Tools for the conservation of African wild dogs

Do we know enough? What more do we need to know?

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Report of a
Workshop on Research for Conservation of the African Wild Dog
Kruger National Park, South Africa – 25th-29th October 2004

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Executive Summary

The African wild dog is one of the world's most endangered large carnivores. Wild dogs represent a challenge for conservation because they live at low densities and range very widely, so that populations require vast areas to remain viable. Sometimes suppressed by competition with larger predators in wildlife areas, wild dogs also fare poorly in human-dominated landscapes: hence they have persisted only where human density is low, disappearing even from many protected areas.

Threats to wild dog populations

In this report, we reassess the threats to wild dog populations. The ultimate threat to wild dogs is destruction and fragmentation of their habitat due to human encroachment. More immediately, we confirm that deliberate killing by game and livestock farmers, accidental capture in snares, vehicle collisions and infectious disease can undermine the viability of remaining populations. The relative importance of these threats varies regionally, and we note that additional threats may operate in West and Central Africa, where potentially critically important populations remain unstudied.

Tools to protect wild dog populations

We also review the state of knowledge concerning tools to mitigate threats to wild dogs. Effective tools are available to protect wild dogs from some of these threats. Improved anti-poaching activities do appear to reduce *accidental snaring* of wild dogs, and measures such as road signs seem to have helped reduce *road traffic accidents*.

Partial solutions are available to mitigate other threats:

Conflicts with livestock farmers are extremely uncommon where some wild prey remain and where traditional livestock husbandry is still practiced. Further research is needed, however, to determine how, or whether, wild dogs can coexist with livestock where livestock graze unaccompanied by herders (e.g. in much of southern Africa).

Conflicts with game farmers are reduced where 'game' are free to roam across property boundaries and are managed cooperatively; incentives to form such conservancies are likely to promote wild dog conservation but further research is needed to evaluate more immediate efforts to reduce conflict, including the economic benefits of wild dog based ecotourism.

Infectious disease is arguably the least tractable threat because disease dynamics in wildlife are poorly understood. Further research is needed to identify the circumstances under which intervention might be warranted, and to develop the most appropriate interventions (e.g. vaccination protocols).

Where lack of information hinders effective wild dog conservation, we identify specific research questions to be addressed, and nominate teams willing to address them. Some of this priority research has already commenced.

Next steps in conservation planning for wild dogs

The next steps for planning effective wild dog conservation are

- to identify priority areas for conservation action
- to engage with local managers and regional policymakers to plan implementation of conservation activities
- to establish surveying protocols to monitor changes in wild dog numbers and distribution

These activities will be taken forward through continued collaboration between the Wildlife Conservation Society and the IUCN/SSC Canid Specialist Group.

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Chapter 1 – Introduction

1.1 Background

The African wild dog is one of Africa's rarest species and one of the world's most endangered carnivores. Wild dogs represent a challenge for modern conservation because viable populations require vast areas to persist – yet Africa's rising human population offers, in most regions, smaller and smaller areas for wildlife conservation.

Priorities for wild dog conservation were reviewed and collated in 1997 (Woodroffe, Ginsberg & Macdonald, 1997b) and partially updated more recently (Woodroffe, McNutt & Mills, 2004). These reports identified threats to wild dogs, and suggested management solutions based on the best data available at the time. However, few conservation interventions had been carried out specifically for wild dogs at that time, and only very limited insights were available into the most effective tools for wild dog conservation. Hence, the 1997 report in particular gave fairly general management recommendations, but provided much more specific research recommendations intended to develop tried and tested methods to halt or reverse wild dogs' rangewide decline.

This report describes the findings of a workshop on 'Tools for the Conservation of the African Wild Dog' held in October 2004. This Workshop was attended by 29 international experts on wild dogs and threats to wild dogs, and aimed to

- reassess threats to the persistence of wild dog populations
- share new information on the most effective tools for wild dog conservation
- identify remaining gaps in knowledge that hinder effective wild dog conservation
- build a community of experts to help lead future conservation efforts for wild dogs, and to fill gaps in knowledge.

The workshop was jointly organised by the Wildlife Conservation Society (WCS) and the IUCN/SSC Canid Specialist Group (CSG) and hosted by South Africa National Parks (SANParks) in Kruger National Park, South Africa. The assembled group constituted the core of the CSG Working Group on African Wild Dogs.

1.2 Wild dog ecology and conservation

African wild dogs are cursorial predators. They can occupy a range of habitats from montane forest to semi-desert and hence were formerly distributed throughout sub-Saharan Africa, absent only from the lowland forests of the Congo basin (Fanshawe, Frame & Ginsberg, 1991). Wild dogs are intensely social, hunting, breeding and even dispersing in close cooperation with other pack members (Creel & Creel, 2002; Malcolm & Marten, 1982; McCreery & Robbins, 2001; McNutt, 1995). Hence packs, rather than individuals, are arguably the most appropriate measure by which to count wild dog populations.

Wild dogs' decline reflects the expansion of human populations; they have persisted only in areas where human densities are low and have even disappeared from all but the very largest protected areas (Woodroffe, 2000; Woodroffe & Ginsberg, 1998, 1999a). Wild dogs' vulnerability to local extinction appears to stem from their unusual ecology: they live at low population densities and each pack ranges very widely, even where prey is abundant. Available data indicate that this wide ranging behaviour is a way of avoiding competition with larger carnivores, particularly lions which reach high densities in prey-rich areas yet may kill wild dogs when they encounter them (Creel & Creel, 1996; Mills & Gorman, 1997). Low population densities mean that even wild dog populations occupying large areas comprise relatively few individuals, and large home ranges mean that even animals which spend much of their time in large protected areas are often exposed to – and threatened by – human activities on reserve borders. Hence, while the ultimate threat to wild dogs identified in the 1997 Action Plan was destruction and fragmentation of habitat through human encroachment, this process generates proximate threats including deliberate killing by livestock and game farmers, accidental capture in snares, road accidents, and infectious diseases possibly transmitted from domestic dogs.

Wild dogs have disappeared from much of West and Central Africa, and the largest remaining populations are in southern Africa and the southern parts of East Africa. Much of what is known about wild dog ecology comes from southern Africa, and from inside large reserves. To date, there have been very few studies of wild dogs outside reserves, and no intensive studies at all in West or Central Africa.

