. Has a review of previous case studies and areas been carried out?
23. Timing of the reintroduction during year must be considered. Dogs' breeding cycle and availability of prey must be considered. Another important factor is the accessibility for staff to monitor the population – for example, monitoring might be difficult during the rainy season. .
24. Consider use of long-acting tranquillisers.

Also refer to Appendix III (from Stanley Price 1989).

Identified factors to be considered <u>during</u> reintroduction included:

1. Holding facilities and conditions.
2. The ability to closely monitor the reintroduction process (for example, in terms of expertise, funding, and other factors).
3. Implementation of above.

The group then worked together to synthesise and collapse the above identified factors/concerns into three MAIN ISSUES affecting reintroduction in southern Africa:

1. Site selection.
2. Animal selection
3. Criteria for reintroduction

1. SITE SELECTION is an important consideration for reintroduction to ensure the successful establishments of a founder wild dog population.

The following key factors for consideration in <u>site selection</u> were identified and later used by the Management Working Group to evaluate potential reintroduction sites in southern Africa (see pgs. 53-56):

- Dogs' requirements concerning habitat type (e.g., desert, bushveld, mountain, etc.). This may not be a major concern as long as dogs historically occurred in the area.
- Competition with other predators likely to interfere/compete with dogs (lions, spotted hyaenas).
- Ensuring enough available prey species and that prey density is sufficient. The following guideline for determining potential prey availability may provide a useful model. Other available prey (medium sized ungulates) should be included, where appropriate, for the specific area.
  - Number adult medium sized animals, the number of potential breeders, and the reproductive success of the prey species in the area. For example, in a population of 1,000 impala in which we assume a 1:1 sex ratio, approximately 50% of the females will breed. Ninety percent of those 250 females will be successful. Since wild dog take an average of 2 impala every 3 days, therefore, we might predict that for a pack of 8 animals, 240-280 impala would be needed per year.

- Using a conservative number, for example, 300 impala taken by dog per year, then a minimum prey base of 1,200 impala, or the equivalent, would be needed for one pack. **<u>The above should be modelled for each specific area and is just a guideline</u>**.
- The utilisation of the prey base by other predators in the area also must be considered
- Other factors contributing to prey mortality also must be considered.

The working group recommended that the reintroduction area under consideration should have a growing prey base that could be utilised by the dogs, and that the prey base trends should be monitored.

- In areas where prey have not been previously exposed to predators and in which initial losses of naïve prey may be high, this cost should be considered in estimating the costs of the overall programme.
- Security of area (secure fencing considerations, for example, electrification, closed mesh fence, serviceability /access to entire fence area, is fence strong enough to handle prey being chased into it) is very important.
- History of the area should be known. For example, are the factors that led to local extinction of the dogs well understood? Have these factors changed or are they now manageable?
- Is there a good potential for corridor connection to other areas in the future, or expansion of the area under protection (reserve, conservancy, etc.)?
- Is there some criterion for minimum size of area?
- Is there neighbour/local community support/awareness regarding wild dog reintroduction efforts? Examples of factors to be considered include things such as -- Will neighbours tolerate dogs that may move out of the protected area? Will the communities co-operate in the translocation effort or at least not interfere? Is there insurance available for stock loss compensation?
- Infrastructure should be in place or planned, and include considerations of:
  - Level of development in the area.
  - Availability of resources.
  - Vehicles.
  - Staff housing.
  - Bomas.
  - Communication.
  - "Dog-friendliness" of roads
  - Information centre.
  - Availability of training of staff.
- Presence of proven, dangerous disease (endemic or exotic) and parasite load in area should be considered. (Refer to Threats and Disease Working Group report).
- There should be resources for and plans made for monitoring.
- Legislative constraints or support need to be considered, including factors such as: how well the area is protected legally? What is the status of the area legally and internationally?
- Other endangered species which wild dogs may have impact on should be considered and monitored.

In descending order of priority, possible solutions and strategies to address the identified <u>site selection</u> factors include:

1. **a)** Initiating a communication awareness campaign utilising the media and especially targeting the local community. Direct interactions with the local community must play a major role in this communication campaign and planning of the project, right from the beginning.
   b) Setting up a working group, comprised of relevant people, to evaluate reintroductions and requests for reintroductions in southern Africa.
   c) Developing a national and international strategy to lobby for legislative assistant and/or support for southern African reintroductions.
   d) Evaluating/modelling the prey base to ensure that there is a high probability of a sustained adequate food supply for dogs.

2. Providing a full literature study compiled in one document. This document would contain a full literature study on wild dogs (see Woodroffe *et al.* 1997) and examine the history of various sites in the literature. This document also would include a determination of preferred habitat type from literature studies, as well as a predator/prey literature study.

3. Censusing suitable areas in southern Africa under consideration for reintroductions for existing and potential disease threat.

4. Identifying and visiting properties that have been identified as potential suitable sites.

5. From the available knowledge, formulating guidelines for minimum fencing standards required for wild dog containment and exclusion from feral domestic dogs.

6. Carrying out a risk analysis with respect to insurance and compensation.

2. ANIMAL SELECTION was defined as the selection of the most suitable and available individuals to develop a founder population, in order to achieve specified reintroduction goals.

The most important factor in animal selection concerns the founder population. These factors include considerations of:

- Size of the founder population. It is recommended that the size should be a minimum of 4 individuals (2 of each sex).
- The sex ratio of the founder population should be even, with males related to males and females related to females, optimally.
- Particular characteristics for individual animals must be considered including factors such as optimal age (e.g., 18 months - 3 years), previous exposure to litters, immune status, and established hunting skills.
- Source of founders, whether wild, captive-bred, or problem animals (see below).
- Regional genotype considerations (ecotype).
- Is there an adequate documented history of founder dogs?
- Genetic status (pertaining to inbreeding).
- The possibility of bringing in new genetic material in the future and managing the population as part of a metapopulation.
- Not compromising existing populations

Possible solutions and strategies to address the identified animal selection factors, in descending order of priority, include:

1. Developing criteria for selection of individuals for southern African programmes including factors such as:.
   -age
   -immune status
   -genetic status (including regional genotype)
   -established hunting skills
   -exposure to litters previously

2. Collecting and collating all information on wild dog distribution and numbers internationally (wild and captive populations).

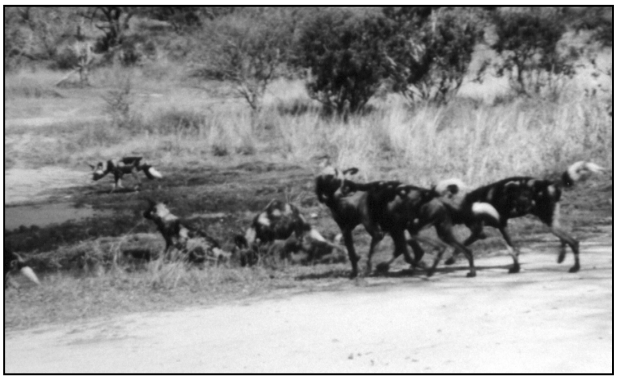
3. Determining and prioritising suitable source populations.

4. Evaluating the effect of the off-take of the population on the existing populations of wild dogs.

5. Evaluating the feasibility of managing the new population as part of a southern African metapopulation.

6. Broadening and maintaining accurate genealogies for all captive populations and striving to include all breeders of wild dogs into the presently existing studbooks/genetic management programmes.

A plenary discussion was held to discuss the wild southern African population of African wild dogs as a source for the proposed reintroduction programme. The reintroduction programme planned for South Africa and Namibia is aimed at establishing a metapopulation, with packs to be distributed across southern Africa with a minimum total of 9 packs over a 10-year period as recommended in the Management Working Group Report. If we begin with the assumption that founders for 9 packs are needed, and that the upper limit of founders needed for one pack is 6 animals, then 50-100 founders will be needed over the 10-year period.



▲ Wild dogs like these in Kruger Park will play a significant role in the development of a managed metapopulation.

Given the desire to have the potential wild founder source represent the southern African genetic "ecotype," founder stock over the 10-year period could come from Kruger National Park, Zimbabwe, or Namibia. It is important to note that it may take time for founder animals to become available. The size of pool combined from these three countries is more than adequate to provide enough founders so that the wild population would not be negatively affected. Given the distinctiveness of the genetic material in the populations of wild dog in South Africa, Zimbabwe, and Namibia, at present the cautionary approach would be to exclude animals from Botswana from the introduction effort. **Workshop participants agreed that there are enough source animals available from the wild to implement the southern African reintroduction programme without compromising the wild population.**

Sources of Wild Dogs for Translocations

In South Africa, there is some information on the captive populations, partly from the African Preservation Programme (APP) and from other sources, that was not available for this workshop. There was no Working Group at the PHVA to analyse those data. Although there is a studbook for South Africa, not all the data has been assembled that is needed to understand the history, genealogy and current status of the captive population. Studies carried out by Girman et al. indicated that the average heterozygosity is lower in the South African captive population than the current wild population. There has not been an analysis of the genetic data set of the European or the North American population. **Lower heterozygosity and uncertain provenance would limit the use of captive animals as a source for wild dog introductions. There needs to be a better-defined structure of the South African captive population (as well as other captive populations) before it could be considered as a source of animals, given the extensive source of animals available from the wild.**

There was general agreement among all workshop participants:

1. That the current southern African metapopulation reintroduction programme for next 5 years be designed to use wild animals as the source for founders. During that time, the captive community will have time to decide how they want to organise and manage that population, and to decide upon the design and some of the uses for that population over time.

2. The captive population needs to undertake organisation of its information to clarify provenance and genetic status and consider developing a research programme to address some of the questions identified by this workshop. Specifically:
   a) organise scientific management of programme and identify participants
   b) undertake a series of research activities to contribute to the conservation of the wild dog
   c) use mitochondrial DNA techniques to identify the captive stock

The general intention of the workshop recommendations is that the southern African reintroduction should be based on wild-caught animals but it is not intended that this generalisation should preclude the option of occasionally using captive-bred animals if circumstances lead to a consensus that it could be advantageous to do so.

The Role of the Captive Population

Many considerations affect the decision to use wild-caught as opposed to captive-bred dogs. For example, commonly accepted advantages of using captive-bred individuals might include their tractability, disposability, cost and reduced risk to wild populations.

There also is a long list of advantages in using wild-caught animals. (In balancing these pros and cons it is noteworthy that "problem" wild dogs occur - as many as 10 - 20 per annum in Namibia - and that these are likely to be destroyed if they cannot be relocated. There is arguably a strong moral imperative to use these dogs in reintroduction schemes whenever feasible, as the alternative is that they be squandered and the wild population further eroded.) To assist in increasing genetic variation in captive populations, Rasmussen (pers. comm.) suggested that debilitated wild individuals should form part of recognised captive units that have vested interest in the conservation of the species. Another contrasting opinion expressed during this discussion was that debilitated animals should be destroyed.

In this workshop, the veterinary and management working groups identified high priority research questions that are needed for wild dog that in some cases can only be adequately addressed using a controlled study population in captivity. A smaller subgroup comprised of Reintroduction Working Group members (Schoeman and Ellis) worked with these two groups to compile these identified questions/problems that could be researched in captive populations.

Veterinary Research priorities for the captive population:

- Testing of drugs specifically needed for translocation projects, in particular Cloxipitol Acuphase and other tranquillising drugs
- Vaccine testing protocols for rabies and CDV (e.g., live vs. killed virus trials and subunit vaccines against CDV)
- Initiating a genetic survey (sample dogs opportunistically while the dogs are being handled)
- Identifying a co-ordinator to ensure that materials go to institution (preferably 2) with proper facilities.
  -Joe van Heerden is willing to serve as the veterinary co-ordinator for sample storage (serum and histopathology samples initially; also will accept parasites and distribute them to appropriate facilities).

Management priority questions that could be addressed with the captive population include:

- What is the basic reproductive biology of the species?
- potential studies might include faecal hormone monitoring and other methods of monitoring and understanding the basic reproductive biology of the species.
- What is the ideal reintroduction age?
  -for example, experiments could be carried out in the wild forming packs combining different age/sex groups from captive stock. (Note: G. Rasmussen and S. Hartwig examining age and social structure as critical factors pertaining to this question.)
- What are optimal holding (boma) facilities and conditions?
- Do isolated packs eventually suffer inbreeding depression?

The captive community and the captive population can also serve other priority functions including:

- Assisting in raising funds and linking with *in situ* projects (note: this may be more feasible in Europe and North America).
- Participation in repetition of the Madikwe experiment.
- Conducting basic behavioural studies, especially in conjunction with hormonal monitoring

Other recommendations made by the subgroup included:
- Appointing a neutral party to serve as the APP wild dog co-ordinator. (One suggestion was Markus Hofmeyr.)
- Re-evaluating PAAZAB's APP guidelines and Memorandum of Participation for participation in the breeding programme by local stakeholders.
- Examining the feasibility and value of reinforcing the captive population genetically. If this were desired, then a stock reasonably close to the wild population would be needed.

3. In order to plan co-ordinated, effective, successful reintroduction programmes, CRITERIA FOR REINTRODUCTION need to be established according to specified objectives and goals of the programme.

Factors to be taken into account in determining criteria for reintroduction include:

- Time of year considerations (sequence considerations).
  - dogs' breeding cycle.
  - availability of prey (juvenile and adult, seasonality).
  - accessibility for monitoring. For example, reintroductions likely should not be undertaken during the rainy season when accessibility for monitoring might be restricted).
- A thorough review of previous case histories should be undertaken to avoid/predict possible problems. This would allow duplication of protocols that have worked and facilitate the se of this information to design an adaptive management strategy, define research needs, and develop contingency plans, if needed.
- Availability of financing, including definitions of potential income and expenses. These considerations would include:
  type of income that might be produced (tourism, sales of dogs, sponsorship, fund raising, joint promotions)
  - type of expenditures required (preparation of area, transport, feeding, veterinary, monitoring etc.)
  - forming funding groups to co-ordinate funding.
- Predicted population viability of reintroduced dogs shows a good likelihood of success.
- Specific criteria and goals are in place to guide decision making during the reintroduction effort.

Possible solutions and strategies to address the identified criteria for reintroduction include, in descending order of priority:

1. Obtaining and maintaining information on previous reintroductions for possible publication.

2. Determining funding needs/expenditures (developing a budget/business plan).

3. Identifying specific objective/goals to guide decision-making during reintroductions.

4. Modelling potential reintroduction scenarios in the area.

5. Determining availability of funding for reintroduction programmes including sponsorship, fund raising and NGOs.

6. Forming a funding group to approach funders (including non-traditional means of funding)

7. Creating a wild dog web site.

It also was agreed that PRACTICAL QUIDELINES FOR REINTRODUCTION IMPLIMENTATION are needed. The Working Group recommended that the *Lycaon* Working Party develop these guidelines and that these guidelines take into consideration:

- <u>Pre-release factors</u>
  - Sources of animals to be reintroduced.
  - Capture methods.
  - Transport method.
  - Holding conditions, management and facilities.
  - Administration.
  - Guideline for reintroduction into the holding facility.
  - Guidelines for timing.
  -Timing guidelines.
  - Monitoring of behaviour and health during captivity.
  - Veterinary management.
  - Release methods.

- <u>Post release factors</u>
  - Post-release monitoring (collars, implants, transponders, photographs).
  - Post-release supplementary feeding and care.
  - Post-release care (level of care).
  - Post-release monitoring of prey.
  - Adaptive management.

Solution 1.
Assimilate as much information on reintroduction of wild dogs as possible, including unpublished data, for dissemination to the *Lycaon* Working Party.
Person responsible: Michael Somers (provisionally). 1 year to complete.

Management Working Group Report

Participants : Kenneth Buk, Mike Knight, Johan Kruger, Ant Maddock, Gus Mills, Alistair Pole, Flip Stander, Dave Wildt (facilitator)

The Working Group began by discussing, collapsing and re-prioritising the factors identified in the original plenary session. The original list was as follows:

- maintenance of suitable habitat outside of protected areas
- inter-predator competition
- habitat loss/conflict
- practical management guidelines for small, enclosed areas
- habitat loss/conflict
- identify objectives and appropriate objectives for monitoring
- guidelines for problem animals
- co-operative implementation for large carnivore management
- development of a wild dog national policy for management giving a uniform policy across provinces
- money to compensate stock losses/insurance
- southern African database/network with possible expansion to East Africa
- monitoring of wild dogs
- conservation priorities for large carnivores
- detailed habitat variables in terms of preferences for wild dogs

The working group collapsed these factors into five primary groups and prioritised them as follows:

1. Fragmentation
2. Problem animals
3. Monitoring
4. Databases
5. Uniform national policies

1. **HABITAT FRAGMENTATION:** Because of conflicts with people and the wide-ranging habits of wild dogs and low densities, fragmentation of suitable habitats for populations in southern Africa is a problem. Management issues associated with the fragmented wild dog populations include:
   a) mapping distribution, protection status and size of existing southern African wild dog populations.
   b) maintaining suitable environments in southern Africa for existing populations.
   c) identifying suitable areas in southern Africa for wild dog re-introduction/expansion.
   d) developing management guidelines for small populations including assessing levels of genetic diversity and interspecific competition.
   e) adhering to and encouraging international co-operation through international treaties, conventions and similar venues.

2. **PROBLEM ANIMALS**: Wild dogs can be classed as "problem animals" in southern Africa because they are perceived to be incompatible with other land uses. Management issues associated with "problem animal" status include:
   a) determining why the wild dog is a problem animal, recommend appropriate action;
   b) developing appropriate action guidelines for short- and long-term solutions to problems with wild dogs.

3. **MONITORING:** Monitoring wild dogs is necessary to provide information on long-term conservation plans in southern Africa. Therefore, there is a need to develop a standardised procedure for gathering information on:
   a) basic distribution and numbers.
   b) detailed demographics to enable modelling of populations.
   c) threats to wild dog survival, including other large carnivores (interspecific competition), disease and genetics.

4. **METADATABASE:** A central metadatabase would be beneficial for swift and convenient exchange of information on all aspects of wild dog conservation. Therefore, there is a need to establish a mechanism.

5. **UNIFORM NATIONAL/INTERNATIONAL POLICY**: Currently, wild dog policies differ provincially and internationally which limits conservation efforts. There is a need for standardisation of these policies.

The above information was presented in plenary and further refined by the working group. The Working Group decided to primarily concentrate on those issues related to fragmentation and small populations and to work with the Reintroduction Working Group to identify potential criteria and sites for future wild dog introductions.

Possible solutions to address the above-defined problems were developed. These included:

Fragmentation

Problem 1
The distribution, protection status and size of existing wild dog populations need to be mapped.

Solution
a) Use data from the *Canid Action Plan* combined with updated information provided by the workshop participants to develop accurate maps for both distribution and size of existing wild dog populations in southern Africa. During the week, the group developed a table of the latest information on wild dog and pack numbers (Table 1).

b) To determine protection status of an area, plot each population on a simple bipolar axis that compares level of security (from secure to threatened) and level of legal protection (from protected to unprotected) (Fig. 1). Thus, a given population could be:
   Category 1: secure and protected (e.g., Kruger National Park; Moremi National Park).

Category 2: secure and unprotected (Tsumkwe; Save Valley Conservancy in Zimbabwe).
Category 3: threatened and unprotected (e.g., Caprivi; Northern Province)
Category 4: threatened and protected (e.g., Madikwe Game Reserve; Hluhluwe-Umfolozi Park).

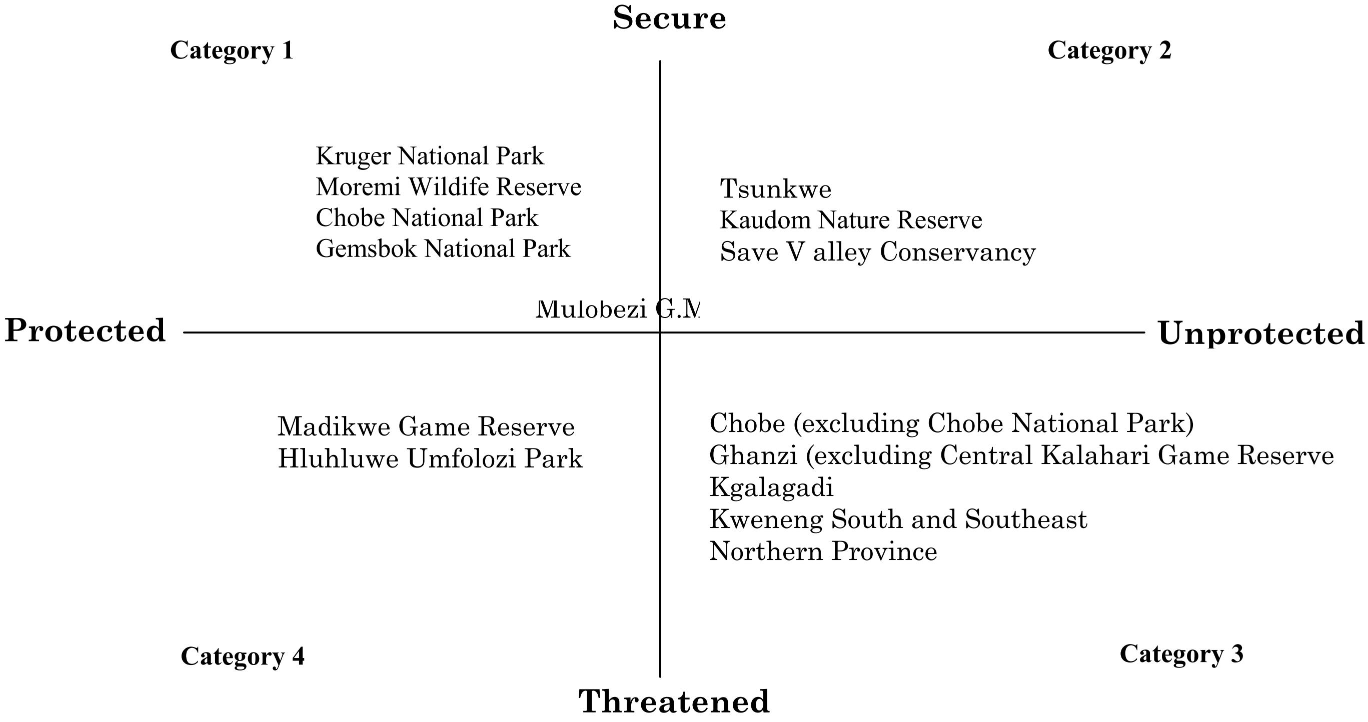


Figure 1. Plot of the protection status of an area, with each population plotted on a simple bipolar axis that compares level of security (from secure to threatened) and level of legal protection (from protected to unprotected).

Within this continuum, a population will fall into different positions on the bipolar axis, indicating their level of security and protection. Obviously, one strategy is to strive for a level of security and protection approaching that of the Kruger National Park (Fig. 1). Reserve size also will be an important consideration.

Table 1. Wild dog populations and pack numbers.

ZAMBIA (The wild dog is a protected animal in Zambia)

Area	sq. Km	resident dogs
Kafue National Park	22 400	200-400
Kasonso-Busanga Game Management Area	7 780	20-60
Liuwa Plain National Park	3 660	20-60

Lower Zambezi National Park	4 140	20-60
Luambe National Park	254	10
Luano Game Management Area	8 930	20-40
Lumimba Game Management Area	4 500	30-60
Lukusuzi National Park	2 720	10-20+Vagrants?
Lunga-Luswishi Game Management Area	13 340	40-100
Lupande Game Management Area	4 840	10-40
Mulobezi Game Management Area	3 420	30-60
Mumbwa Game Management Area	3 370	20-40
Munyamadzi Game Management Area	3 300	0-30
Musalangu Game Management Area	17 350	20-100
Mweru Wantipa National Park	3 134	10-15+Vagrants?
Namwala Game Management Area	3 600	15-45
Sichifulo Game Management Area	3 600	30-60
Sioma-Ngwezi National Park	5 276	15-60
South Luangwa National Park	9 050	50-150
Sumbu National Park	2 020	5-20
West Lunga National Park	1 684	5-20
West Zambezi Game Management Area	38 070	20-50+vagrants?

+ *unknown number of vagrants in and around protected areas*

Table 1, continued

SOUTH AFRICA (* = protected)

Area	**sq. Km**	**resident dogs**	**packs**	**sex ratio**
Kruger National Park	22 000	434	32	50/50
Kalahari Gemsbok National Park		9 591+ vagrants		
Hluhluwe-Umfolozi Park*	960	13	2	
Magudu/Itala area		26	3	
Madikwe Game Reserve	700	6	1	
Northern Province		40 vagrants	4 (?)	

ZIMBABWE

Area	sq. Km	resident dogs	packs
Gonarezhou National Park	5 003	25 - 45	3
Save Valley Conservancy	3 414	60 – 80	4

NAMIBIA

Area	**sq. Km**	**resident dogs**
Suitable habitat:		
Kaudom Game Reserve	4 800	
Tsumkwe District,		
Kavango and Eiseb Block	27 650	166-525
Questionable habitat:		
East and West Caprivi,		
Western Kavango,		
Eastern Owambo	12 800	76 – 243

Table 1, continued

BOTSWANA

Area	Sq.km	# Packs	# Wild Dogs	Confidence	Resident/ Vagrant	Protected	Status
Protected Areas							
Moremi Wildlife Reserve	4,000	15	165	Hi	Res	Yes	Stable
Chobe National Park	11,000	8	88	Est	Res	Yes	Stable
NP-MAK. NP	4,600	2	20	Hi	Vag	Yes	Vulnerable
CKGR	52,800	2	20	Est	Vag	Yes	Vulnerable
Gemsbok National Park	26,000	4	40	Guess	Res	Yes	Vulnerable
Districts							
Ngamiland (Excl. Mwr)	95,00034		272	Hi	Res	No	Vulnerable
Chobe (Excl. Cnp)	12,00012		96	Est	Res	No	Threatened
Central & N.E.	128,000 4		32	Est	Res	No	Vulnerable
Ghanzi (Excl. CKGR)	62,000 4		32	Guess	Res	No	Threatened
Kgalagadi (excl. GNP)	61,000 6		48	Guess	Vag	No	Vulnerable
Kweneng, S. & S.E.	56,000 2		20	Est	Vag	No	Vulnerable

Problem 2
Suitable environments for existing populations of wild dog in southern Africa need to be maintained.

Solution
a) Identify high priority factors to be considered which will <u>differ</u> for each area in southern Africa. Among these are the following:
   i) large carnivore density (appropriate interspecific competition).
   ii) ability to monitor and control disease.
   iii) maintain sufficient prey base.
   iv) avoiding inappropriate management (e.g., burning during the denning season) and development (e.g., building roads).
   v) limiting human threats (e.g., monitor human activities and making recommendations to limit these threats).
   vi) fencing (maintenance, removal and/or erection where appropriate).
   vii) improve legislation.

These factors then can be used to create a draft set of management guidelines for small populations (see below).

Problem 3
Suitable areas for wild dog re-introduction/expansion in southern Africa need to be identified.

Solution
a) Develop a list of suitable reintroduction/expansion sites for South Africa, Namibia, Botswana, Zimbabwe and Zambia. The Management Working Group identified the following potential sites for reintroduction:

<u>South Africa</u>:
1. Dongola/Tuli Trans-Frontier National Park (Northern Province; Botswana, Zimbabwe)
2. Vaalbos National Park - Rooipoort - Pniel (Northern Cape)
3. Marakele National Park - Welgevonden (Northern Province)
4. Pilansberg Game Reserve (Northwest Province)
5. Addo National Park (Eastern Province)
6. Kalahari Trans-frontier National Park (Kalahari, Northern Cape)
7. Waterburg Conservancy (Northern Province)
8. Tswalu Game Reserve (Northern Cape; near but isolated from Kalahari Gemsbok National Park)
9. Hluhluwe - Umfolozi - Mkuzi - St. Lucia Game Reserves (Northern KwaZulu-Natal)
10. Sam Knot - Andries Vosloo Game Reserves- Double Drift (Eastern Province)
11. Karoo National Park (Western Cape)
12. Letaba Ranch (Northern Province adjacent to Kruger Park)
13. Tussen die Riviere Game Reserve (Free State Province)
14. Tembe Nduma Game Reserve (Northern KwaZulu-Natal)
15. Madimbo - Makuy Game Reserve (Northern Province)
16. Lehatwla Military Area (Northern Cape)

17. Itala Game Reserve (Northern KwaZulu-Natal)
18. Madikwe Game Reserve (Northwest Province)

Namibia:
19. Etosha National Park (northern Namibia)
20. Mangetti Game Camp (northern Namibia)
21. Waterburg Plateau Park (central Namibia)
22. Southern Namib (southern Namibia)

Zimbabwe:
23. Bubiana Conservancy (southwest lowveld)
24. Midlands Conservancy (midlands region)
25. Lemco Ranch (southeast lowveld)
26. Mvuradona National Park
27. Matusadona National Park (northwest Zimbabwe) [NOTE: both wild and translocated dogs already are present at this site]

Botswana:
28. Okavango West (western side of Okavango Delta)

Zambia:
29. Bangweulu Ecosystem (northeastern Zambia)

Each of these sites then were identified and plotted on a map of southern Africa (Fig. 2).

Problem 4

Management guidelines for small populations, including assessing levels of genetic diversity and interspecific competition, need to be developed.

Solution

a) Small populations are more likely to go extinct. Therefore, there is a need to develop a set of guidelines that will be used to reduce the probability of extinction of extant or introduced local populations.

   Factors of importance in generating the overall guidelines are:
   i) genetics.
   ii) interspecific competition.
   iii) disease.
   iv) stochastic events (e.g., fire, floods, etc.).
   v) monitoring population demography for use in modelling to determine the threat of local extinction.
   vi) fencing.
   vii) prey population.
   viii) metapopulation management (simulated dispersal; infusions of new genetic material)
   ix) linkage management (physical; linkages to other populations).

LEGEND

SOUTH AFRICA
1. Dongola/Tuli Trans-Frontier National Park
2. Vaalbos National Park - Rooipoort - Pniel
3. Marakele National Park - Welgevonden
4. Pilansberg Game Reserve
5. Addo National Park)
6. Kalahari Trans-frontier National Park
7. Waterburg Conservancy
8. Tswalu Game Reserve
9. Hluhluwe - Umfolozi - Mkuzi - St. Lucia Game Reserves
10. Sam Knot - Andries Vosloo Game Reserves - Double Drift
11. Karoo National Park
12. Letaba Ranch
13. Tussen die Riviere Game Reserve
14. Tembe Nduma Game Reserve
15. Madimbo - Makuy Game Reserve
16. Lehatwla Military Area
17. Itala Game Reserve
18. Madikwe Game Reserve

NAMIBIA
19. Etosha National Park
20. Mangetti Game Camp
21. Waterburg Plateau Park
22. Southern Namib

ZIMBABWE
23. Bubiana Conservancy
24. Midlands Conservancy
25. Lemco Ranch
26. Mvuradona National Park
27. Matusadona National Park

BOTSWANA
28. Okavango West

ZAMBIA
29. Bangweulu Ecosystem

Figure 2. Map of potentially suitable reintroduction/expansions sites for South Africa, Namibia, Botswana, Zimbabwe and Zambia.

The Working Group recognises that small population size can only be increased through linkages or metapopulation plans.

The Working Group also recognises that all necessary information needed to provide optimal guidelines is unavailable. Therefore, more new knowledge is needed. To achieve the best guidelines possible, it will be necessary to:

a) periodically remove some animals while infusing new genetic material.
b) monitor.
c) conduct research.

The Working Group agreed that the high priorities for research (from the above list) are:

1. Genetics and metapopulation management (e.g., how frequently do we need to reintroduce animals to maintain genetic diversity into a small population? do isolated packs eventually suffer inbreeding depression? how should new genetic material be infused into a small population; growth rates for various populations; types of dogs best for reintroduction; finding the indicators for maximum carrying capacity?)
2. Disease (e.g., is there a need for vaccination, and how is this to be done?)

Recommendation
For future effective management of extant small populations of wild dog, more research is needed to understand: how to maintain genetic diversity in a small isolated population; if these small populations suffer inbreeding depression; if there is a need to vaccinate to prevent disease, and, if so, how is this to be done; and determining the indicators for maximum carrying capacity.

The Working Group then set forth to develop guidelines for the management of small populations of wild dogs in southern Africa. The Working Group developed the following overall goal.

Goal
Within the next 10 years, establish two, second viable populations of wild dogs, one in the Republic of South Africa and one in Namibia.

Defining sentences for the Goal:

a) A "viable population" is defined as having more than 8 packs. This definition may change with time as more information is gathered.
b) For a second viable population to occur in South Africa, it may be necessary for trans-frontier co-operation with Botswana and Zimbabwe.
c) For both South Africa and Namibia, establishing these second viable populations is likely to be based on a metapopulation management approach.

Recommendation (for future consideration)
The Working Group recommends that consideration be given to maintaining the linkages from Namibia to Zimbabwe, between all existing, trans-frontier populations in southern Africa.

Using the goal outlined above, the Working Group then developed first draft guidelines for managing small populations of extant wild dogs.

Guidelines for Management of Small Populations (more than eight packs) of Wild Dogs (Extant)

Steps

1. Ensure systematic monitoring of demographic data. Approaches should include:
    a) photographs
    b) telemetry
    c) sightings
    d) questionnaires.

Ideally, each pack should be monitored (with respect to location and demographics) at least once per month.