Figure 1.1 *– Workshop participants, Kruger National Park, October 2004. From left to right: front row Jonna Mazet, Kellie Leigh, Kim McCreery, Amy Dickman, Rosie Woodroffe; second row Greg Rasmussen, Linda Munson, Fred Bercovitch, Benjamin Andulege, Harriet Davies-Mostert, Micaela Szykman, Bob Robbins, Pat Fletcher, Anne Carlson, Markus Hofmeyr; back row Claudio Sillero-Zubiri, Karen Laurenson, Gus Mills, J.W. (Tico) McNutt, Maurus Msuha, Pete Coppolillo, Jean-Marc André, Peter Lindsey, Robin Lines, Alistair Pole, Megan Parker, Matt Swarner, Lucy Kemp.*

1.3 Scope of this report, and how to read it

This report falls into three main sections.

The first, Chapter 2, reassesses threats to wild dog populations based on new data collated since publication of the 1997 Action Plan. This reassessment was carried out to ensure all current threats were discussed and documented.

The second section, Chapters 3-9, assesses available tools to mitigate these threats. This report does not aim to provide exhaustive guidelines on techniques for the conservation and management of wild dogs. Rather, it outlines approaches that have been taken, or might be taken, to conserve wild dogs, briefly summarises their known (or expected) effectiveness, and where possible provides reference to sources of further information. It then evaluates whether sufficient information is available to provide good, scientifically based, advice to conservation managers.

These evaluations are based upon discussions held at the Kruger Workshop. Where insufficient information is available, clear priorities for further research are presented with, where possible, specific people or organisations nominated to take the lead on pursuing these necessary studies. In addition, each chapter lists workshop participants with specific experience or expertise in dealing with the particular issue under discussion. For each issue, a coordinator is nominated (see Chapter 9). Those concerned with specific issues are encouraged to contact these experts; their contact details are provided in Appendix 2.

The third substantial section of the report, presented in Appendix 1, provides abstracts of the talks presented at the meeting. These give additional information and are cross-referenced, where appropriate, in the main text of the report.

1.4 Acknowledgements

Preparation of this report, and the Workshop it stems from, were both very much team efforts. However RW would especially like to thank several individuals and organisations for their contributions. The Workshop was organised jointly by the Wildlife Conservation Society and the IUCN/SSC Canid Specialist Group, and James Deutsch, Graeme Patterson, Pete Coppolillo, Monica Wrobel and Louis D'Souza at WCS, David Macdonald, Claudio Sillero-Zubiri, Gus Mills and Tico McNutt of CSG, and Josh Ginsberg and Megan Parker (associated with both) all helped with arranging this. Wilderness Safaris provided additional sponsorship which kept the meeting running smoothly.

Gus Mills and SANParks, assisted by Lucy Kemp and Harriet Davies-Mostert, hosted the workshop and organised most of the logistics. Merle Whyte provided excellent catering. Workshop sessions were ably chaired by Gus Mills, Tico McNutt, Pete Coppolillo, Claudio Sillero-Zubiri, Anne Carlson, Megan Parker, Karen Laurenson and Kim McCreery and recorded by the sharp wits and nimble fingers of Megan Parker, Anne Carlson, Matt Swarner, Amy Dickman, Jonna Mazet, Pete Coppolillo, Peter Lindsey and Harriet Davies-Mostert. Many thanks to all.

***Figure 1.2** – Coordinators of the CSG Working Group on African Wild Dogs, J.W. (Tico) McNutt and Rosie Woodroffe, at the Kruger workshop*

Chapter 2 – Reassessing threats to wild dog populations

Summary
The ultimate threat to wild dogs' persistence is the destruction and fragmentation of wildlife-friendly habitat. Reassessment of more proximate threats to wild dogs indicates that

- *deliberate and accidental killing by people (e.g. snaring, shooting, road kills) are important causes of mortality both inside and outside reserves. Human caused mortality occurs in addition to natural mortality outside reserves, and may also be additive inside*
- *the importance of infectious disease might be under-estimated by current monitoring programmes; steps have been taken to improve evaluation of disease risks in populations of different sizes and levels of protection*
- *predation is an important cause of mortality but is considered a natural process, not a threat*

These findings indicate that the focus of subsequent chapters on snaring, conflicts with game and livestock farmers, road and rail accidents, and infectious disease, are appropriate.

2.1 Introduction

Effective conservation of any species depends upon correctly identifying the threatening processes which cause decline or hinder recovery. Only by identifying these threats can the most appropriate conservation activities be determined (Caughley, 1994). Therefore, the first step in evaluating tools for wild dog conservation was to determine whether all of the relevant threats were being discussed.

Threats to the persistence of African wild dogs were last formally assessed during preparation of the 1997 Action Plan (Woodroffe *et al.*, 1997b). However, it was recognised at that time that threatening processes are dynamic. For this reason Ginsberg *et al.* (1997b) recommended that monitoring should continue at established long-term sites to identify new threats that might emerge and to determine whether old threats were still relevant. Most such monitoring has indeed continued; moreover, several other projects have commenced, in diverse areas, since that time. The 2004 meeting provided an opportunity to re-evaluate threats to wild dogs, using updated data from a larger sample of areas.

2.2 Where to start?

The ultimate threat to wild dogs is from destruction and fragmentation of wildlife-friendly habitat, associated with human encroachment (Woodroffe, 2000; Woodroffe *et al.*, 1998, 1999a). This threat must be addressed by land use planning at the very largest scale, which would most likely require multinational collaboration. Policy initiatives likely to maintain and, where possible, expand the size and connectivity of large wildlife areas have very high priority for wild dog conservation (See Section 9.5). Effectively conserving wild dogs within such landscapes, however, demands insights into the proximate threats that undermine the viability of remaining wild dog populations.

Several PVA analyses (Ginsberg & Woodroffe, 1997a; Mills *et al.*, 1998; Vucetich & Creel, 1999) have highlighted the pivotal rôle played by adult mortality in determining the persistence of model wild dog populations. A more recent analysis, using a different form of sensitivity analysis, suggested that pup mortality might be as important as, or even more important than, adult mortality (Cross & Beissinger, 2001), and in-depth demographic analysis from three well-studied populations tends to confirm these findings (Creel, Mills & McNutt, 2004). Hence, consideration of the factors contributing to wild dog mortality is a valuable starting point to evaluate proximate threats to the persistence of populations. Such analyses must, however, take account of two caveats. First, just because a factor causes mortality does not mean that it is a threat. All animals have to die of *some* cause, and factors which cause mortality, even if they are anthropogenic, may have no effect on population viability if they simply kill animals that would otherwise have died of other causes. Second, because causes of mortality vary from place to place, conclusions will be influenced by the locations where wild dogs are under study. For example, it would not be possible to extrapolate threats to wild dogs outside protected areas on the basis of causes of mortality measured in the interior of a large reserve. Likewise, threats affecting well-studied populations in southern and East Africa may not apply to important but un-studied populations in Central and West Africa. Despite these caveats, consideration of rates and causes of mortality in current study populations is at least a first step in identifying factors that could threaten wild dog populations.