2. Consider the carrying capacity of the area to determine the number of packs that can be maintained.

3. Link this population to a southern Africa metapopulation plan that is based on genetic and demographic information.

4. Control for rabies and canine distemper. Approaches for control will vary depending upon situations.

5. Maintain the integrity of the area in which the population is living, including securing fences and eliminating snares and other human threats.

6. Enact an education programme with local communities and area visitors.

7. Identify a person who is ultimately responsible for the wild dog project in this particular area. Responsibilities include monitoring of the population, education, data analysis, report writing and fundraising.

8. Generate an annual report that is submitted for periodic review and discussion by the Lycaon Working Party.

Reintroduction Site Selection Criteria in the Context of Potential Geographic Sites

The 29 potential reintroduction sites shown in Figure 2 then were cross-plotted on a matrix against 29 criteria for site selection prepared by the Reintroduction Working Group (Table 2). A paired ranking test then was used by nine of the workshop participants to identify the highest ranking selection criteria. This exercise resulted in the following ranking of site selection criteria (in decreasing order). The number of votes received by each follows the criteria in parentheses.

1. Total biomass of potential prey per km^2. *Low, Medium, High* (214)

2. Vulnerability of wild dogs to disease, i.e., CDV and rabies. *Low, Medium, High* (192)
3. Potential expansion of area. *Yes or No* (180)
4. Density of the human population inside the area. *Low, Medium, High* (178)
5. Potential linkage to other areas by corridors. *Yes or No* (175)
6. Habitat size available = *actual* km^2 (171)
7. Density of other competing predators in area per km^2 *L=# lion/*km^2*; H=# hyaena/*km^2 (161)
8. Does this reintroduction make a contribution to wild dog conservation objectives? *Yes or No* (159)
9. Is there funding for adequate monitoring programme? *Yes or No* (156)
10. Level of contact with domestic dogs. *Low, Medium, High* (151)
11. Is the area securely and appropriately fenced? *Yes, No = no fence; P = prey fence, D = dog fence, C = cattle area* (150)
12. Level of neighbour/local community support? *Low, Medium, High* (142)
13. Conservation status of the area. *NP =National Park. GR = Game reserve, C = Conservancy, H = Hunting area, N =None* (127)
14. Predicted human population growth in and around the area. *I = increasing, D = decreasing, S = stable* (125)
15. Neighbour/local community education or awareness programme in place or planned? *Yes or No* (124)
16. Land use in surrounding areas. *GR = Game reserve, R = Game ranching, P = Pastoralism, T = Tourism, L = Livestock ranching, A = Agriculture* (116)
17. Readiness of the area for the reintroduction programme? *Low, Medium, High* (114)
18. Potential threat from roads. *Low, Medium, High* (112)
19. Value of the animals to the area (ecological, economic, intrinsic, educational, visitor enjoyment). *Low, Medium, High* (104)
20. Is there insurance for compensation available? *Yes or No* (96)
21. Density of human population in and around the area. *Low, Medium, High* (94)
22. Presence of valuable prey species in area. *Yes or No* (94)
23. Level of facilities to support successful monitoring and management. *Low, Medium, High* (91)
24. Majority of prey resident or migratory. *R = resident M = migratory* (72)
25. Political stability in area. *Low, Medium, High* (71)
26. Predicted human population growth around area. *I = increasing, D = decreasing, S = stable* (61)
27. History of area documented? (e.g., cause of extinction known? causes now gone? causes now manageable? *Yes or No* (49)
28. Habitat type. *G = grassland, B = bushveld, M = mountain, D = desert, F = Forest, W = wetland, VB = valley bush, SD = semi-desert* (39)
29. Rainfall = *actual mm/year* (22)

During this initial effort, it was decided to focus on the first seven factors from total biomass of prey through density of competing predators.

Recommendation:
It was recommended that all potential reintroduction sites in each southern African country be analysed on the basis of total biomass of available prey, vulnerability of the introduced population to disease, potential of the introduction are for expansion, the human density inside the proposed area, the potential of the area to be linked to other areas containing wild dogs, the area size of available habitat and the density of competing predators.

The Management Working Group had too little remaining time to use the top seven criteria to then rank the potential reintroduction sites using pair wise testing.

However, these criteria were used in an experimental exercise by two of the participants, Flip Stander and Alistair Pole to compare the seven identified site criteria across the potential reintroduction sites for Namibia and Zimbabwe. Using this approach, these sites ranked as follows for each country:

Namibia:

1. (first priority) Etosha National Park (8 votes)
2. Waterberg Plateau (7 votes)
3. Mangetti Game Park (5 votes)
4. Southern Namib (2 votes)

Zimbabwe:

1. (first priority) Lemco Ranch (19 votes)
2. Bubiana Conservancy (15 votes)
3. Matusadona National Park (14 votes) - – [NOTE: both wild and translocated dogs already are present at this site]
4. Midlands Conservancy (13 votes)
5. Mvuradona Game Ranch (9 votes)

Recommendation:
It is recommended that this paired ranking approach (that has identified seven high priority environmental criteria) be used for all relevant countries as a potential approach for selecting the highest priority reintroduction sites for wild dogs. It is recommended that a high priority for the *Lycaon* Working Party will be to use this approach on the 18 potential reintroduction sites identified in South Africa.

Table 2. Potential reintroduction sites cross-plotted against criteria for site selection.

	CRITERIA FOR SELECTION, IN ORDER OF IMPORTANCE														
SITE	**1, Prey Biomass**	**2. Vulnerability to disease**	**3. Pot. Expansion**	**4. Human density inside**	**5. Linkage Potential**	**6. Habitat Size km2**	**7. Dens. Competing preds.**	**8. Contrib. To conservation**	**9. Funding for monitoring**	**10. Contact dom. Dogs**	**11. Adequate fencing**	**12. Community Support**	**13. Conservation Status**	**14. Human Growth inside**	**15. Comm. Educ. program**
1. Dongola	M	M	Y	0	Y	1000	L 4.9 H 3.0	Y	Y	M	A	M		S	N
2. Vaalbos-Rooipont	M	L	Y	0	N	800	0	Y	Y	L	P	M			Y
3. Marakele N.P.	L	L	Y	0	Y	450	0	Y	Y	L	P	M		S	N
4. Pilanesberg	H	L	N	0	N	580	L 4.5	Y	Y	L	D	H		S	Y
5. Addo N.P.	L	L	Y	0	N	600	0		Y	L	P	M		S	Y
6. Kalahari Transfr.	L	L	Y	0	Y	3600	L 0.6 H 0.3	Y		L	P	M		S	N
7. Waterburg Cons.	L		Y		Y	800	0	Y	Y	M	Y	H		S	N
8. Tswalu G.R.	M	L	Y	0	Y	1000		Y		L	Y	M		S	N
9. HUP-GSWP-Magudu	H	H	Y		Y	3000	L<0.1 H 0.3	Y	Y	H	R/N	M		I	Y
10. Sam Knott	L		Y	0	N	450	L 0 H 0	Y	N	M	R/N	N		S	N
11. Karoo N.P.	M	L	Y	0	N	450	0	Y	Y	L	Y	M		S	N
12. Letaba Ranch	M	M	N	0	Y	450		Y	N	H	Y	?		S	N
13. Tussen die Riviere	M	L	Y	~0	N	300?	0	Y		L	R/N				N
14. Tembe-Ndumu	H	M	Y	~0	Y	800?	L 0 H Lo	Y	Y	M	P	?		S	Y
15. Madimbo/Makuya	L	M	Y	0	Y	200	L Lo H Lo	Y	N	L	Y	?		I	N
16. Lehathala Mil. Area	L	L	Y		N	1200		Y		L	N			D	N
17. Itala G.R.	M	M	Y	0	N	450	L 0 H Lo	Y	Y	M	Y	M		S	Y
18. Madikwe	M	M	Y	S	Y	600	L 2.5 H 4.0	Y	Y	L	D	M		S	Y
19. Etosha N.P.	M	M	N	0	N	22000	L 1.5 H 4.0	Y	Y	L	P	M		S	Y
20. Mangetti	M	M	Y	0	Y	250	L 0 H 1	Y	Y	M	Y	M		S	Y
21. Waterberg Plateau	H	M	N	0	N	450	L 0 H 0	Y	Y	L	Y	M		S	Y
22. Southern Namib.	L	L	Y	0	Y	~40000	L 0 H vLo	Y	Y	L	N/Y	L/M		S	N
23. Bubiana Cons.	H		Y	0	Y	1300	L Lo H Lo	Y	Y	M	P	M		S	Y
24. Midlands Cons.	M		N	0	N	500	L Lo H Lo	Y	Y	L	P	M		S	N
25. Lemco	M		Y	0	Y	2500	L Lo H Med	Y	Y	L	P	M		S	N
26. Mavuradona	L		N	0	N	400	L Lo H Lo	Y	N	M	N	M		S	N
27. Matusadona	M		Y	0	Y	1200	L Hi H Lo	Y	Y	M	N	M		S	N
28. Okavango West	H	M	Y	0	Y	3000	L Hi H Mod	Y	Y	L	N	M		S	Y
29. Bangweulu	M	M	N		Y	~10000	L Lo H Lo	Y	N	M	N	L/M		S	Y

Table 2. *Continued*

	CRITERIA FOR SELECTION, IN ORDER OF IMPORTANCE													
SITE	**16. Surrounding Land Use**	**17. Readiness of area**	**18. Threats from roads**	**19. Value WD to the area**	**20. Compens. Insurance**	**21. Human density around**	**22. Pres. Of valuable prey**	**23. Level of facilities**	**24. Prey resid. Or migratory**	**25. Political stability**	**26. Human growth around**	**27. History of area known**	**28. Habitat type**	**29 Rainfall**
1. Dongola	G,R,L,A,P	H	L	H	Y	L	N	M	R/M	M	I	Y	SD	350
2. Vaalbos-Rooipont	G,R,L	M	L	H	N	L	Y	M	R	M	I	Y	B,G	420
3. Marakele N.P.	L,G	M	L	H	N	L	Y	M	R	H	S	Y	M,B,G	700
4. Pilanesberg	G,P	H	L	H	Y	H	N	H	R	H	I	Y	G,B,M	630
5. Addo N.P.	L,P,A	M	Y	M	N	M	M	H	R	H	I	Y	M,B,F	450
6. Kalahari Transfr.	L,T,P		N	M		L	N	H	M/R	H	S	Y	SD	220
7. Waterburg Cons.	G,P,A,L	H	M	H	Y	L	Y	H	R	H	I	N	B,G	600
8. Tswalu G.R.	L,G		Y	M		L	Y	H	R	M	S	Y	SD	220
9. HUP-GSWP-Magudu	A,P,G		M/H	H	Y	M	N	H	R	H	I	Y	B,F	500-1200
10. Sam Knott	A,P,G		L	M	N		N	L	R	H	S/I	Y	VB	400
11. Karoo N.P.	L,G	M	L	H	N	L	L	H	R	H	S	Y	SD	350
12. Letaba Ranch	P,A,G,L	N	L	H	N	H	N	L	R	M	I	Y	B	700
13. Tussen die Riviere	L,G		L	H		L	N	H	R	H	D		G	500
14. Tembe-Ndumu	P,L	M	L	M	?	M	N	M	R	H	I	Y	F,W,B	600
15. Madimbo/Makuya	G,R,L	N	L	H	N	M	N	N	R	M	S	Y	B	350
16. Lehathala Mil. Area	L,G		Y	L			N		R	M	D			350
17. Itala G.R.	A,P,G		L	H	Y	M	N	H	R	M		Y	G,B	800
18. Madikwe		M	L	M	Y	L	N	H	R	M	S	Y	B	520
19. Etosha N.P.	G,R,P,L	H	L	H	N	M	N	H	R	H	I	Y	G,B	300-400
20. Mangetti	L	L	M/H	M	N	M	N	M	R	H	I	Y	B	500
21. Waterberg Plateau	G,R,L	M	L	M	N	H	Y	H	R	H	S	Y	B	400
22. Southern Namib.	L	L	L	L	N	L	N	L	M	H	S	N	D,SD	20-50
23. Bubiana Cons.	L,P,A	M	L	H	N	L	N	H	R	M	I	Y	B	400-500
24. Midlands Cons.	L,P,A	M	M	M	N	M	N	M	R	M	I	Y	B	600
25. Lemco	L,P,A	M	L	M	N	M	N	M	R	M	I	Y	B	400
26. Mavuradona	L,P	M	L	H	N	L	N	L	R	M	I	Y	B/M	750
27. Matusadona	P	H	L	H	N	L	N	L	R	M	I	Y	B/M	500-600
28. Okavango West	P	*	L	M	N*	L	N	L	R	H	I	Y		350
29. Bangweulu	P,A,T,L	L	L	M	N	~10/ km	N	L	R	M	I	N	G,W,B ,F	1400

Modelling / Life History Working Group Report: considerations for the creation of a managed metapopulation of African wild dogs, *Lycaon pictus*, in southern Africa based on a pack-based simulation model

Participants: David Macdonald, J. Weldon McNutt, Gus Mills, Claudio Sillero-Zubiri, Rosie Woodroffe, Mike Bruford (facilitator)

The aim of this Working Group was to develop a model to underpin practical recommendations for a managed meta-population in southern Africa.

Introduction

Few populations of African wild dogs survive, and few of these are sufficiently large to ensure their survival. In southern Africa, reasonably safe populations include the wild dogs in the Kruger National Park in South Africa, in Hwange and the Zambezi Valley National Parks in Zimbabwe, in the Okavango delta in Botswana, and in the Selous National Park in Tanzania. Outside these enclaves, the status of the species is perilous.

For two reasons, this makes it imperative to accurately understand the dynamics of very small populations of African wild dogs, and in some cases these small populations may comprise no more than one pack. The first reason is that many surviving wild dogs exist in scattered pockets. The second reason is that the opportunity may exist to create, by translocation and reintroduction, new pockets. In both cases these constellations of pockets may function as metapopulations. Some of these pockets, and possibly the majority of them, may be created in fenced areas. In this case, with areas too small to sustain a viable population indefinitely, and with immigration and emigration forestalled, there will be a need for management as a metapopulation. Decisions will have to be made regarding the size and composition of founder stock, the imposition of a schedule of artificial immigration and emigration, the necessity for regulation of numbers, and any management action necessitated to contain the impact of catastrophes, such as disease. Until recently, it has not been possible to provide practical guidelines to questions regarding the consequences of various combinations of these options. In short, the practitioner asks 'What if...', but the theoretician has no robust framework with which to predict the answer. However, data do exist for southern African wild dogs that can be used to parameterise a model to provide such answers.

Two features are necessary to make this model useful. First, it must simulate metapopulations, and second it must use packs as its unit of operation. A metapopulation is one that is spatially structured into assemblages of local breeding populations, such that migration between the local populations has an effect on their aggregated population dynamics. A metapopulations is therefore a constellation of local populations whose fates are linked. Because wild dogs are increasingly fragmented into pockets, and yet they have high dispersal capabilities, they probably behave as metapopulations. Furthermore, in the case of a collection of managed, fenced sub-populations, they could only function as a metapopulation. Because some sub-populations comprise just one pack, and because factors operating at the pack level determine population parameters such as mortality and natality, and because almost all relevant data have been gathered on a pack-by-pack basis, it is desirable for the operational unit of the model to be the pack.

Before elaborating on the modus operandi of our pack-based, meta-population model, it may be helpful to illustrate two scenarios under which meta-population management may be relevant. In the first case, having defined the sub-population as a pack, a cluster of several linked packs can be considered a meta-population. In the second case, several such clusters can, at a higher tier of resolution, interact as a metapopulation. For example, in the case of the proposed managed metapopulation, one might envisage half a dozen widely dispersed fenced reserves to which wild dogs were introduced. Each reserve might support a small number of packs. With packs defined as sub-populations, one tier of metapopulation dynamics encompasses the several packs in one reserve, whereas a second tier links together (through active management - dispersal imposed through translocation etc.) the constellation of dispersed reserves. While one of our goals is to produce a model that will offer management guidance to this second level, our first step focuses on the first scenario.

The Model and definitions

Various general population simulation models exist. Each has its own assumptions and, set the same problem, each may therefore produce a different result. They should therefore be used cautiously. None of these models is specifically customised to the social complexities governing the population dynamics of African wild dogs. Inevitably, therefore, in seeking to devise one of these models using data from African wild dogs, there are aspects of the operation that approximate fitting the proverbial round peg into a square hole. Nonetheless, at least as a first step, this activity is likely to be heuristic. Furthermore, while the outputs of different models almost invariably differ in detail, they generally reveal parallel trends and therefore illustrate important principles. Against this background, we used VORTEX 7.4 (Appendix IV).

VORTEX works by asking the operator a series of questions. To answer these consistently it is necessary to define key units in ways that satisfy both biological realities and VORTEX's mechanics.

Definition of a pack

A central aspect of our analysis is to predict the likelihood of an entity going extinct. Because our sub-populations are packs, we seek measures of the extinction risks to packs. However, packs may be defined in many different ways. Packs have life spans, and these may begin when a potential reproductive unit is formed (one or more males and females coming together as founder members). A biologically convenient definition of a pack's life span is, therefore, the life span on the longest-lived member of the shortest-lived sex of the founding group.

However, in terms of our metapopulation model, this definition is insufficient to accommodate complications arising from, for example, dispersals between social units or the continuity of lineages but not of spatial units. Therefore, in our simulations we define a pack as that reproductive sub-population which occupies a conceptual space between its inception and extinction. The conceptual space is not actually a spatially defined territory (because wild dogs are not territorial) but is, analogous to a territory, a portion of the carrying capacity within the area.

Modus Operandi

Our goal is to simulate small populations. However, if we did this by simply allocating plausible parameter values to a model of a few packs, the results might be intriguing, but we would have no measure of their validity. Therefore, our first step was to model an existing population, so that we could verify that the outputs of the model were broadly in accord with observed reality. Having achieved such accord, and fortified by the hope that the likelihood is low of a complex model giving the right answer for the wrong reason, we can advance to running the model on our hypothetical managed metapopulation. To the extent that the simulation behaved 'sensibly' in mimicking the real population, we may put faith in the insights it offers for the management of the hypothetical one.

For the development and validation of the model we selected Kruger National Park (KNP), with supplementary data from Moremi, in the Okavango Delta of Botswana (data provided, respectively, by Drs M.G.L. Mills and J.W. McNutt). We used southern African data because the management we hope to underpin will be conducted in southern Africa.

Twenty-seven packs are found in the KNP. While it would be advantageous to simulate this entire population, it is not computationally feasible. Instead we modelled the eight packs found south of the Sabie River. In terms of metapopulation terminology, these represent our meta- population, whereas each pack is a local or sub-population.

Parameterising the model and Compromises

VORTEX interrogates the user with respect to parameter entered. We will not discuss the detail of this process here, except to draw attention to those parameters where the mismatch between VORTEX's logic and the wild dog's biology forced us into a compromise. Some of these compromises became apparent only as we ran preliminary versions of the model.

1) Pack fission

We were unable to model pack fission and thereby the creation of new packs. In contrast the reality is that new packs were established. A potential solution to this, within the options offered by VORTEX, is to reconfigure our grid so that initially it involves some empty cells which, in due course, become occupied (however, see below for the errors introduced to dispersal elements when genuinely empty sub-populations were simulated).

2) Dispersal rates

Dispersal rates (that is, successful immigration) within the eight packs, are available for a six-year period. We used these 56 data points to calculate a real measure of dispersal probabilities. However, we were forced to assume that pack size at the time of dispersal was the average pack size over the six years of study. Furthermore, VORTEX does not allow us to distinguish between the sexes (this is an obvious limitation insofar as both sexes may disperse to neighbouring territories or may move several territories distant).

Although the published KNP data were a tremendous asset, our initial use of them revealed several inadequacies in our treatment of dispersal. First, the fate of those individuals which disappeared from each pack in the Kruger focal study area but which did not safely immigrate into one of the other seven focal packs was largely undocumented; in reality, some likely died, but others will have successfully immigrated to packs outside the core study area. Furthermore, other wild dogs from outside the focal study area will have successfully immigrated. This reality was not captured when we implanted the data on successful dispersals within the study area into our simulated 8-pack metapopulation. In short, it suffered the fate of a sink. We do not know whether our population is a source or a sink with respect to neighbouring groups, so we assume they are in balance, and therefore we need to plug this leak. Indeed, the reality is that the packs in our focal area in KNP appear reasonably stable, and therefore there was a logical need to match emigration by members of one sex by immigration by members of the other. We did not have data to resolve this problem, so we added 3% level of background immigration to each group (a figure extrapolated from genetic data).

A second problem was that we had initially set immigration success at 75%, and yet our data included ONLY successful immigrations, and therefore were an underestimate by 4/3 of real dispersal. We remedied this second problem by multiplying our dispersal rates from each group by 4/3. In passing, it is worth mentioning that the intuition of the field biologists varied rather widely regarding the likely percentage of successful dispersal (defined as surviving emigration up to the point of acceptance in a new pack). Therefore, our compromise of 75% is in especial need of sensitivity testing.
A third problem is that it so happens that our initial starting pack structure recorded as extinct two of the packs from which our dispersal data were drawn (this arose because we used dispersal data from one year, and pack structure data from a later year). A consequence of this was that dispersal rate within the simulation was grossly underestimated. We therefore interpolated pack compositions to fill those two empty packs (the other six pack structures were drawn from 1997 pre-breeding season reality, and ideally we might have drawn compositions for the two extinct packs from earlier years in their history, but these data were not to hand). We nominated two hypothetical packs, one new and the other well established, and allocated them the following compositions: New: 2 females and 4 males; Established: females 3 yearling, 1x 2 yr. old, 0 x3 yr. olds, 1x4 year old = 6; males 2 x2yr old, 1x 3yr old, 4 yearlings, 1x 5 year old and 1x 6 year old.

3) Inbreeding:

In Botswana, McNutt finds frequent matings between cousins and uncle/aunt-niece/nephew, whereas in Kruger, Mills has few (or no) instances of inbreeding. For the purposes of this exercise, we assumed that inbreeding occurred.

4) Correlation of environmental variance and survival:

There is potentially an inverse relationship between conditions that are 'good' for hunting dogs and for impala. In general, good years for survival of dogs are likely also to be good years for their reproduction. Therefore, we assume that EV (survival) is correlated with EV(breeding), throughout our metapopulation.

5) Catastrophes

Catastrophes are an important element of the model, and have recently been recorded in populations from Madikwe and Moremi and, further afield, the Serengeti-Mara ecosystem. The most likely catastrophe is epizootic disease, and in some cases this may be devastating (100%) within each sub-population (i.e. pack).Using evidence from a real catastrophe in Moremi in 1996 we simulated a situation in which 10 packs were monitored for six years, giving 60 pack years. During this time there was one event, in 1996, during which 5 packs contracted disease and were annihilated. We therefore set the probability of catastrophe at 8.3%. Of course, this is not a proper estimate, in so far as it records the interval between the start of observations and the first catastrophe, and not the interval between successive catastrophes. Consequently, we explored various catastrophe rates ranging from 0-8% per pack annually.

6) Density dependence in reproduction within packs:

In both Botswana and KNP there are instances in which several females breed. McNutt reports an instance of five breeding females of which the surviving aggregate litter of 26 pups included individuals from at least three mothers. Mills reported a litter of 27 pups with three lactating mothers. We therefore assume that while the number of potentially breeding (physiologically competent) adult females increases with pack size, the proportion of them breeding may decrease. In this context, breeding is defined as giving birth.

To quantify this density dependence we assume that when pack size is two the one female invariably breeds, that is p(0)=1. From KNP in 50% of four packs with two females both females bred, whereas at Moremi the suspicion that it is closer to 100%. We therefore speculate that the second female breeds in 70% of groups in which two adult females are present. The number of potential breeding females per pack (physiologically competent females) does not increase in direct proportion to pack size, so empirically we set a ceiling on the maximum number of such females equal to five. It seems that the proportion of these supernumerary females breeding is generally about 60-70%. We therefore conclude that the percentage of breeding females changes approximately linearly with population size (an exponent of 1).

7) Allee Effect:

The Allee effect does not apply because our population is defined as a pack and we envisage no possibility of females being unable to find a potentially available mate within the pack.

8) Litter size

A general result is that mean litter size of African wild dogs is about 10, but at KNP it is 11.5 (SE 0.8). However, we expect that per capita litter size of females in multiple litters is lowered. Indeed, where a second female breeds, she almost invariably loses the entire litter. On the other hand, we think that litters of 1-3 effectively never occur. Because VORTEX does not enable us to correlate survivorship in litters with numbers of breeding females, and because we can specify only one mean litter size, we opt to give a value that is somewhat lower than the mean litter size that would apply for single breeding females. Data were available from the KNP to make this estimate. 16 females were the sole breeders in their pack and produced an average litter of 11.8 pups per capita. Six females gave birth in multiple litters, with a mean of 8.7 pups. Combined, these gave a mean of 11.04 (SD 4.14) pups per capita. Therefore we opted for a mean litter size of nine.

9) Breeding pool:

We considered that all adult males were in the breeding pool.

10) Age specific mortality:

We explored two different age-specific mortality schedules, as tabulated below:

AGE	MALES	FEMALES
0-1 years	KNP 70.4% (Moremi 61%)	KNP 70.4% (Moremi 61%)
1-2 years	KNP 35.7% (Moremi 21%)	KNP 35.7% (Moremi 24%)
>2	KNP 31.7% (Moremi 37%)	KNP 31.7 (Moremi 15%)

11) Starting Population Structure:

For our starting point we sought one snapshot in time; we therefore opted for the current pack sizes of the eight focal KNP packs. For simplicity we took the real pack sizes for each pack before the breeding season of 1997. As it happened, two packs were extinct that year; this introduced error into our dispersal parameters, as discussed above, and these two were therefore replaced by hypothetical average packs. We allocated animals to age classes:

PACK	SIZE
Pretoriuskop	6 ads + 1 yr. = 7
Doispan	2 ads + 1 yr. = 3
Newu	extinct
Mbyamiti	10 ads = 10
Afsaal	12 ads + 13 yr. = 25
Skukuza	extinct
Thekwane	7 ads + 1 yr. = 8
Gommodwan	0 ads + 4 yr. = 4

Results

Summary of Runs
Iteration effect
Run 1 10
Run 2 100
Run 3 1000
Dispersal
Run 4 factored up original model by 4/3
Run 5 put individuals in two empty territories
Run 6 put 3% background dispersal on everything
Run 7 use Moremi mortality data
Catastrophe frequency (rabies)
Run 8 alter catastrophe to 3%
Run 9 alter catastrophe to 5%
Run 10 2%
Run 11 4%
Run 12 6%
Run 13 7%
Run 14 8%
Run 15 catastrophe @ 2% with KNP mortality
Run 16 4% " "
Run 17 0% " "
Run 18 0% with Moremi data
Run 19 catastrophe @ 2% with KNP mortality with 2 additional vacant cells
Run 20 5% with Moremi mortality " " "
Catastrophe frequency (Distemper)
Run 21 KNP mortality data with a 5% chance of 30% global mortality
Run 22 Moremi mortality data " " " "
Harvesting models
(A harvest model mimics collection of translocees)
Run 23 KNP mortality data with a 2% chance of rabies; harvest 2 per annum
Run 24 " " " " " " " 3 "
Run 25 " " " " " " " 4 "
Run 26 Moremi mortality data with a 5% chance of rabies; harvest 2 pa
Run 27 " " " " " " " 3 pa
Run 28 " " " " " " " " 4pa
Single pack models
(Runs 29-36 modelled single packs with various founder combinations, all aged 3 years, KNP mortality schedule, and 0% rabies mimicking vaccination)
Run 29 1f1m
Run 30 2f2m
Run 31 3f2m
Run 32 3f3m
Run 33 4f4m
Run 34 2f4m

Run 35 4f3m
Run 36 3f4m
(runs 37-49 were exploratory and are not presented here)
Runs 50-55 involve 3f3m founders and attempt to mimic frequency and magnitude of genetic exchange)
Run 50 exchange 2f (aged 1and 2), 2m (aged 2 and 3); these animals were supplemented to the pack at years 5,10,15 and 20, and a similar cohort of individuals was removed at years 6, 11, 16 and 21.
Run 51 as for Run 50 except we carried out an additional supplementation at year 25.
Run 52 as for Run 50 except that harvesting and supplementation occurred in the same years, namely 5,10, 15 and 20.
Run 53 as for Run 52 except that harvest and supplementation was restricted to 4 females (2 aged 1 year and 2 aged 2 years) at 5, 10, 15 and 20 years
Run 54 as for Run 52 except that five females were exchanged (3 aged 1 year and 2 aged 2 years) and two males (1 aged 2 and 1 aged 3).
Run 54a as for Run 53, except only males (2 aged 2 and 2 aged 3) were exchanged
Run 55 as for Run 54, except the compositions for males and females were swapped.

1. Iteration

Three iterations of the original model (runs 1-3) revealed a huge difference between 10 and 100 interactions, and little difference between 100 and 1000 iterations.
Subsequently all iterations = 100.

2. Dispersal

Runs 4-6 successively correct the three flaws in our dispersal parameters that are discussed above. Each improvement resulted in the metapopulation behaving in a way that more closely approximated our perception of reality, but nonetheless left radical inadequacies in the simulation. Specifically, extinction rate (Fig 1) and inbreeding (Fig 2) were unrealistically high.

One lesson learned from the unrealistic (in terms of Kruger) setting of our initial dispersal parameters was to reveal that when immigration was effectively prevented, there was a high risk that packs (i.e. sub-populations) go extinct. In practice, this result may mirror the events at Umfolozi.

3. Age specific mortality

The results of runs 1-6 caused us to suspect that a demographic parameter was incorrectly set, which drew us back to earlier debate regarding age-specific mortality levels. In particular, it was hypothesised that the given KNP values were unrealistically high, whereas the conditions at Moremi were arguably more conducive to quantifying this aspect because of a greater chance of detecting animals when they leave that study site (and because of a greater chance of distinguishing mortality from emigration within the broader category of disappearance).

This refinement, therefore, links with our evaluation of dispersal insofar as we suspected that the high mortality levels recorded at KNP might partly reflect difficulty in distinguishing mortality and dispersal. Therefore, for Run 7 we used Moremi mortality data. This reduced the tendency of the population to go extinct, from c. 40-70% down to c. 10% within 25 years (Fig 1). In addition, in Runs 4-6 using KNP mortality schedules the average size of the metapopulation (Fig 3) declined steadily to c. 30. However, when in Run 7, we replaced KNP morality data with the less severe mortality data from Moremi, the average size of the metapopulation stabilised at c. 100. However, even this correction left the simulated metapopulation more extinction-prone than the two real populations that it was supposed to mimic. (It should be noted here that the figures used here were preliminary, and that they were calculated quickly at the workshop from an incomplete data set.)

4. Catastrophes:

Runs 1-7 all suggested a higher extinction rate than we had anticipated. All had used the 8.3% catastrophe rate estimated from the sample at Moremi (with its artificial start-point, see above). We therefore undertook a series of iterations at which catastrophe was set between 0-8%. It became apparent that there was a critical level of catastrophe at somewhere between 3-5%, which became devastating in terms of elevated probability of metapopulation extinction. In effect, reducing this probability from 8% to 3% (i.e., reducing the risk of a pack suffering catastrophe from once every 12 years to once ever 20 years) reduced the risk of metapopulation extinction from c. 10% to c. 1%. We explored this sensitivity analysis between the limits set by the mortality data from KNP and Moremi (Runs 8-14 Moremi mortality; Runs 15-17 KNP mortality). Fig. 4 reveals that the critical threshold at which a catastrophe of this sort (intended to simulate rabies) becomes devastating lies between 3-7% probability of occurrence per year per pack. These catastrophes elevated the probability of metapopulation extinction within 25 years to 7%. Furthermore, each increase in the probability of catastrophe further erodes the eventual population size after 25 years, which we interpret as further evidence that catastrophes are keeping populations well below carrying capacity. Fig 5 illustrates parallel results when using the KNP mortality schedule but, in each case, the impact is more severe.

An initial practical conclusion is that it will be imperative to vaccinate small, managed populations against disease. In the case of rabies, vaccine technology requires this to be repeated annually.

5. Pack Fission

To simulate the opportunity for new packs to be created, as observed in KNP, we modified the conceptual space within our simulation to incorporate 10 sub-units or packs, of which the additional two were initially vacant. Fig 6 reveals that this variant had little impact on either the probability of extinction or the eventual population size in Kruger, whereas using Moremi mortality the population stabilises at a higher level. This effect probably arises because the vacant territories offer dogs the opportunity for dogs to disperse into ranges in which their numbers inevitably start low and are therefore more prone to stochastic misadventure.

6. Catastrophes (Distemper)

The effects of a CDV epizootic were simulated in the eight sub-populations under the two different mortality schedules (see Fig 7). In both cases the probability of metapopulation extinction was increased from 0 to 5% at Moremi and in Kruger it increased from 6% to 19%, and the mean final population size was reduced from c. 90 to c. 70, whereas in Moremi there was no such effect. These results assume that rabies is still in the system, in addition to CDV.

7. Takeoff

The removal of two individuals annually from our simulated metapopulation equates to a total takeoff of six individuals annually from the whole KNP population, and 48 translocees over the whole eight years. Equally, three individuals taken from the 8 packs scales to nine in total over the entire KNP and 72 over the eight-year period. Four individuals annually represent 12 annually from the entire park, and a total of 96 translocees over the eight-year period.