2.3 Methods

We collated data on rates and causes of mortality from eight areas where wild dogs were the subject of long term study (Table 2.1, Figure 2.1). Researchers at each site contributed raw data on the date individual wild dogs were first radiocollared (or first individually identified for uncollared dogs), whether collared (or identified) inside or outside a protected area, and either the date that monitoring of these animals ceased (e.g. due to collar failure, dispersal from the study area, or completion of the study), or the date that they were confirmed dead. These data were used to estimate rates of mortality in each area (and in all areas combined) using an extension of the Kaplan-Meier procedure to permit staggered entry of animals (Pollock *et al.*, 1989). We compared mortality rates between different categories of wild dogs (e.g. those collared inside *vs* outside protected areas) using a log-rank test, which gives a test statistic distributed as χ^2 (Pollock *et al.*, 1989). Given the comparatively small size of the sample, we made no attempt to investigate effects of adult dogs' age or rank on rates or causes of mortality.

For study animals that were confirmed dead, cause of death, or suspected cause of death, was reported where this was known. In a small number of cases, more than one factor appeared to have contributed to a death – e.g. one wild dog was killed by hyaenas many months after losing a leg to a snare. In these cases, mortality was attributed to the ultimate cause of death (hyaenas in the example given); the number of such instances was sufficiently small that it is very unlikely that attributing causes of death in other ways would influence the overall conclusions.

Mortalities were classified as human-caused (e.g. road accident, snared, shot) or natural (e.g. predation, intraspecific aggression, hunting injury). Deaths due to infectious disease were classified separately since some infections (e.g. anthrax) are natural whereas others (e.g. rabies, distemper) can be contracted from domestic dogs and might thus be ultimately human caused. The location of each death (inside/outside protected area) was also reported. Several studies also reported causes of mortality for animals found dead that had not been previously identified and were not under intensive study.

Study Area	protected?	years	Number of study animals *radiocollared*	 *uncollared*
Kruger NP, South Africa	yes	1989-2004	89	292
Hluhluwe-iMfolozi Park, South Africa	yes	1997-2004	7	53
Venetia Limpopo Reserve, South Africa	yes *(private)*	2002-4	9	21
Marakele NP, South Africa	yes	2002-4	4	26
Lower Zambezi NP, Zambia	yes	2000-4	4	42
Hwange NP and nearby unprotected lands, Zimbabwe	partly	1990-2004	79	9
Savé Valley Conservancy, Zimbabwe	yes *(private)*	1996-2004	3	38
Samburu & Laikipia Districts, Kenya	no	2001-4	26	0

***Table 2.1** – Studies contributing data to the analysis of rates and causes of mortality. Note that the number of animals under study does not equate to the number of animals dying (reported in Table 2.2) due to collar failure, dispersal of animals from study areas, and disappearance.*

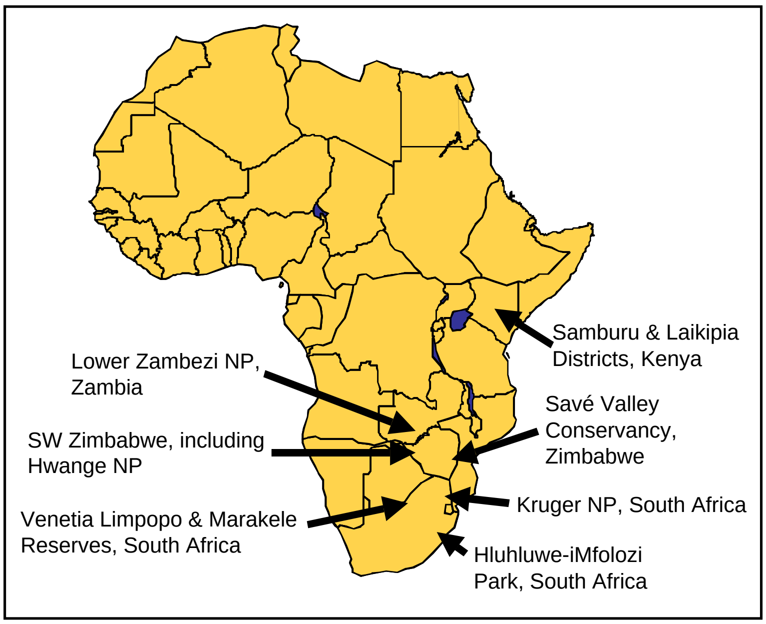


***Figure 2.1** – Locations of study areas contributing data on rates and causes of mortality*

2.4 Results

2.4.1 Causes of adult mortality

Causes of mortality recorded across the eight studies are shown in Table 2.2. Preliminary examination of these data would suggest that human causes are the most important contributor to wild dog mortality, a conclusion reached by Woodroffe & Ginsberg (1997a) based on a largely separate dataset. However, substantial differences between causes of mortality subjected to different levels of monitoring suggest that this simplistic conclusion may be influenced by reporting bias. Overall, the proportion of human-caused mortality appears to increase as the intensity of monitoring declines, with a high proportion of non study animals apparently killed by people, but a far smaller proportion of radio-collared dogs dying in this way (Figure 2.2). Uncollared members of study packs show intermediate numbers of human-related deaths (Figure 2.2).