For KNP mortality schedules, capture of two individuals annually for eight years reduced the mean final population size from c. 90 to 82, and the probability of persistence from 95% to 92%. The capture of three individuals annually had a more profound effect: it reduced the mean final population size to 70, and probability of persistence to 88%. When the take-off was increased to four individuals per annum the mean final population size remained at approximately 70, but the probability of persistence plummeted to 80%. However, regardless of the off-take level, when applied to the simulated KNP population with the Moremi mortality schedule, the mean final population sizes were virtually identical at 120 and the probability of persistence did not drop below 95% (see Runs 26-28).

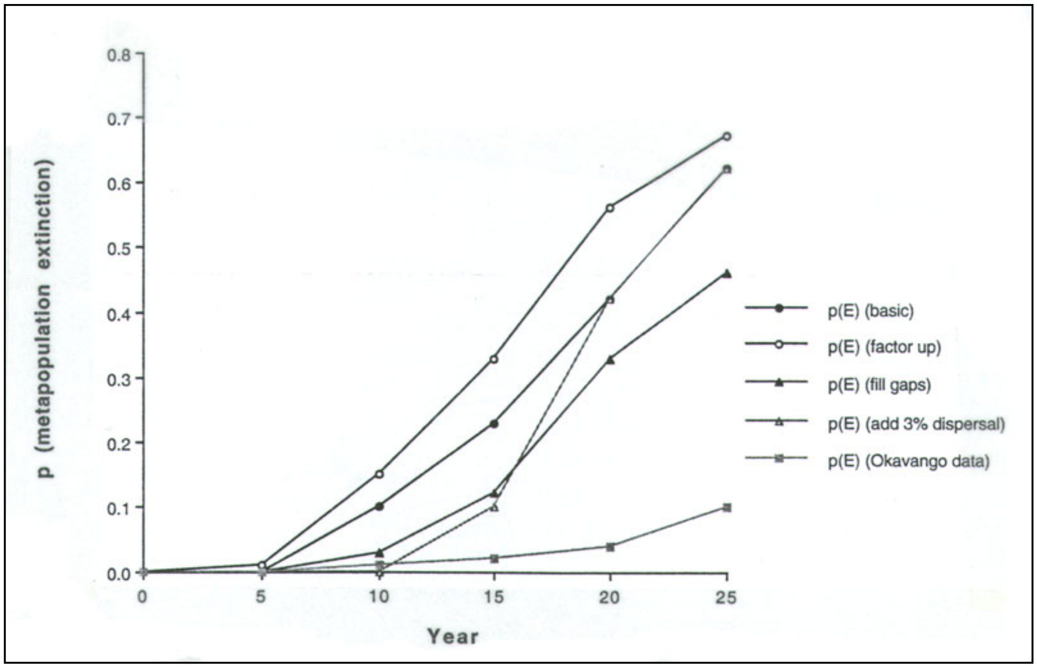


Figure 1. Sensitivity analysis and probability of metapopulation extinction in initial runs of the KNP metapopulations. Parameters were varied to account for errors in initial dispersal estimates and to incorporate Moremi mortality data. Basic = Run 2; Factor up = Run 4; Fill Gaps = Run 5; Add 3% = Run 6; Okavango = Run 7 (see page 61).

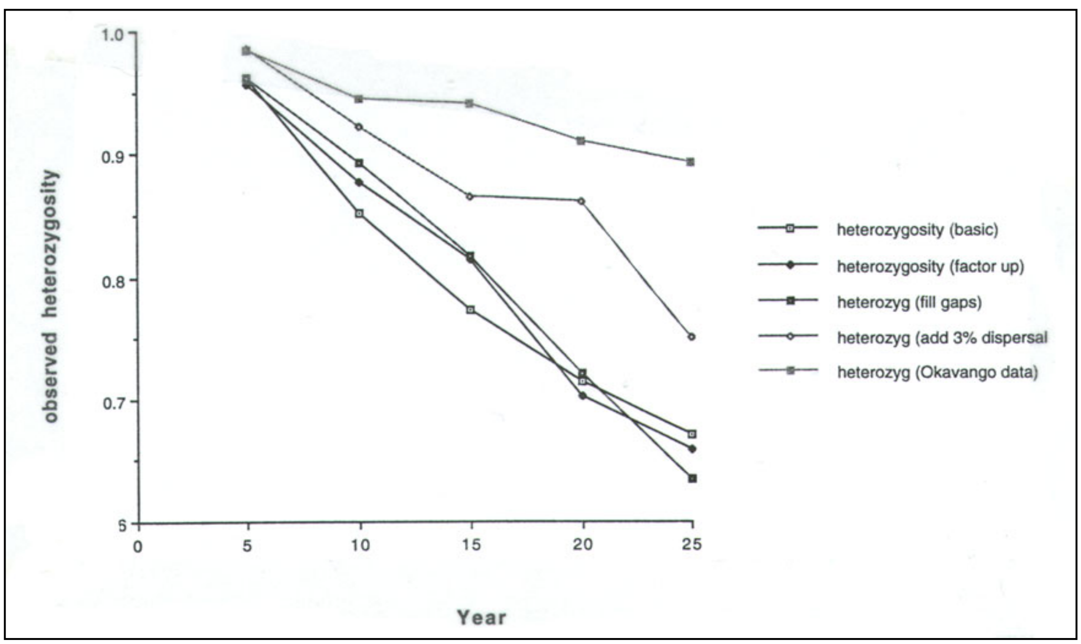


Figure 2. Sensitivity analysis and heterozygosity change over time in initial runs of the KNP metapopulations.

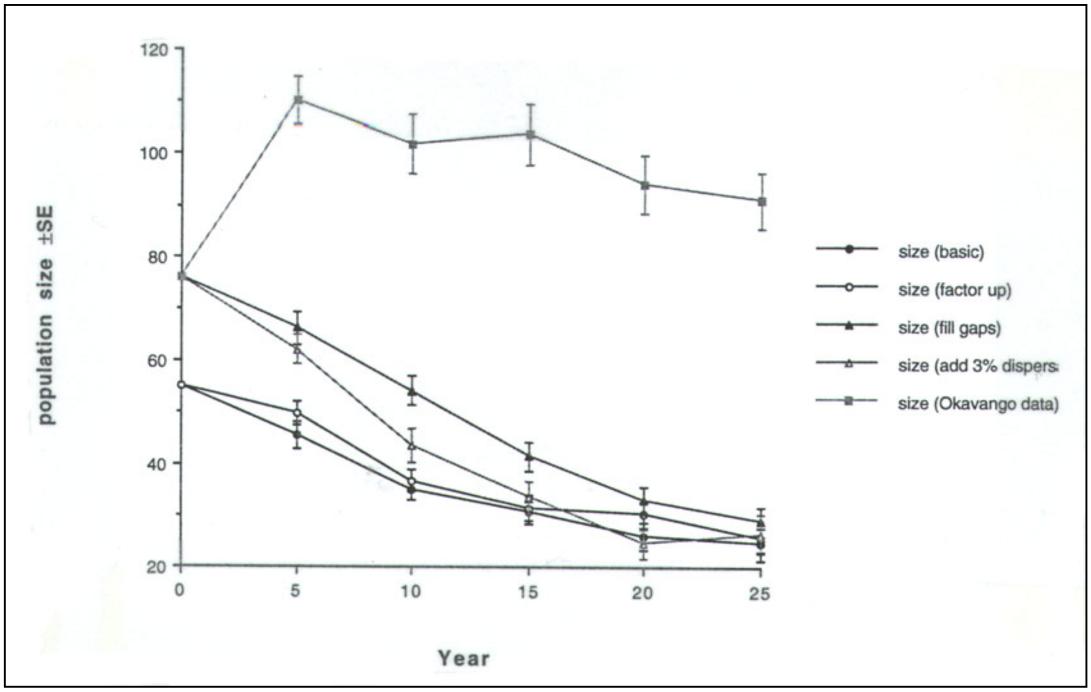


Figure 3. Sensitivity analysis and population size change over time in initial runs of the KNP metapopulations.

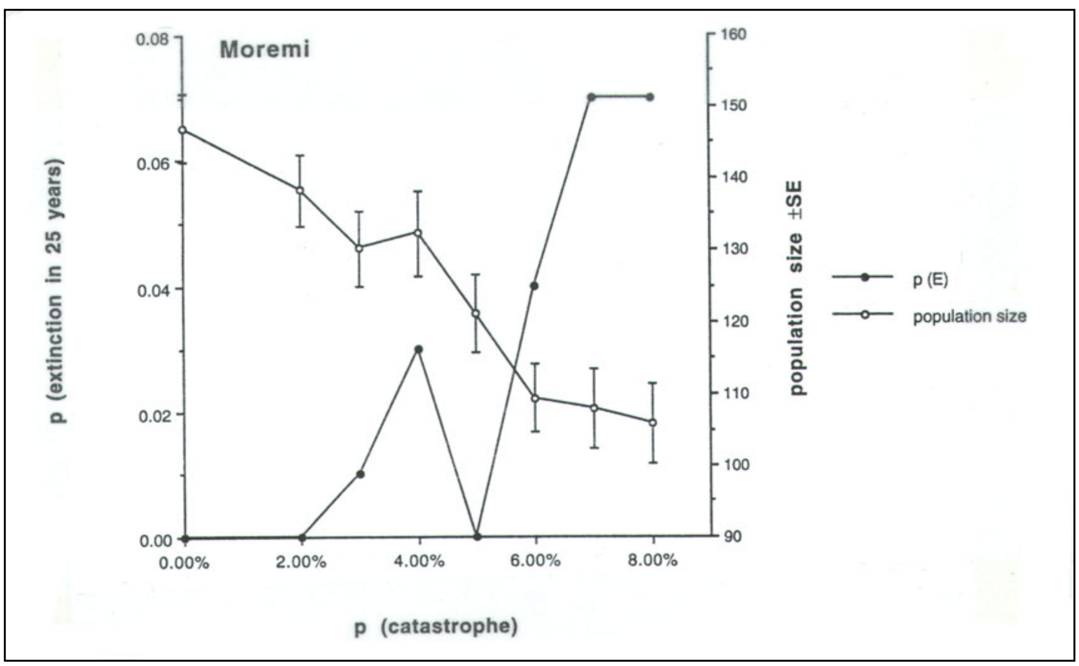
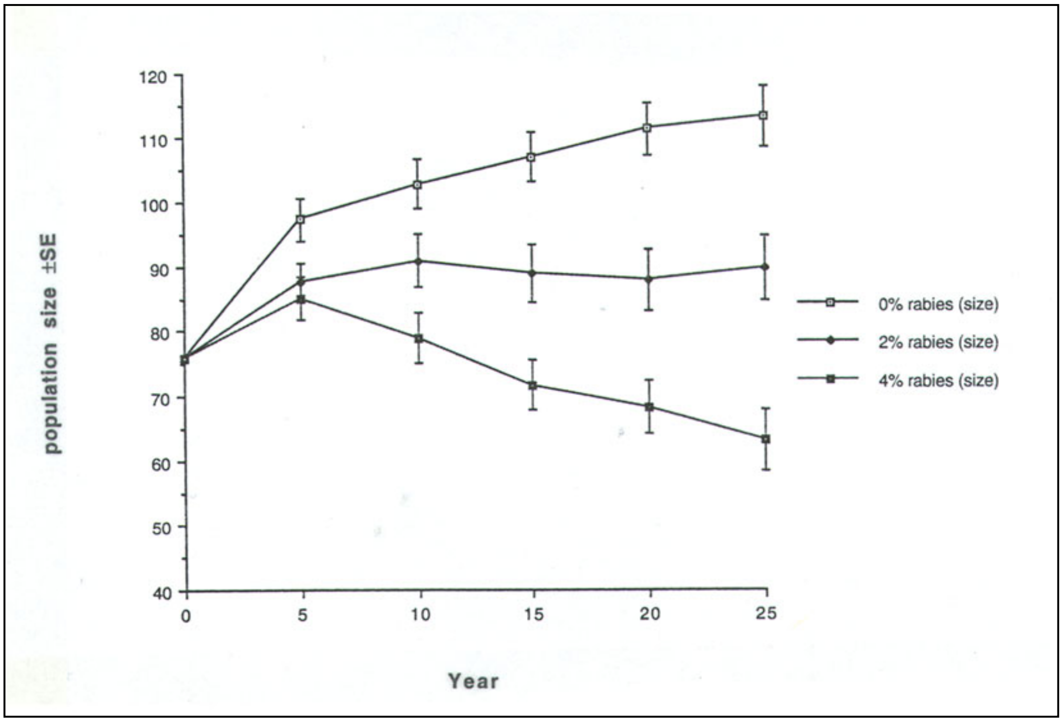
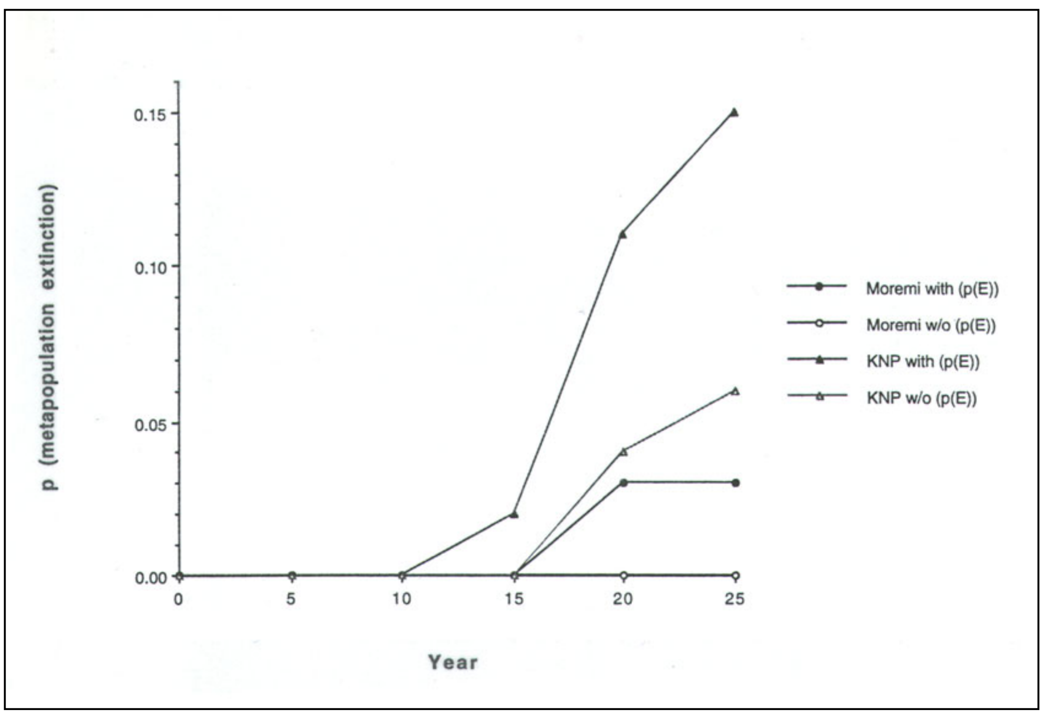
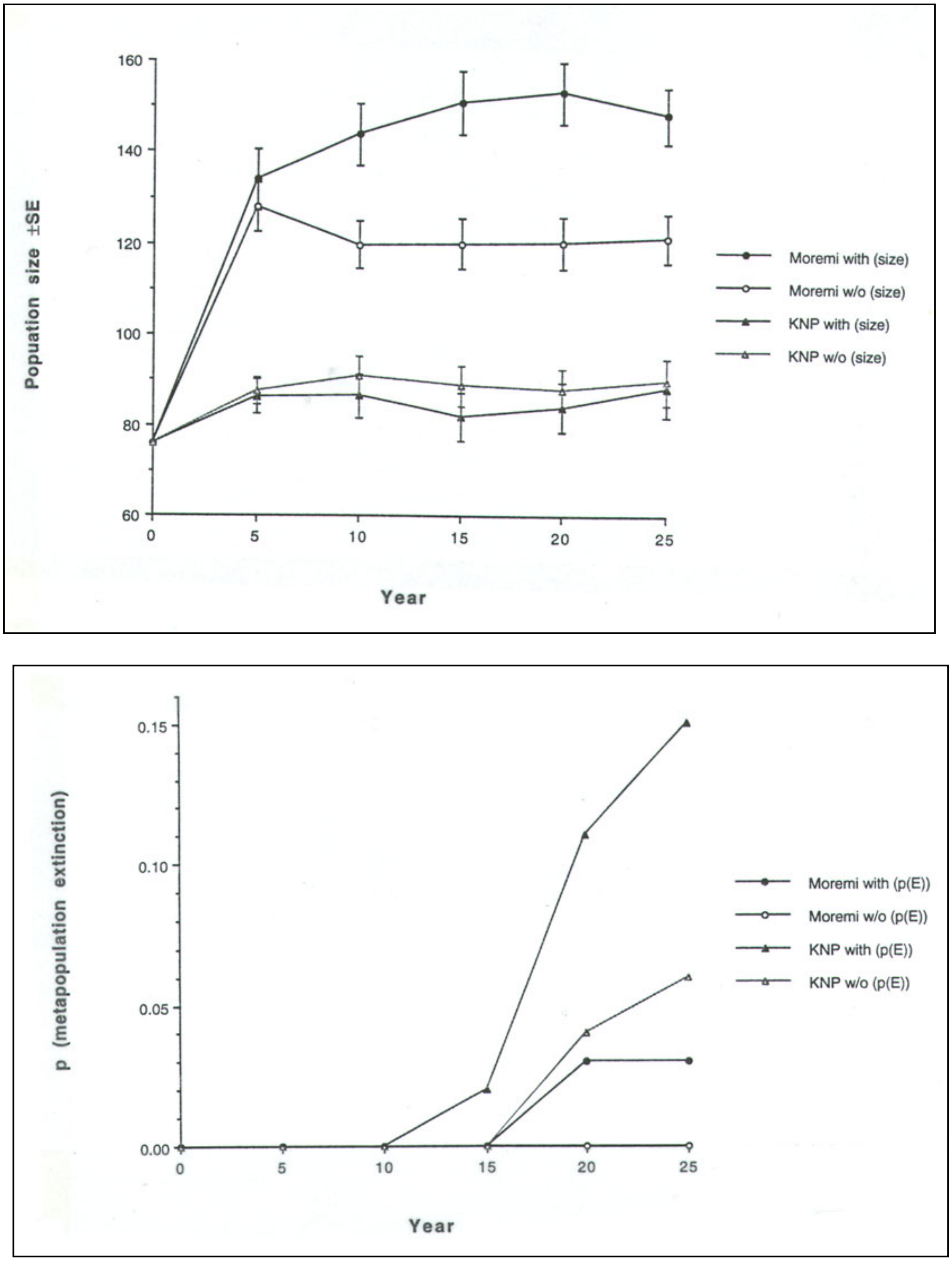


Figure 4. Sensitivity analysis to assess the effects of changing the frequency of catastrophe (to simulate an epizootic) using Moremi mortality data. Runs 8-14 (page 61).

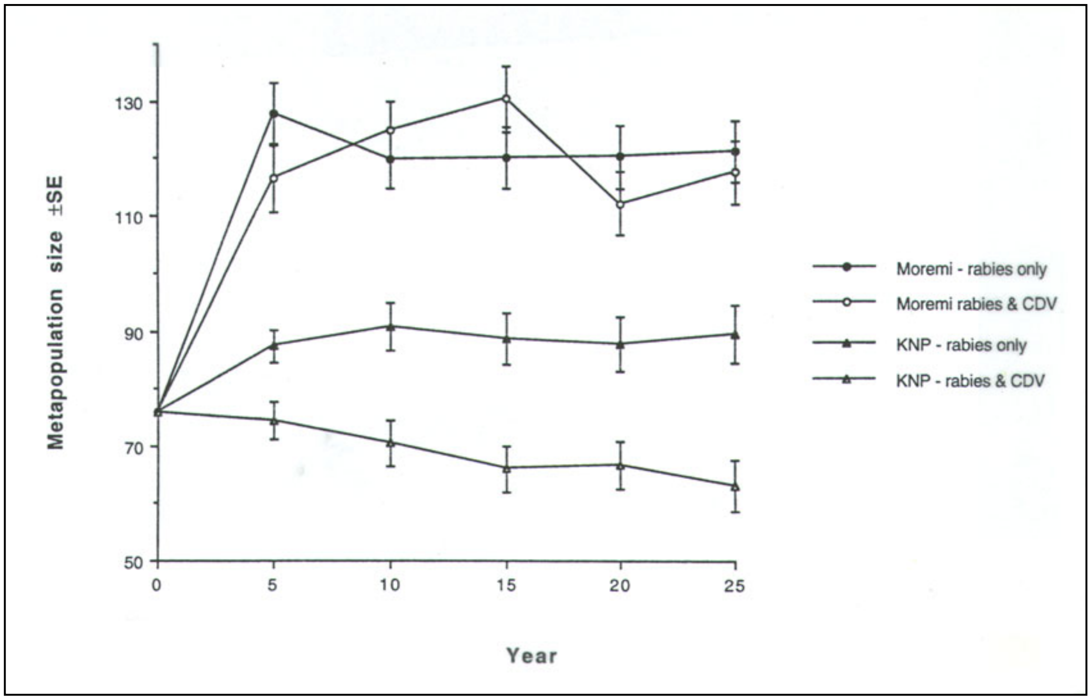


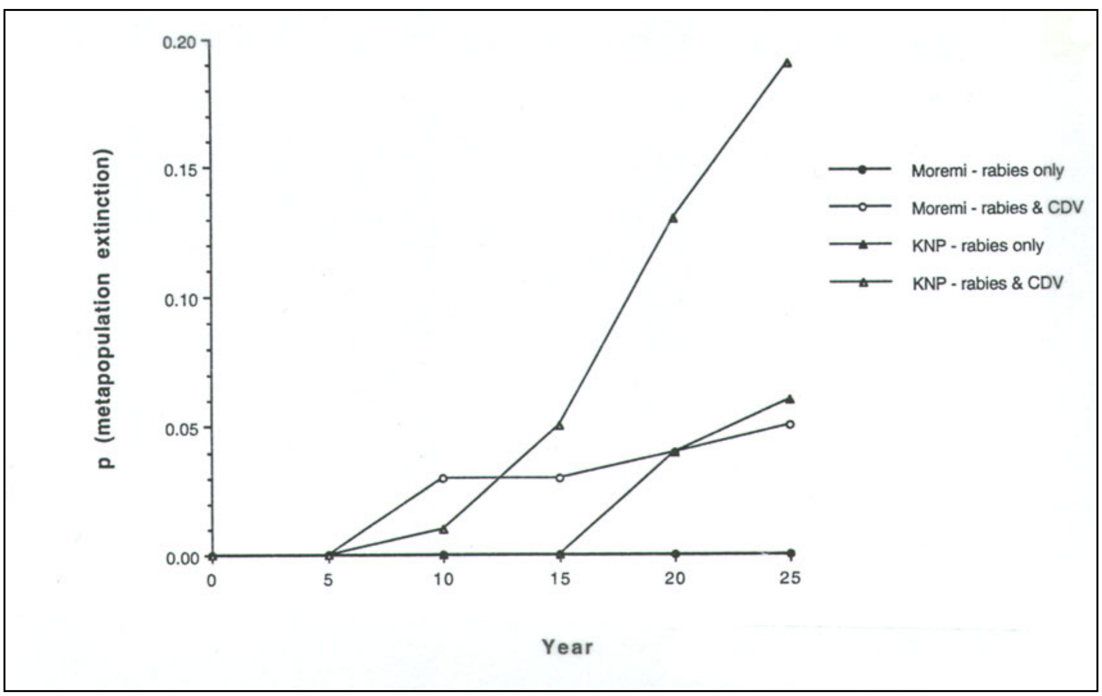


Figures 5a and 5b. Population size and extinction results of the catastrophe sensitivity analysis using KNP data (runs 15-17, page 61).



Figures 6a and 6b. The results of introducing two vacant pack territories on population size and extinction rate in both KNP and Moremi.





Figures 7a and 7b. The results of combining catastrophes simulation both rabies and canine distemper virus on population size and extinction in Moremi and KNP.

8. Single-pack model

In order to create a single-pack model, we abstracted from the eight-pack metapopulation model one sub-population. In a succession of runs we explored the consequences of initial pack size and sex composition varying between a minimum size of one male and one female to a maximum size of four males and three females and vice versa. We assumed that this pack was vaccinated against rabies, that the KNP mortality schedule prevailed, and that all founder members were 3 years old. Furthermore there was neither supplementation nor offtake.

Of those simulated packs that survived the 25-year time course, the mean final population size was between 19-20 and the inbreeding coefficient ranged between 0.3-0.5. With an inverse relationship with initial pack size; probability of pack extinction also varied inversely with initial pack size, ranging between 0.14-0.74.) Note that despite the fact this was a closed system inbreeding was bound to reach high levels, we did not include in the model any measure of inbreeding depression. Therefore our estimates of extinction probabilities are inevitably low. The variance in these single pack simulations after 25 years was sufficiently great that we judged it unhelpful to explore every possible combination of founder membership, and instead, on the basis of guidance from fieldworkers we opted to conduct subsequent runs on simulated packs founded by three yearlings of each sex. Selection of yearlings maximised the reproductive futures of the founding populations. We opted to seed the packs six individuals because our modelling had suggested that this was a sensible compromise that reduced the probability of extinction.

This exploration raised the concern that the model did not adequately address the mitigating effects of gene flow. To redress this we simulated a succession of packs in which we attempted to mimic dispersal and immigration such as may be carried out in future metapopulation management. The combinations of individuals supplemented and removed are shown on page 50 and were selected as plausible management options and we opted for manipulations at five-year intervals to accommodate knowledge of the species' breeding biology.

The results of Runs 50-55 revealed, once again, that those populations that persisted for 25 years had a mean viable population size of c. 20 individuals, however inbreeding was much reduced and ranged between 0.08 in Run 55 (2 females and 5 males exchanged) and 0.14 in Runs 50, 51 and 53. In practical terms the model suggests that effective population management, with manipulations that mimic immigration and emigration at 5 five yearly intervals, can reduce the mean inbreeding coefficient by factors of as much as four within the 25 year span of our simulations. And, it should be noted that manipulating only one sex at a time (e.g., Run 53 and 54a) has a major impact on the probability of persistence (as low as 0.8 when only females are exchanged). Unfortunately, VORTEX does not permit us to alternate the sex of translocees between successive manipulations within a single run. This limitation of the model should not preclude managers from considering such refinements, which, from both genetic and logistic viewpoints, may be desirable.

In conclusion, the results of our model indicate that single packs (representing sub-populations within a metapopulation) can be maintained at desirable levels given realistic levels of manipulation. The crucial intervention that we have modelled is that which mimics the enforced immigration and emigration of pack members, with the primary objective being to reduce inbreeding. These simulations were conducted under conditions intended to mimic vaccination against rabies, but we did not definitively explore the necessity of this condition.

Our conclusions and recommendations are strictly confined to the results of our simulation model. The results of the model led the Working Group tentatively to recommend:

1. The model reveals the importance of mortality schedules and therefore we recommend that a priority for research should be the quantification of mortality factors.

2. Our model reveals that metapopulations comprising only few packs are likely to require management. Putting a precise value on the number of packs below which such intervention is required is beyond the scope of the modelling that has taken place to date. However, the simulations using the model generated here emphatically alert us to the risk of metapopulation extinction as a consequence of even low frequencies (e.g. 8%) of catastrophic loss. Indeed, even populations as large as eight packs may require intervention.

3. Insofar as our metapopulation analysis represents reality, it leads us to recommend that metapopulations even as large as eight packs require management to secure an acceptable level of persistence. This conclusion is in accord with the judgement of field biologists in our working group, and leads us to conclude that in practice it is likely that some intervention will often be required to achieve a satisfactory probability of persistence for metapopulations of eight packs or fewer.

4. We recommend that consistent, periodic managed gene flow (through tranlocations) be implemented to reduce damaging levels of inbreeding and the resulting risks of meta- and sub-population extinction. The model indicated that by using a frequency of exchange based on the natural reproductive life span of wild dogs (up to five years) inbreeding can be reduced by two thirds and population persistence can be assured.

5. Based on this understanding we also recommend that any proposed creation of sub-populations includes a feasibility study to confirm that the necessary level of management to achieve gene transfer is practical.

6. Although our model has not yet definitively explored this, the results are compatible with the conclusion that annual anti-rabies vaccination is likely to increase the probability of persistence and to that extent we recommend that option. Vaccination programmes should be contingent upon further research, using captive animals, to establish vaccination protocols which are both safe and effective.

7. The single pack model also demonstrated that any founding group size from 2 to 7 could persist but that a founding pack of 6 or more reduces the probability of extinction to acceptable levels.

8. Based on our initial eight-pack model which comprised one third of the KNP population, we conclude that an offtake of six animals per years for the next eight years is sustainable, and that an additional six per year may be sustainable under relaxed mortality conditions.

Threats and Diseases Working Group Report

Participants: Pieter Buss, Markus Hofmeyr, Githaiga Kamau, Darryn Knobel, Greg Rasmussen, Joseph van Heerden (facilitator)

The Working Group worked together to define two types of threats to wild dog in southern Africa: those that cause anthropogenic mortalities and those caused by disease.

1. ANTHROPOGENIC MORTALITIES

A. Direct Persecution

Direct persecution of wild dogs as a result of poisoning and or shooting stems from negative attitudes of people towards wild dogs, stock losses from wild dogs and the fact that some people even derive pleasure from shooting / killing wild dogs. Because of a lack of suitable habitat or simply sufficient habitat in southern Africa, dogs are forced into land inhabited by people, which results in conflict.

Solutions

1. Education
   Educating the community at large is of primary importance. Priority targets will be local people in the immediate vicinity of areas utilised by wild dogs, children and nationals. Ways of educating people include:
   a) establishing a resource information network of basic educational material that is country specific and distributed throughout the region. The network will also be used to facilitate expertise sharing.
   b) giving priority to the establishment of a national / international education strategy.
   c) investigating establishment of a national register of wild dogs which must be marketed and "sold" on a national and international basis and becomes public knowledge. This will encourage national and even international ownership of dogs.

2. Compensation
   Ranchers always call for compensation but the high proportion of unproven losses to predators could undermine any sensible compensation scheme. Compensation schemes can also create administrative problems and would require mobile manpower to verify each claim and claims that were not met or verified on time would cause more friction between interested parties. Nevertheless there is a strong argument for some scheme in key zones adjacent to southern African National Parks / Conservancies as packs of dogs operating in the boundaries of unfenced national parks are highly vulnerable to becoming victims of the "vacuum effect". In essence, should a pack be eliminated from a preferred habitat adjacent to the protected area, the next adjacent pack will in all likelihood leave the sanctuary of

the Park to take up part of the home range. This pack will then likely suffer the same fate as the previous pack whose now-vacant home range they are occupying.

As a result of anthropogenic mortalities when dogs leave the Park, even temporarily, there will be a large turnover with resulting population instability. Consequently a 30-km deep *cordon sanitaire* for dogs is highly desirable to increase the effective safe area for packs inside national parks. Another tool, perhaps in such zoned areas, could be for ranchers to insure valuable stock against predation, particularly with pedigreed herds. Premiums could then be reflected by parameters such as management strategies and risk of predation due to proximity to the wildlife area. As a result, rather than "managing the predator", in order to meet regulations set by insurers, such a system could encourage ranchers to adopt an active herd management strategy. Alternatively a sum of money substituting compensation could be paid to all ranchers, as well as perhaps the general community, within the *cordon sanitaire* irrespective of losses.

3. Legislation
   Wild dogs require specially protected status throughout the southern African region. A national register will assist this. A central authority (state veterinarians, police) should be notified of deaths of wild dogs. Legislation is required and control must be increased with respect to the distribution, sale and use of poisons, especially those sold to farmers or landowners.

4. Livestock management
   Measures which show promise in decreasing the predation of livestock should be investigated, including:
   a) promoting farming with indigenous breeds and acclimatised animals. (Rely on the herding instinct of cattle to form a protective circle around calves. Acclimatised cattle are less likely to be intimidated and in particular indigenous breeds as well as resident breeding herds. Fattening stock brought in from outside may not be so well acclimatised to the region, easier stressed and thus likely to sustain higher losses).

   b) promoting the use of a "visually closed" kraal. This may prevent entry into the kraal, as *Lycaon* living on farmlands are particularly wary of entering an area where there is reduced visibility.

   c) promoting "kraaling" at night and herding during daytime. Advantages include: increased vigilance and inter herd proximity, reduced stock theft, increased calf weights at weaning, sick animals or cows with calving difficulties are noticed earlier, bulling power is doubled, infertile bulls can be identified earlier by noticing if the cow(s) recycle, cattle become more manageable with the continual handling thus reducing losses to physical injuries from breakouts, as well as benefits from fewer stress related problems.

5. Creating a value for wild dogs
   Promote co-ownership of dogs and participation in conservation programs.

B. Road Mortalities

Measures to reduce road deaths should include the identification of "hot spots" (areas of road where dogs are killed and once these are identified, the utilisation of road signs which must be incorporated into the highway code); fitting of reflective collars onto members of or entire vulnerable packs*****; education of authorities (police).