Cause	Number of deaths recorded collared	not collared	not study animal	Total
natural causes				
natural injury	9 (8%)	9 (9%)	1 (2%)	19 (7%)
other wild dogs	12 (11%)	1 (1%)	0 (0%)	13 (5%)
predator	14 (13%)	7 (7%)	4 (8%)	25 (10%)
disease	5 (5%)	2 (2%)	3 (6%)	10 (4%)
human causes				
road/train accident	6 (5%)	4 (4%)	18 (34%)	28 (11%)
shot/speared	10 (9%)	18 (18%)	2 (4%)	30 (11%)
poisoned	1 (1%)	7 (7%)	14 (26%)	22 (8%)
snared	18 (17%)	29 (29%)	4 (8%)	51 (19%)
unknown	33 (31%)	24 (24%)	7 (13%)	64 (24%)
TOTAL	108	101	53	262

Table 2.2 *– Causes of mortality recorded in the eight studies*

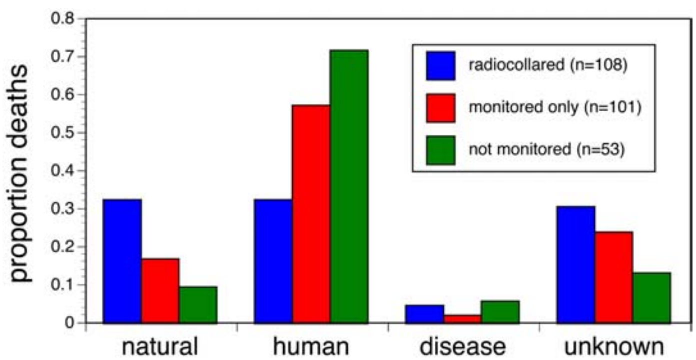
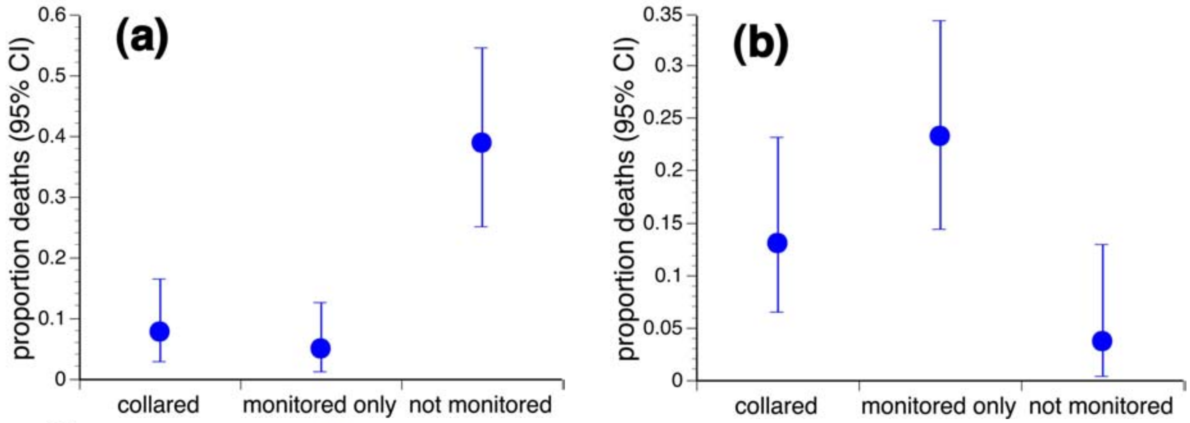


Figure 2.2 *– Causes of mortality among adult wild dogs subject to varying levels of monitoring*

It seems likely that various forms of mortality may be over- or under-reported in dogs that are not systematically located. In particular, road traffic accidents account for a far higher proportion of deaths recorded among non-study animals than those in monitored packs (Figure 2.3 (a)). This is almost certainly because wild dogs killed on roads are conspicuous and hence likely to be reported. In contrast, shooting and spearing, and snaring, may be under-reported as comparatively few deaths of non-study animals are attributed to these causes (Figure 2.3 (b),(c)).

Wild dogs that are radio-collared can be, and usually are, located when they die irrespective of the cause or location of the mortality. Hence data from these animals probably provide the least biased estimate of mortality causes. While it has been proposed that radiocollared wild dogs may have experienced higher mortality than uncollared dogs in the Serengeti ecosystem (Burrows, Hofer & East, 1994, 1995), this trend has not been found elsewhere (Ginsberg *et al.*, 1995). Conversely, it has been suggested that radiocollars may provide some protection against snaring and hence might underestimate the importance of this mortality cause (the data in Figure 2.3 (c) suggest a trend in this direction but the confidence intervals show no significant effect). Given the high probability of biases in the data from uncollared dogs, and the substantially smaller probability of bias in data gathered from collared animals, subsequent analyses of mortality rates and causes are restricted to radio-collared animals.



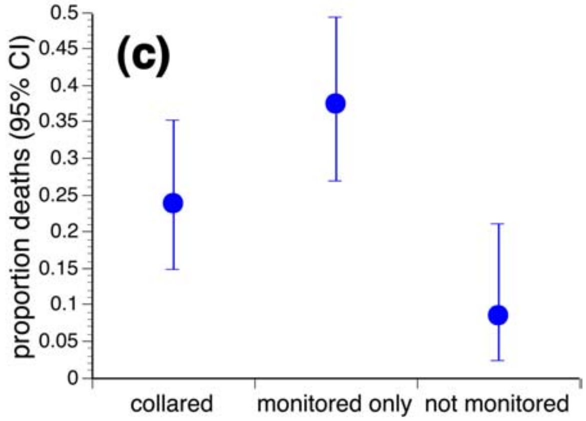


Figure 2.3 *– Proportions of adult wild dog deaths attributed to (a) road and train accidents (χ^2=31.1, d.f.=2, p<0.0001); (b) shooting and spearing (χ^2=9.8, d.f.=2, p=0.007); and (c) snaring (χ^2=12.8, d.f.=2, p=0.0016).*

2.4.2 Causes of mortality in radio-collared adult wild dogs

Restricting analysis entirely to radio-collared wild dogs indicates that 32% of adults are recorded to die from anthropogenic causes, precisely the same proportion as die from natural causes (Figure 2.5). However, almost the same proportion die of unknown causes (Figure 2.5). The majority of these animals are found dead inside protected areas. Anthropogenic causes, particularly shooting and poisoning, may be less likely to occur in these areas (though snaring and road accidents certainly do occur). This raises the possibility that deaths due to natural causes (e.g. predation, intraspecific strife), and also infectious disease (which may be a natural or an anthropogenic cause, depending on the source of the infection) might be under-estimated in this dataset. Better data would allow a more confident assessment of the relative importance of particular mortality causes.

Figure 2.4 *– Wild dog dead from unknown causes in northern Kenya. It is very difficult to determine cause of death from such a decomposed carcass (photograph © Rosie Woodroffe)*

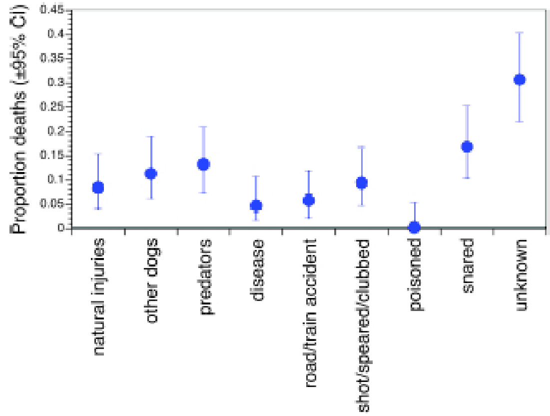


Figure 2.5 *– Causes of mortality recorded among radio-collared adults in eight study areas*

2.4.3 Regional variation in the importance of mortality causes

There is regional variation in the importance of particular causes of wild dog mortality. Most striking is the variation in the importance of snaring, which is the most important cause of mortality in some areas, and never recorded in others (Figure 2.6), despite comparable sample sizes. This almost certainly reflects local variation in the prevalence of hunting wild ungulates using snares.

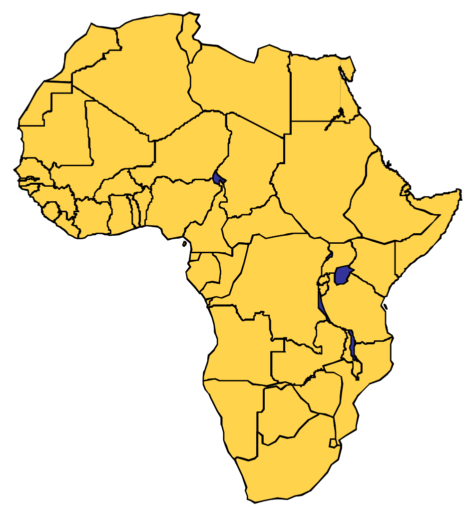


Figure 2.6 *– Regional variation in the importance of snaring as a mortality cause. Pie charts indicate (in red) the proportion of deaths of radio-collared adult wild dogs caused by snares. Results from uncollared study animals are similar, except that four of 33 uncollared dogs in Kruger died of snare wounds, in comparison with none of 41 collared dogs. Data from Venetia and Marakele (in South Africa) are combined.*

2.4.4 Rates and causes of mortality inside and outside protected areas

Of 78 adult wild dogs radio-collared inside protected areas, 16 (21%) died outside. Of course, this is influenced by the size and shape of the protected areas under study.

Data suggest that the annual adult mortality rate recorded among wild dogs radio-collared inside reserves might be lower than that experienced by those collared outside, although the differences are not statistically significant either when all data are combined (inside: 28.0%, 95% confidence interval 22.8-33.8%, outside: 32.0%, 95% confidence interval 22.4-42.9%, log rank test χ^2=1.73, d.f.=1, p=0.19), or considering only the study area where wild dogs were collared both inside and outside the same protected area (in and around Hwange National Park, Zimbabwe, inside: 24.1%, 95% confidence interval 16.3-33.4%, outside: 32.3%, 95% confidence interval 20.6-46.0%, log rank test χ^2=2.21, d.f.=1, p=0.14). A larger sample size might detect a significant trend; additional data are needed to be confident of this pattern. Note that this analysis is based upon the locations where dogs were collared, rather than where they died, because calculation of mortality rates entails using data also on survival, and there is no way to classify animals as having died inside or outside a reserve if they did not die during the monitoring period.

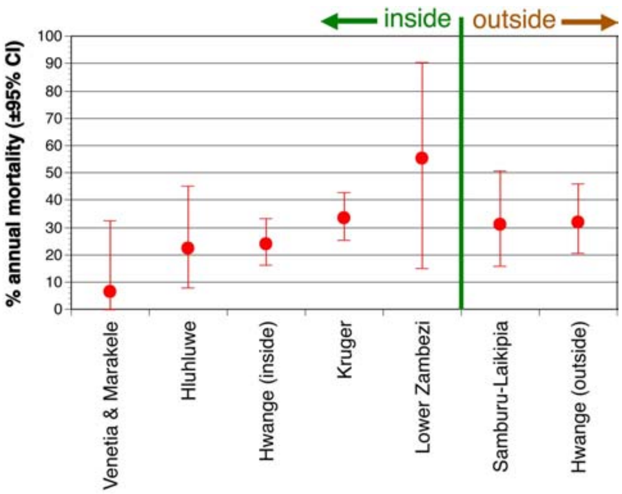
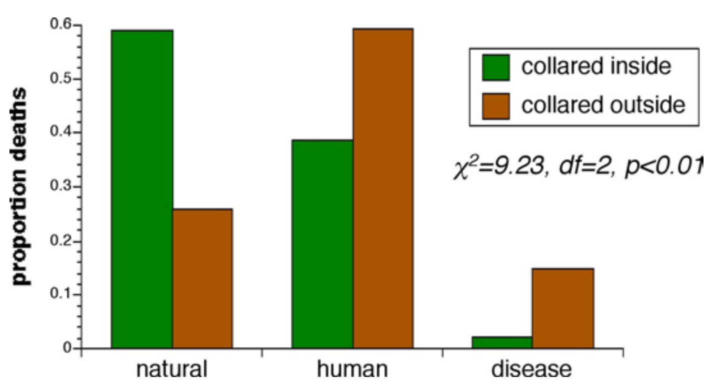


***Figure 2.7** – Annual mortality rates of adults radiocollared inside and outside protected areas. Savé is omitted due to incomplete data on survivorship. Variation in the width of confidence intervals reflects variation in the sample size (number of collared animals and period monitored) available from each site.*

While there was no significant difference in mortality *rates* inside and outside protected areas, known mortality *causes* did vary. Not surprisingly, a higher proportion of dogs collared outside reserves died due to human causes (Figure 2.8). Consequently, a smaller proportion of deaths are attributed to natural causes. However, these proportions are necessarily not independent of one another since proportions of deaths due to different causes must add up to 1. To determine whether human-induced mortality outside protected areas is additive to natural mortality, or compensates for deaths that would otherwise occur due to natural causes, Figure 2.9 shows *rates* of mortality due to varying causes among dogs collared under different circumstances. This shows that, while the annual mortality rate due to natural causes is similar among those collared inside and outside reserves (log rank test; χ^2=0.007, d.f.=1, p=0.93), those collared outside experience significantly higher mortality rates due to human causes (log rank test; χ^2=11.8, d.f.=1, p=0.0006), suggesting that anthropogenic mortality is additive to natural mortality outside reserves.