▲ African wild dogs traveling across roads, paved or unpaved, are often killed by automobiles.

[***Note**: R. Woodroffe, one of the workshop participants and report editors, voiced a strong objection to this recommendation. Woodroffe requested that a note be added here that the efficacy of reflective collars should be tested prior to use, with the design of a proper experiment including a control group to which no collars are fitted. Such a study also should include a cost-benefit analysis of the benefits of fitting snare collars vs. controlling the snaring itself. The *Wild Dog Action Plan* (Woodroffe *et al.* 1997) notes that handling wild dogs is a difficult, expensive, controversial and potentially dangerous procedure and that it should be kept to a minimum.]

C. Snares

Accidental or intentional (to obtain material for traditional medicine). The effects of snares could be minimised by:
1. Education
2. Anti-poaching patrols (particularly during denning)
3. Fitting of "special" collars

Removing snares from free-ranging animals is time consuming and difficult. Snared animals are invariably wary and difficult to dart. Badly injured animals that may survive in captivity should be considered for relocation to captive breeding / holding centres.

D. Researcher effect

1. Direct problems with immobilisation
   Wild dogs should only be immobilised / anaesthetised for approved research projects incorporating an ethics committee, i.e., immobilisation should be justified. Wildlife researchers immobilising wild dogs must work in collaboration with a veterinarian. The

veterinarian, however, at all times remain responsible for the drugs that s/he may have issued to a non-veterinarian. Wild dogs should preferably be immobilised by a veterinarian (but definitely under veterinary authority) whether for research or management purposes.

Detailed guidelines for immobilisation of wild dogs need to be compiled.

2. Indirect effect
   Researchers must have an understanding of dog behaviour and the change of dominance hierarchy that could occur with disturbance. Only drugs known to be safe on dogs should be used on wild dogs. All drugs should be first tested on captive animals using well-designed research protocols. Collar design must be appropriate for *Lycaon* in accordance with guidelines established by the *Lycaon* Working Party, and, unless there is a justifiable reason, no dog less than 12 months should be collared. If it is essential (for whatever reason) then ample space MUST be left for growth.

   Den localities must be treated with respect and sensitivity. However, it also must be noted that reality dictates that den sites may present the only opportunity a researcher has of collaring a dog, especially in cases where the dogs are not well-habituated. Researchers should aim to work with habituated packs at den sites and with a responsible researcher/guide fully aware of the adverse consequences to the pups if the pack is made to move its den. The same applies to both the adults and pups, as it has been suggested by some that as a result of human presence the pack may leave behind unnecessary babysitters that otherwise could help with hunting. Dogs can be susceptible to predators and thus routine immobilizations and collaring should be carried out during the morning. Appropriate drug selection is essential; immobilisation times should be as short as possible.

When wild dogs are immobilised, the following data should be collected:

1. An identikit should be compiled. Take left and right side photographs.
2. Clinical examination. Note clinical abnormalities
3. Serum sample for haematology as well as future genetic analysis
4. Ectoparasites
5. Faeces for internal parasites
6. Blood smear

<u>Optional specimens</u>

- Blood in heparin and EDTA tubes
- Blood in formalin (1ml in 9ml of 10% formalin)
- Biopsies of relevant tissues for future genetic analysis
- Swabs- culture and antibiogram
- Skin scrapings
- Semen samples: there are currently problems with the collection of semen from immobilised animals. The collection of semen and ova may be considered but currently does not appear to be a viable option.

A complete necropsy should be conducted on any dead animal. If the carcass is fresh, specimens for histopathology should be collected.

2. DISEASE

There currently is no strategy for the control of diseases in wild dogs in southern Africa. There is, however, a need to formulate a strategy to enable wild life managers to cope with disease outbreaks. In view of recent outbreaks of disease in free ranging *Lycaon* as well as the necessity to establish metapopulations, the development of these guidelines is timely. Current management often is not able to cope with disease outbreaks for the following reasons:

a) the concept of a metapopulation is relatively new;
b) managers do not have background in disease or epidemiology or control for that matter;
c) monitoring systems are not in place to detect problems in early stages of crisis or catastrophe.

Disease has been proven to be a major catastrophic cause of reductions in wild dog numbers both in natural and re-introduced populations (e.g., Serengeti, Okavango, and Madikwe). It is therefore clear that disease control and prevention may be of the utmost importance for naturally occurring populations as well as containing reintroduced populations managed under a metapopulation strategy.

A clear distinction, however, must be made between metapopulations and large natural (viable) populations. Large viable populations are represented by the Kruger National Park and Selous populations in a stable and relatively disease-free scenario. Populations (including those that are part of a managed metapopulation) at risk of extinction due to a catastrophic event may be:

a) isolated natural populations that have no immigration taking place, are surrounded by human habitation and where emigration results in ultimate termination of the group, e.g., the Magudu population. Actual numbers of animals should not necessarily be taken into consideration.
b) natural and wild populations which have large areas in which to survive but occur at very low densities, and immigration and emigration takes place at low intervals, e.g., Kaudom Game Reserve / Tsumkwe District, Namibia.
c) introduced populations into "small" reserves; often only very small numbers in 1 or 2 packs.

In large, viable populations no direct disease control for wild dogs should be encouraged. However, effective and ongoing monitoring of wild dog health status needs to be in place. Control and monitoring specifically aimed at anthropogenic causes of death (direct or indirect) is needed(e.g., control of domestic animals in large conservation areas or the close and effective monitoring of potential wildlife disease vectors like jackals and mongooses).

In metapopulations, direct control measures for wild dogs with the above measures should be considered. These are discussed under each specific disease.

The following diseases are regarded as existing or potential problems:
Rabies
Canine distemper
Anthrax
Parvovirus-enteritis
Babesiosis
Ehrlichiosis
Internal parasite infections
External parasites
Sarcoptic mange
Tuberculosis

Rabies and canine distemper are considered the two priority disease threats. They have the potential to have a catastrophic effect on small populations as well as large, stable populations. Therefore, the control and prevention of these two diseases is of the utmost importance. The other diseases are considered less important.

1. RABIES
Priority: Research urgently is needed on the following aspects of rabies.

- vaccine efficacy in wild dogs when using commercially available vaccines.
- vaccination intervals.
- effective routes of vaccination.
- levels of maternal immunity in puppies from vaccinated dams.
- wild life vectors and possible control measures

In light of the lack of knowledge regarding rabies in wild dogs, the following are temporary guidelines that should be considered in the case of a disease outbreak.

Control measures

Preventive measures and health programs directed at domestic (i.e., pet) dogs and cats are vitally important in a zones around conservation areas in which wild dogs occur. These preventative measures and programs should be carried out in conjunction with State veterinarians and Park managers. In addition to more general measures of control, rabies vaccination of domestic animals should be accompanied by vaccination against canine distemper and *Parvovirus-enteritis* and regular treatment for internal and external parasites.* Sterilisation of dogs and cats should be strongly promoted.

[*Note: R. Woodroffe, workshop participant and report editor, requested that a note be added here that from her perspective, control of domestic population numbers is a higher priority than vaccination. Crucially, veterinary care apart from rabies vaccination should not be given to domestic dogs and cats, unless the population is "tiny" and its numbers well controlled. Most of these populations likely will be losing a lot of animals to disease and such care could likely lead to a population increase.]

Within the conservation area the keeping of any dogs or cats should be discouraged. All stray or feral animals within this area should be destroyed. Health care programs for any animals allowed to live within the conservation area should be compulsory and include: regular clinical examinations, vaccination and compulsory sterilisation.

Monitoring for disease needs to be carried out with all potential wildlife vectors in southern Africa. This should include full autopsies in all dead animals, with the appropriate samples being collected. Routine disease surveys utilising blood serum also should be undertaken.

Recommendation
Rabies vaccination should constitute the absolute minimum health program around a conservation area, not only to protect the wildlife species and domestic animals, but also humans in the area.

Control measures in wild dogs

Despite a lack of vaccine trials, there is enough circumstantial evidence to indicate that commercially available rabies vaccines may produce an antibody response and no negative effects have been recorded.

1. *Recommendations for vaccination*
   Annual vaccination by hand. Dart vaccinations are known to be unreliable (e.g., darts may incompletely discharge and pieces of the dart may remain embedded in tissue for a prolonged period). Until further trials have been carried out, dart vaccinations are not recommended. Ideally, vaccination should take place without immobilisation, e.g., capture in boma. Otherwise, the animals should be immobilised, routine health checks performed and samples collected (see protocol for immobilised animals). Oral vaccination is currently not appropriate for use in wild dogs.

   Concurrently, research should be carried out with captive animals to determine the best protocol to be used vaccination (e.g., safety of vaccination by hand vs. dart, examining stress levels in packs captured in bomas). (See page 72, this report.)

2. *Recommendation in case of a disease outbreak*
   Tentative diagnosis should be confirmed as soon as is possible. The population at risk must be monitored closely, even to the extent of putting them in a boma. All animals at risk must be immediately vaccinated. Once a diagnosis of rabies is confirmed, animals showing clinical signs must be euthanized to prevent further exposure of other animals and to reduce the individual's suffering.

All people coming in contact with affected dogs must be vaccinated. The vaccination of all domestic animals in an outbreak is compulsory.

2. **CANINE DISTEMPER**

Most guidelines for the prevention and control of canine distemper are similar to that proposed for rabies. The following aspects are highlighted:

- Research is vitally important to test vaccine efficiency
- The problem with commercially available vaccines is that distemper virus is mainly available as a multiple vaccine.
- Vaccine is a modified live form and there are documented cases of vaccine-induced mortalities in pups. This does not, however, seem to be the case in adult dogs (J. van Heerden, REJ Burroughs).
- Killed vaccines do not appear to stimulate antibody response (based on experiences at Mkomazi and de Wildt).

Guidelines for control in species other than wild dog

- The same principles need to be followed as with rabies.
- Evidence suggests that discontinuation of a vaccination process may make the distemper problem worse rather than prevent it, by allowing a totally naive wild dog population the possibility of being exposed to endemic distemper. In small re-introduced populations, therefore, careful consideration of this must be taken especially because of the possible dangers in vaccinating wild dog. It is therefore strongly suggested that domestic dogs around threatened or small wild dog populations be vaccinated annually against distemper and also parvovirus, rather than the wild dogs. This will serve to reduce exposure of wild dogs to distemper as domestic dogs seem to be the main transmitters of distemper to wild dogs).
- Monitoring of wildlife is critical, especially because of the lack of knowledge on wildlife distemper vectors, i.e., post-mortems, sample collection and diagnosis.

Control measures in wild dogs

- Where it is impossible to vaccinate domestic dogs in surrounding areas and the domestic dogs have access to wild dog territories, it is recommended that the wild dogs be vaccinated. However, the risk of vaccine-induced distemper should be borne in mind.
- Animals at risk of developing the disease from the vaccine, however, should not be vaccinated, i.e., young animals(< 1 year), sick, debilitated, or old animals, or those animals with high parasite burdens.
- If a diagnosis is confirmed, animals with clinical signs should not be euthanized because recovery is possible.
- Supportive therapy should be given to sick animals, especially if the group has been placed in a boma.

The following diseases could cause problems and have been documented but are not necessarily a priority concern. (Note: in small populations like one-pack introductions, etc., contraction of most of these diseases may be serious.)

3. ANTHRAX

- Some deaths in Selous, Kenya, Botswana, and KNP have been attributable to anthrax.
- Anthrax is a potential problem
- Diagnosis must be confirmed (possible via Anthrax protective antigens chromatography assay) – anthrax is difficult to diagnose from a blood smear.
- Once diagnosis has been confirmed in the wild, consideration should be given to the treatment of animals showing clinical signs, as well as those at risk, with long-acting penicillin.
- Vaccination is not necessary

4. TUBERCULOSIS (TB)

- In light of the latest epidemic of tuberculosis in several wildlife species (which are potential prey species of the wild dog), this disease needs to be monitored.
- It is difficult to detect TB in live animals. Routine monitoring of all wildlife species and wild dogs for health status is necessary. Single dogs in a pack which look thin and sick may be an indication of TB.
- Treatment for TB may not be viable or practical.

5. MANGE (Sarcoptic)

- Sarcoptic mange apparently has been diagnosed in Kenya, but not in Southern Africa.
- Health status monitoring in other wildlife species and wild dog for sarcoptic mange is important.
- If animals are found with mange, they should be diagnosed and treated.
- Sarcoptic mange often is an indicator of an underlying disease.
- In small, introduced populations, wild dogs with mange could be treated.

6. PARVOVIRUS

See guidelines with respect to monitoring for canine distemper. Parvovirus never has been diagnosed in free-ranging dogs but seroconversion has been found.

7. BABESIOSIS

Babesiosis is a potential problem. Carrier status has been diagnosed in wild populations and clinical cases have been diagnosed in captive populations. This, however, is rare. Stressed animals may develop clinical signs that should be diagnosed and treated.

8. ERHLICHIOSIS

The threat to wild dogs is not known, but they are susceptible. No antibodies or vectors of *E. canis* have been documented in surveys. Diagnosis is difficult but curative treatment is possible.

9. INTERNAL AND EXTERNAL PARASITES

Internal Parasites

Ancyclostoma caninum (Nematode)
Ancyclostoma caninum has been confirmed to kill captive-bred pups and diagnosed in free-ranging dogs. It should be diagnosed and treated if it is a problem.

Ecchinococcus spp: (Tapeworm)
This parasite is of importance because of the potential danger to humans.

Neospora caninum (Protozoa)
This is a parasite of unknown threat to wild dogs but has been known to cause mortality in dogs in Kruger National Park.

Encephalitozoon cuniculi (Protozoa)
The significance of this parasite is unknown but mortalities have been found in captive pups.

Helicobacter spp: (Bacteria)
The significance of this parasite is not known but has been tentatively diagnosed in stressed dogs.

External parasites

Large ectoparasite burdens usually indicate poor health status and should be investigated.

The Working Group then summarised and prioritised the most important recommendations:

1. There is a need for basic research into vaccination of wild dogs against rabies and canine distemper.

2. Compile guidelines for crises handling of wild dogs.

3. Establish a national / international strategy on education.

4. Establish a resource information network.

5. Insist on legislation granting special protection to wild dogs throughout the Southern African region.

6. Investigate the value of establishing a national register of wild dogs.
7. Compile guidelines for the immobilisation of wild dogs.

8. Compile guidelines on collars for dogs.

9. Promote wild dog friendly stock and management practices.

10. Compile proposals on traffic signs aimed at protecting wild dogs.

Different Group members took responsibility for implementing certain tasks to be carried out immediately. These included:

1. Setting up a research project on vaccination protocols for rabies and distemper in wild dogs, using captive population to develop these protocols.
   Persons responsible: J. van Heerden, M. Hofmeyr, P. Buss

2. Developing guidelines on crisis handling of disease outbreaks in wild dogs.
   Persons responsible: J. van Heerden. M. Hofmeyr, P. Buss, G. Kamau

3. Developing guidelines for immobilisation.
   Persons responsible: J. van Heerden. M. Hofmeyr, P. Buss, G. Kamau

4. Developing guidelines on collars.
   Persons responsible: G. Rasmussen, G. Mills

Population and Habitat Viability Assessment for the African Wild Dog *(Lycaon pictus)* in Southern Africa

Final Report from the Workshop
Held 13-17 October 1997 in Pretoria, South Africa

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Edited by

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Section 3

Appendices

Appendix I.

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Appendix II.

IUCN - THE WORLD CONSERVATION UNION
Re-introduction Specialist Group, Species Survival Commission

GUIDELINES FOR RE-INTRODUCTIONS
(as approved by 41st Meeting of Council, May 1995)

INTRODUCTION

These policy guidelines have been drafted by the Re-introduction Specialist Group of the IUCN's Species Survival Commission, in response to the increasing occurrence of re-introduction projects worldwide, and consequently, to the growing need for specific policy guidelines to help ensure that the re-introductions achieve their intended conservation benefit, and do not cause adverse side-effects of greater impact. Although IUCN developed a Position Statement on the Translocation of Living Organisms in 1987, more detailed guidelines were felt to be essential in providing more comprehensive coverage of the various factors involved in re-introduction exercises.

These Guidelines are intended to act as a guide for procedures useful to re-introduction programmes and do not represent an inflexible code of conduct. Many of the points are more relevant to re-introductions using captive-bred individuals than to translocations of wild species. Others are especially relevant to globally endangered species with limited numbers of founders. Each re-introduction proposal should be rigorously reviewed on its individual merits. It should be noted that re-introduction is **always** a very lengthy, complex **and expensive** process.

Re-introductions or translocations of species for short-term, sporting or commercial purposes - where there is no intention to establish a viable population - are a different issue and beyond the scope of these guidelines. These include fishing and hunting activities.