***Figure 2.8** – Causes of mortality recorded among wild dogs radiocollared inside and outside protected areas, all study sites combined*



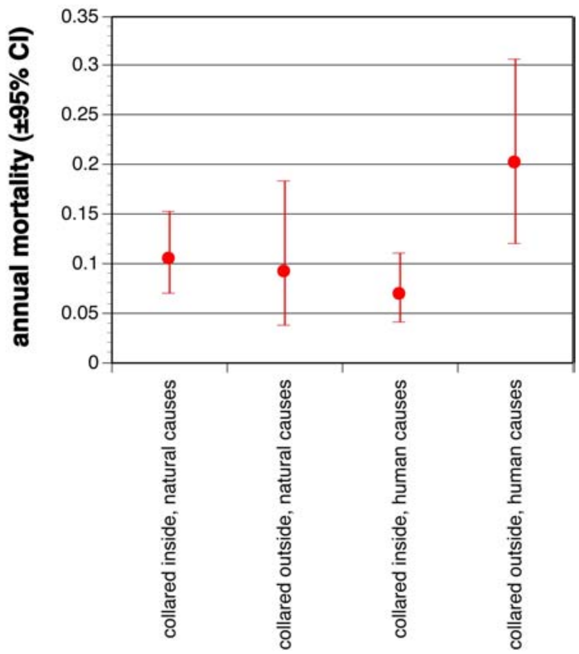


***Figure 2.9** – Rates of mortality due to human vs natural causes among wild dogs radiocollared inside and outside protected areas. While animals collared inside and outside reserves experience similar rates of natural mortality* (χ^2=0.007, d.f.=1, p=0.93), *those collared outside experience additional mortality due to human causes* (χ^2=11.8, d.f.=1, p=0.0006).

2.4.5 Causes of pup mortality

It is impossible to obtain unbiased estimates of causes of pup mortality, since pups are too small to radiocollar, and cannot even be seen for the first few weeks of life – at least not without substantial disturbance to dens likely in itself to cause mortality. Any analysis of causes of pup mortality must therefore be interpreted with extreme caution.

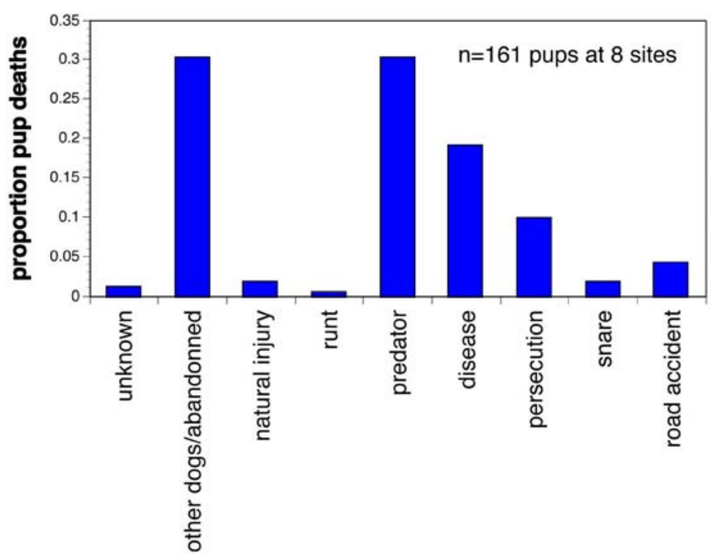


***Figure 2.10** – Recorded causes of pup mortality. These data must be interpreted with caution as the majority of pups simply disappear for unknown reasons.*

Figure 2.10 shows available data on causes of pup mortality. These data suggest that most pups die of natural causes such as infanticide and predation. Disease also appears important, and may be underestimated, especially in the first few weeks of life when pups are still inside the den. Human causes appear less important. However, it is important to stress that most of these data come from inside protected areas, in part because it is very difficult to monitor pup survival in human-dominated landscapes where wild dogs are often wary and difficult to observe. Deliberate disturbance of dens is known to have killed an unknown number of very young pups outside protected areas in northern Kenya (Figure 2.11), and disturbance of dens by tourists is rumoured to have killed at least part of a litter in Botswana.

Figure 2.11 *– Den smoked out by herders in northern Kenya. Such activities may kill an unknown number of pups outside protected areas. Photograph © Rosie Woodroffe.*

2.5 Discussion

The analyses presented here broadly support the conclusions of the 1997 Action Plan (Woodroffe *et al.*, 1997a). Most natural mortality experienced by wild dogs is due to predators and other wild dogs; human-caused mortality (which may affect wild dogs collared inside, as well as outside, protected areas) includes snaring, road accidents, and deliberate shooting, spearing and clubbing. While the relative importance of these mortality causes varies from place to place, no new external threats have been identified since 1997.

2.5.1 Sampling bias

Radio-collaring greatly increases the chances of locating dead wild dogs and hence achieving less biased estimates of mortality rates and causes, but the aims and intensity of monitoring also have important consequences for the attribution of mortality causes. Some of the projects participating in this study were designed specifically to investigate mortality causes and therefore involved very regular monitoring of collared animals and careful necropsy of any carcasses retrieved. In contrast, other projects with different aims located collared animals more sporadically, and often retrieved carcasses too decomposed to establish cause of death, or no carcass at all. As discussed above, most of these ‘unknown cause’ deaths occurred inside protected areas and it is possible that factors such as predation, intraspecific strife, and infectious disease may be more likely causes than deliberate killing by people. Improving data collection is the only way to reach a confident assessment of the relative importance of different mortality causes; in the interim, however, it is important to entertain the possibility that the importance of some threats may be under-estimated in this dataset.

2.5.2 Mortality rates and causes inside and outside protected areas

This study confirmed that human-caused mortality affects nominally protected populations: of 78 wild dogs that died after having been radiocollared inside reserves, 21% died from human causes. It is not clear whether this anthropogenic mortality inside reserves occurs in addition to natural mortality. However, analysis indicates that anthropogenic mortality is almost certainly additive outside reserves, because wild dogs collared outside die of natural causes (e.g. hunting injuries, intraspecific aggression) at the same rate as those collared inside, yet also experience markedly higher anthropogenic mortality. This additional mortality does not translate into significantly higher overall mortality outside reserves, but the trend suggests that higher mortality may be confirmed in future when a larger sample size has been accumulated. This analysis draws on data from only two projects that have radiocollared wild dogs outside reserves. More information on wild dog mortality – and hence the possibilities for wild dog persistence – outside reserves is clearly a priority, since unprotected lands are likely to be very important for the long-term conservation of ecologically functional wild dog populations.

2.5.3 Local variation in mortality causes and threats

These data provide a general picture of the threats that affect wild dog populations under study, but it is important to stress that threats vary substantially from site to site. For example, snaring is a serious problem in the Lower Zambezi, but is almost non-existent in northern Botswana and northern Kenya. Hence appropriate management (e.g. measures to curtail snaring in Lower Zambezi; Abstract 4.3) must be based upon a realistic assessment of local threats.

2.6 Conclusions

This updated analysis revealed no new proximate threats to wild dogs, beyond those identified in the 1997 Action Plan. Hence, the threats evaluated in subsequent sections of this report appear to be appropriate.

The level of anthropogenic mortality inside reserves may have been over-estimated by the 1997 Action Plan, but this is still an important concern. Anthropogenic mortality appears to occur in addition to natural mortality outside reserves, and may also be additive inside reserves.

The impacts of some threats may be under-estimated due to insufficiently intensive monitoring by some projects (which were never designed to evaluate mortality causes). Steps are being taken to acquire better data.

Figure 2.15 *– Wild dog dead from confirmed anthrax in northern Kenya. Photograph © Peter Lindsey.*

Chapter 3 – Resolving conflicts with livestock farmers

Summary

Livestock farming is the dominant land use across most of wild dogs' geographic range, and conflict with livestock farmers is consequently a major barrier to wild dog recovery, as well as directly threatening unprotected populations and those inhabiting small unfenced reserves. Findings from Kenya and Zimbabwe show that coexistence of wild dogs and livestock is attainable under the right circumstances. Wild dogs' impact may be small relative to other factors affecting livestock production (including predation by other species), but there is no doubt that they can and do cause serious problems in some areas. Problems in Kenya and Zimbabwe are minimal where both wild prey and traditional livestock husbandry had been retained; however the generality of these results is not known. Further information is needed to determine

- *wild dogs' true impact on livestock production, and how this relates to farmers' perceptions; this will doubtless vary with local conditions.*
- *the most effective interventions to reduce wild dog-livestock conflicts. This is likely to require collaboration across multiple study sites.*
- *whether, and how, wild dogs and livestock can coexist in areas where livestock are not accompanied by herders.*
- *whether (and why) some packs become habitual stock killers, or whether conflict problems relate primarily to local conditions of wildlife and livestock management.*

Addressing these questions requires continued work at existing study areas but also establishment of at least one new study area in a livestock farming region.

3.1 Introduction

Deliberate killing of wild dogs – often illegal – is an important cause of mortality, especially outside protected areas (Chapter 2). One reason for this lethal control is that in many areas wild dogs are perceived to be serious predators of livestock and are killed either in response to depredation or with the intention of preventing it. It was partly for this reason that colonial governments often considered wild dogs to be 'vermin' and sponsored their eradication from many areas (Fanshawe *et al.*, 1991).

Livestock farming, both for commerce and subsistence, is the major land use across much of Africa and livestock often share the landscape with wildlife or occupy areas immediately adjoining reserves. This has two implications for wild dog conservation. First, it may mean that wild dogs inhabiting protected areas become involved in conflicts with neighbouring livestock farmers, risking being shot, speared or poisoned as predators (or perceived predators) of livestock, and potentially undermining population viability. Second, it may mean that, if livestock conflicts can be resolved, large areas of land dedicated to commercial or subsistence livestock farming (e.g. much of Botswana and Namibia, Tanzania's Masai Steppe) have the potential to support globally important populations of wild dogs in the long term. Hence, resolving conflicts with livestock farmers is a high priority for wild dog conservation.

3.2 The nature of the threat

While local farmers may sometimes overestimate the risk that wild dogs pose to livestock (Rasmussen, 1999), there is no doubt that they can and do kill small stock such as sheep and goats, as well as larger livestock including fully grown cattle (M. Swarner, unpubl. data, R. Lines unpubl. data, Davies & Du Toit, 2004; Rasmussen, 1999; Woodroffe *et al.*, 2005b). In northern Kenya, wild dog attacks on livestock occur much less frequently than attacks by other predators such as lions, leopards and hyaenas, even after adjusting for the species' relative population densities (Woodroffe *et al.*, 2005b and Woodroffe unpubl. data). In contrast, wild dogs are reported to be the second most important predator of livestock in Ghanzi District, Botswana (Abstract 1.8). It should be stressed, though, that impacts of predation on livestock herds are usually much less than the effects of other factors such as infectious disease and theft (Frank, 1998, Abstract 1.6; Rasmussen, 1999). Nevertheless, wild dogs often kill multiple animals when they do attack (wild dogs in northern Kenya kill 3.2 sheep or goats per attack on average, with up to 13 killed on confirmed attacks, Woodroffe *et al.*, 2005b), so the impact on particular farmers can be severe (Abstract 2.1). Hence, it is not surprising that livestock farmers often have negative attitudes towards wild dogs (Lindsey, du Toit & Mills, in press-b).

Figure 3.1 *– Wild dogs genuinely do kill livestock. Photos show a two year old cow killed by wild dogs in Ghanzi, Botswana (left, photograph © Matt Swarner), and a goat killed by wild dogs in northern Kenya (right, photograph © Leonard Chenguli.*

Because wild dogs range widely, even a small number of farmers can have a disproportionate effect on population viability if they are sufficiently hostile to kill wild dogs (Woodroffe & Frank, 2005a; Woodroffe *et al.*, 1998). There are multiple reports of farmers killing wild dogs in livestock farming areas (e.g. Lindsey, Du Toit & Mills, 2005b). Even in study areas, a number of deliberate killings may go unreported: shooting deaths are rarely detected unless the animals are radiocollared (Figure 2.4).

It is often assumed that most depredation is carried out by 'problem animals' (or packs) which have developed a 'taste' for killing livestock. The extent to which such 'problem animals' really exist among carnivores in general is a matter for debate (Linnell *et al.*, 1999), and can be difficult to determine. Localised areas often experience particular problems, but it can be difficult to determine whether this is because those areas are occupied by a 'problem animal' or because characteristics of the area may predispose that area to conflict (Stahl *et al.*, 2002). Area characteristics can also predispose animals to develop a habit of killing livestock; for example, Woodroffe & Frank (2005a) suggested that poor livestock husbandry on one ranch encouraged lions to become persistent stock killers.

Insufficient data are available to determine whether packs of wild dogs become 'problem animals' or whether predation problems relate to the characteristics of the areas they inhabit. Research in northern Kenya has linked livestock predation to depletion of wild prey and has thus far provided little evidence that wild dogs continue killing livestock when they move into areas with abundant wild prey (Woodroffe *et al.*, 2005b). Long term studies in Zimbabwe, however, have shown that wild dogs sometimes start killing livestock after several years' residence in the same areas with no problems (G. Rasmussen, unpubl. data; A. Pole unpubl. data).