This document **has been written to encompass the full range of plant and animal taxa and is therefore general**. It will be regularly revised. Handbooks for re-introducing individual groups of animals and plants will be developed in future.

CONTEXT

The increasing number of re-introductions and translocations led to the establishment of the IUCN Species Survival Commission's Re-introduction Specialist Group. A priority of the Group has been to update IUCN's 1987 Position Statement on the Translocation of Living Organisms, in consultation with IUCN's other Commissions.

It is important that the Guidelines are implemented in the context of IUCN's broader policies pertaining to biodiversity conservation and sustainable management of natural resources.

The philosophy for environmental conservation and management of IUCN and other conservation bodies is stated in key documents such as "Caring for the Earth" and the "Global Biodiversity Strategy," which cover the broad themes of the need for approaches with community involvement and participation in sustainable natural resource conservation, an overall enhanced quality of human life and the need to conserve and, where necessary, restore ecosystems. With regard to the latter, the re-introduction of a species is one specific instance of restoration where, in general, only this species is missing. Full restoration of an array of plant and animal species has rarely been tried to date.

Restoration of single species of plants and animals is becoming more frequent around the world. Some succeed, many fail. As this form of ecological management is increasingly common, it is a priority for the Species Survival Commission's Re-introduction Specialist Group to develop guidelines so that re-intro-ductions are both justifiable and likely to succeed, and that the conservation world can learn from each initiative, whether successful or not. It is hoped that these Guidelines, based on extensive review of case-histories and wide consultation across a range of disciplines will introduce more rigour into the concepts, design, feasibility and implementation of re-introduction despite the wide diversity of species and conditions involved.

Thus, the priority has been to develop guidelines that are of direct, practical assistance to those planning, approving or carrying out re-introductions. The primary audience of these Guidelines is, therefore, the practitioners (usually managers or scientists), rather than decision-makers in governments. Guidelines directed towards the latter group would inevitably have to go into greater depth on legal and policy issues.

1. DEFINITION OF TERMS

a) "**Re-introduction**": an attempt to establish a species[2] in an area which was once part of its historical range, but from which it has been **extirpated** or become extinct[3]. ("Re-establishment" is a synonym, but implies that the re-introduction has been successful).

b) "**Translocation**": deliberate and mediated movement of wild individuals to an existing population of conspecifics.

c) "**Re-enforcement/Supplementation**": addition of individuals to an existing population of conspecifics.

d) "**Conservation/Benign Introductions**": an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within an appropriate habitat and eco-geographical area. **This is a feasible conservation tool only when there is no remaining area left within a species' historic range.**

2. AIMS AND OBJECTIVES OF RE-INTRODUCTION

a) **Aims:** The principal aim of any re-introduction should be to establish a viable, free-ranging population in the wild, of a species, subspecies or race, which has become globally or locally extinct, or extirpated, in the wild. It should be re-introduced within the species' former natural habitat and range and should require minimal long-term management.

b) **Objectives**: The objectives of a re-introduction may include: to enhance the long-term survival of a species; to re-establish a keystone species (in the ecological or cultural sense) in an ecosystem; to maintain and/or restore natural biodiversity; to provide long-term economic benefits to the local and/or national economy; to promote conservation awareness, or a combination of these.

3. MULTIDISCIPLINARY APPROACH

A re-introduction requires a multidisciplinary approach involving a team of persons drawn from a variety of backgrounds. As well as government personnel, they may include persons from governmental natural resource management agencies, non-governmental organizations, funding bodies, universities, veterinary institutions, zoos (and private animal breeders) and/or botanic gardens, with a full range of suitable expertise. Team leaders should be responsible for coordination between the various bodies and provision should be made for publicity and public education about the project.

4. PRE-PROJECT ACTIVITIES

4a. BIOLOGICAL

(i) Feasibility study and background research

- An assessment should be made of the taxonomic status of individuals to be re-introduced. They should preferably be of the same subspecies or race as those which were extirpated, unless adequate numbers are not available. An investigation of historical information about the loss and fate of individuals from the re-introduction area, as well as molecular genetic studies, should be undertaken in case of doubt as to individuals' taxonomic status. A study of genetic variation within and between populations of this and related taxa can also be helpful. Special care is needed when the population has long been extinct.

- Detailed studies should be made of the status and biology of wild populations (if they exist) to determine the species' critical needs. For animals, this would include descriptions of habitat preferences, intraspecific variation and adaptations to local ecological conditions, social behaviour, group composition, home range size, shelter and food requirements, foraging and feeding behaviour, predators and diseases. For migratory species, studies should include the potential migratory areas. For plants, it would include biotic and abiotic habitat requirements, dispersal mechanisms, reproductive biology, symbiotic relationships (e.g. with mycorrhizae, pollinators), insect pests and diseases. Overall, a firm knowledge of the natural history of the species in question is crucial to the entire re-introduction scheme.

- The species, if any, that has filled the void created by the loss of the species concerned, should be determined; an understanding of the effect the re-introduced species will have on the ecosystem is important for ascertaining the success of the re-introduced population.

- The build-up of the released population should be modelled under various sets of conditions, in order to specify the optimal number and composition of individuals to be released per year and the numbers of years necessary to promote establishment of a viable population.

- A Population and Habitat Viability Analysis will aid in identifying significant environmental and population variables and assessing their potential interactions, which would guide long-term population management.

(ii) **Previous Re-introductions**

- Thorough research into previous re-introductions of the same or similar species and wide-ranging contacts with persons having relevant expertise should be conducted prior to and while developing the re-introduction protocol.

(iii) **Choice of release site and type**

- The site should be within the historic range of the species. For an initial re-enforcement there should be few remnant wild individuals. For a re-introduction, there should be no remnant population to prevent disease spread, social disruption and introduction of alien genes. In some circumstances, a re-introduction or re-enforcement may have to be made into an area which is fenced or otherwise delimited, but it should be within the species' former natural habitat and range.

- A conservation/benign introduction should be undertaken only as a last resort when no opportunities for re-introduction into the original site or range exist and only when a significant contribution to the conservation of the species will result.

- The re-introduction area should have assured, long-term protection (whether formal or otherwise).

(iv) **Evaluation of re-introduction site**

- Availability of suitable habitat: re-introductions should only take place where the habitat and landscape requirements of the species are satisfied, and likely to be sustained for the foreseeable future. The possibility of natural habitat change since extirpation must be considered. Likewise, a change in the legal/political or cultural environment since the species' extirpation needs to be ascertained and evaluated as a possible constraint. The area should have sufficient carrying capacity to sustain growth of the re-introduced population and support a viable (self-sustaining) population in the long run.

- Identification and elimination, or reduction to a sufficient level, of previous causes of decline: could include disease; over-hunting; over-collection; pollution; poisoning; competition with or predation by introduced species; habitat loss; adverse effects of earlier research or management programmes; competition with domestic livestock, which may be seasonal.

- Where the release site has undergone substantial degradation caused by human activity, a habitat restoration programme should be initiated before the re-introduction is carried out.

(v) **Availability of suitable release stock**

- It is desirable that source animals come from wild populations. If there is a choice of wild populations to supply founder stock for translocation, the source population should ideally be closely related genetically to the original native stock and show similar ecological characteristics (morphology, physiology, behaviour, habitat preference) to the original sub-population.

- Removal of individuals for re-introduction must not endanger the captive stock population or the wild source population. Stock must be guaranteed available on a regular and predictable basis, meeting specifications of the project protocol.

- Individuals should only be removed from a wild population after the effects of translocation on the donor population have been assessed, and after it is guaranteed that these effects will not be negative.

- If captive or artificially propagated stock is to be used, it must be from a population which has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology.

- Re-introductions should not be carried out merely because captive stocks exist, nor solely as a means of disposing of surplus stock.

- Prospective release stock, including stock that is a gift between governments, must be subjected to a thorough veterinary screening process *before* shipment from original source. Any animals found to be infected or which test positive for non-endemic or contagious pathogens with a potential impact on population levels, must be removed from the consignment, and the uninfected, negative remainder must be placed in strict quarantine for a suitable period before retest. If clear after retesting, the animals may be placed for shipment.

- Since infection with serious disease can be acquired *during* shipment, especially if this is intercontinental, great care must be taken to minimise this risk.

- Stock must meet all health regulations prescribed by the veterinary authorities of the recipient country and adequate provisions must be made for quarantine if necessary.

Release of captive stock

- Most species of mammals and birds rely heavily on individual experience and learning as juveniles for their survival; they should be given the opportunity to acquire the necessary information to enable survival in the wild through training in their captive environment; a captive bred individual's probability of survival should approximate that of a wild counterpart.

- Care should be taken to ensure that potentially dangerous captive-bred animals (such as large carnivores or primates) are not so confident in the presence of humans that they might be a danger to local inhabitants and/or their livestock.

4b. SOCIO-ECONOMIC AND LEGAL REQUIREMENTS

- Re-introductions are generally long-term projects that require the commitment of long-term financial and political support.

- Socio-economic studies should be made to assess impacts, costs and benefits of the re-introduction programme to local human populations.

- A thorough assessment of attitudes of local people to the proposed project is necessary to ensure long-term protection of the re-introduced population, especially if the cause of species' decline was due to human factors (e.g. over-hunting, over-collection, loss or alteration of habitat). The programme should be fully understood, accepted and supported by local communities.

- Where the security of the re-introduced population is at risk from human activities, measures should be taken to minimise these in the re-introduction area. If these measures are inadequate, the re-introduction should be abandoned or alternative release areas sought.

- The policy of the country to re-introductions and to the species concerned should be assessed. This might include checking existing provincial, national and international legislation and regulations, and provision of new measures and required permits as necessary.

- Re-introduction must take place with the full permission and involvement of all relevant government agencies of the recipient or host country. This is particularly important in re-introductions in border areas, or involving more than one state or when a re-introduced population can expand into other states, provinces or territories.

- If the species poses potential risk to life or property, these risks should be minimised and adequate provision made for compensation where necessary; where all other solutions fail, removal or destruction of the released individual should be considered. In the case of migratory/mobile species, provisions should be made for crossing of international/state boundaries.

5. PLANNING, PREPARATION AND RELEASE STAGES

- Approval of relevant government agencies and land owners, and coordination with national and international conservation organizations.

- Construction of a multidisciplinary team with access to expert technical advice for all phases of the programme.

- Identification of short- and long-term success indicators and prediction of programme duration, in the context of agreed aims and objectives.

- Securing adequate funding for all programme phases.

- Design of pre- and post-release monitoring programme so that each re-introduction is a carefully designed experiment, with the capability to test methodology with scientifically collected data. Monitoring the health of individuals, as well as the survival, is important; intervention may be necessary if the situation proves unforeseeably favourable.

- Appropriate health and genetic screening of release stock, including stock that is a gift between governments. Health screening of closely related species in the re-introduction area.

- If release stock is wild-caught, care must be taken to ensure that: a) the stock is free from infectious or contagious pathogens and parasites *before* shipment and b) the stock will not be exposed to vectors of disease agents which may be present at the release site (and absent at the source site) and to which it may have no acquired immunity.

- If vaccination prior to release, against local endemic or epidemic diseases of wild stock or domestic livestock at the release site, is deemed appropriate, this must be carried out during the "Preparation Stage" so as to allow sufficient time for the development of the required immunity.

- Appropriate veterinary or horticultural measures as required to ensure health of released stock throughout the programme. This is to include adequate quarantine arrangements, especially where founder stock travels far or crosses international boundaries to the release site.

- Development of transport plans for delivery of stock to the country and site of re-introduction, with special emphasis on ways to minimise stress on the individuals during transport.

- Determination of release strategy (acclimatization of release stock to release area; behavioural training - including hunting and feeding; group composition, number, release patterns and techniques; timing).

- Establishment of policies on interventions (see below).

- Development of conservation education for long-term support; professional training of individuals involved in the long-term programme; public relations through the mass media and in local community; involvement where possible of local people in the programme.

- The welfare of animals for release is of paramount concern through all these stages.

6. POST-RELEASE ACTIVITIES

- Post-release monitoring is required of all (or a sample of) individuals. This most vital aspect may be by direct (e.g. tagging, telemetry) or indirect (e.g. spoor, informants) methods as suitable.

- Demographic, ecological and behavioural studies of released stock must be undertaken.

- Study of processes of long-term adaptation by individuals and the population.

- Collection and investigation of mortalities.

- Interventions (e.g. supplemental feeding; veterinary aid; horticultural aid) when necessary.

- Decisions for revision, rescheduling, or discontinuation of programme where necessary.

- Habitat protection or restoration to continue where necessary.

- Continuing public relations activities, including education and mass media coverage.

- Evaluation of cost-effectiveness and success of re-introduction techniques.

- Regular publication in scientific and popular literature.

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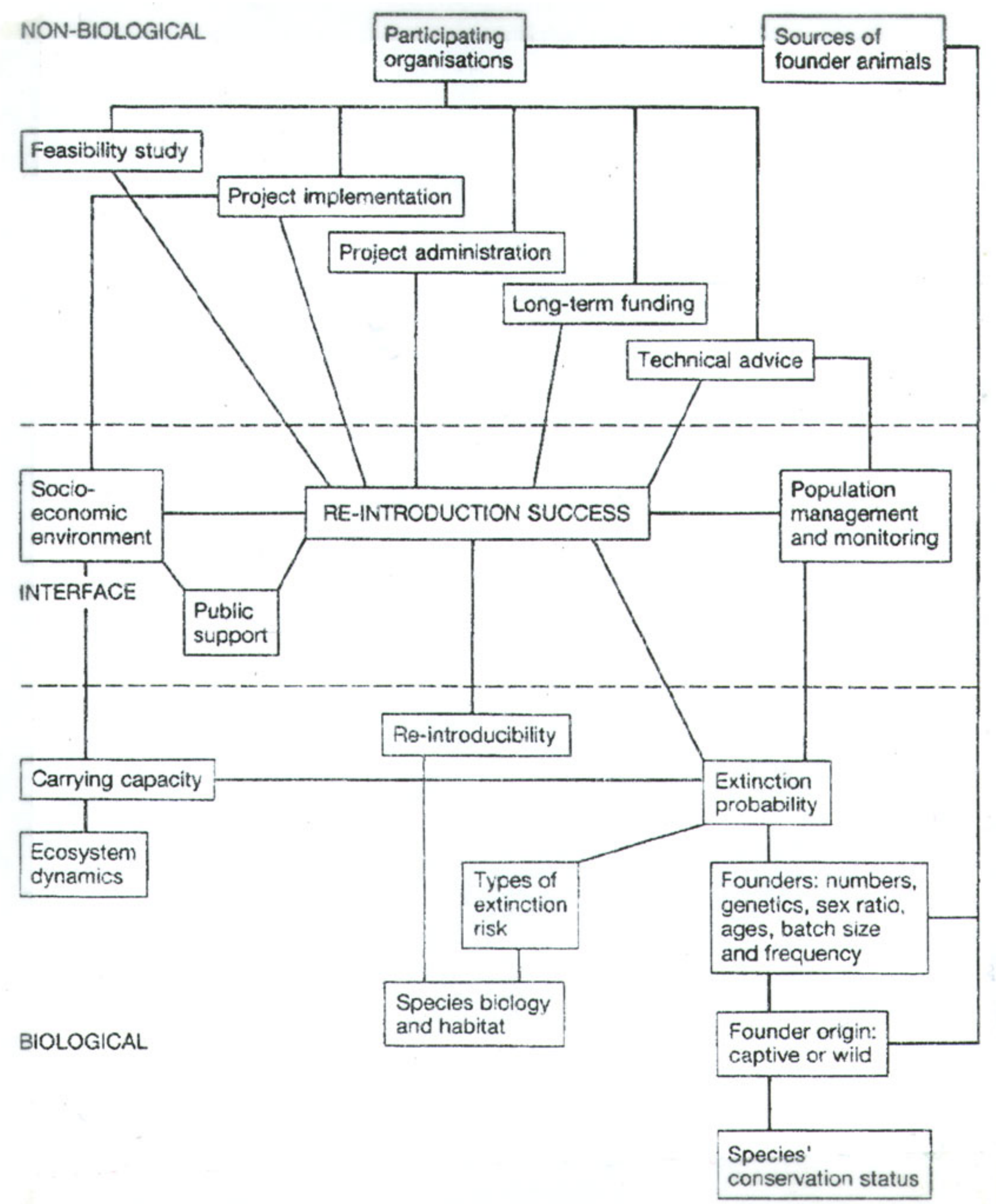
(1) Guidelines for determining procedures for disposal of species confiscated in trade are being developed separately by IUCN.

(2) The taxonomic unit referred to throughout the document is species; it may be a lower taxonomic unit (e.g. sub-species or race) as long as it can be unambiguously defined.

(3) A taxon is Extinct when there is no reasonable doubt that the last individual has died.

Appendix III.

Factors relevant to a successful reintroduction (from Stanley Price 1989).



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