Lack of insight into this issue is a serious concern, because the existence (or not) of problem animals profoundly affects the management solutions likely to be effective. If a pack develops a habit of killing livestock, removal of that pack may lead to the area being recolonised by animals that do not cause problems. By contrast, if predation problems reflect an underlying problem of poor husbandry or depleted wild prey, then any animals inhabiting the area are likely to kill livestock and removing dogs will not solve the problem in the long term. It is important to be realistic about the aims of a local conservation programme. If the aim is to enlarge the area available to vulnerable populations, it may be appropriate to encourage packs to reside in livestock areas. In this case, conservation measures will be needed to avoid creating circumstances where wild dogs kill livestock, and removing animals may directly conflict with the local conservation goals. By contrast, if the aim is to conserve a population inhabiting a protected area by reducing mortality in neighbouring livestock areas, the most appropriate measures may be to discourage wild dogs from leaving the protected area, and removing those that do so. This dichotomy is complicated, of course, by lack of information about the environmental conditions needed for wild dogs to inhabit human-occupied landscapes without serious conflict. To illustrate this, wolf recovery in the northern Rocky Mountains in the USA was initially targeted at designated zones consisting mainly of wilderness; however these zones were de-emphasised as naturally recolonising packs showed themselves able to inhabit surrounding lands without causing serious problems (Bangs *et al.*, in press).

3.3 Possible solutions

Several approaches have been taken to reduce conflicts between livestock farmers and wild dogs (as well as other predators). Strategies may involve attempts to modify predators' behaviour, and/or human behaviour, and range from the technical (e.g. electric fencing to protect livestock) to the social (e.g. encouraging land uses that reduce reliance on livestock). As discussed above, approaches to the problem of livestock depredation may involve encouraging wild dogs to prey exclusively on wildlife even when they are in livestock areas, attempting to exclude them from farming areas, or removing offending animals. These are discussed in order; note that this order reflects logic rather than any suggestion of which approaches may be most successful. In deciding which measures to implement in a particular area, it is important to bear in mind the overall objectives of local conservation activities.

3.3.1 Conserving wild prey

Studies in northern Kenya have linked wild dog predation on livestock to depletion of natural prey (Woodroffe *et al.*, 2005b). Depredation occurs only sporadically in areas occupied by pastoralist people who rarely, if ever, hunt wild ungulates. In contrast, areas inhabited by communities who are keen hunters have more depleted wild prey and much more serious problems of livestock depredation by wild dogs. Recent observations from areas bordering Serengeti National Park in northern Tanzania (Abstract 1.17) appear to replicate this pattern (K. Laurenson, unpubl. data). Why wild dogs would choose to live in areas with such depleted wild prey (especially when they adjoin areas with much higher prey densities) is not clear but may reflect avoidance of areas frequented by larger competitors such as lions.

These data suggest that measures which augment wild prey populations – such as establishment of community reserves, reducing livestock densities, and encouragement of wildlife-based land uses such as ecotourism and hunting – may help to alleviate livestock predation problems. Of course, such measures would have to form part of an overall evaluation of the relative contribution that livestock and wildlife can make to local people's incomes. However, before doing so it would be valuable to quantify relationships between wild prey density and livestock predation in other areas, especially as depredation by wolves has been linked to both low (Mech, Fritts & Paul, 1988; Meriggi & Lovari, 1996) and high (Treves *et al.*, 2004) densities of wild prey. Moreover, it is important to bear in mind that substantial increases in prey density will tend to favour competitors such as lions and hyaenas over wild dogs, and may create as many problems as they solve.

***Figure 3.2** – Project staff in northern Kenya gather data on (left) wild prey availability by counting dung and (right) livestock husbandry by interviewing herders. Photographs © Rosie Woodroffe.*

3.3.2 Improved livestock husbandry

Traditional husbandry was developed over thousands of years to protect livestock from predators and thieves, and is highly effective (Breitenmoser *et al.*, in press). Careful herding of livestock, and enclosure in 'bomas' at night, has been linked to reduced livestock predation by lions, leopards and hyaenas in northern Kenya (Ogada *et al.*, 2003), and such husbandry – especially daytime herding – appears equally effective against wild dogs in both Kenya (R. Woodroffe, unpubl. data) and Zimbabwe (G. Rasmussen unpubl. data). Traditional pastoralists in the Kenya study area have often commented that '*if wild dogs kill my livestock, it is my own fault*' (R. Woodroffe, unpubl. data). A case-control study is in place to evaluate which aspects of herding practices are most important in deterring wild dog attacks (Abstract 2.1).

Traditional husbandry practices have been abandoned across many parts of Africa, and it is not clear to what extent this has increased conflicts between people and wild dogs. Husbandry practices such as establishment of calving camps have been suggested as ways to reduce conflicts, and particular breeds of livestock, with well-developed antipredator behaviours, have also been recommended. Moreover, many more high-tech approaches have also been developed to protect livestock against other predators (Breitenmoser *et al.*, in press). However, no data have been published to show the effectiveness of such approaches to alleviate wild dog depredation. More rigorous work in this area has a high priority for future research.

3.3.3 Compensation, insurance and performance payments

Compensation for lost livestock is one approach that might be expected to improve local people's attitudes towards stock-killing wild dogs, and reduce the chances that these animals will be killed by private individuals. Compensation schemes were operated by many colonial governments in the past but were, almost without exception, abandoned due to serious problems associated with corruption and poor infrastructure making it near-impossible to verify claims (Nyhus *et al.*, in press). Compensation played an important role in combating opposition to wolf reintroduction in the northern Rocky Mountains of the USA, but is costly (requiring rapid confirmation of all reported attacks – far more costly than the value of the compensation paid out) and may be difficult to sustain in the long term. Recent experience with a compensation fund established to conserve lions and hyaenas in southern Kenya has revealed similar problems and may also discourage effective livestock husbandry, potentially increasing depredation rates (S. McLellan & L.G. Frank pers. comm.). Compensation for wild dog depredation has been paid out, on a local scale, close to the (fenced) Venetia-Limpopo Nature Reserve in South Africa. This private reserve is insured against damage caused by animals that break out; just two payments have been made since 2002 (H. Davies-Mostert unpubl. data). This is the only area in which we are aware of compensation being paid for wild dog depredation in recent years; however there is no reason to suppose that larger scale compensation programmes would be more effective than those established for other predators.

Recently, several projects working with other carnivore species have experimented with establishing local insurance schemes to offset the costs of depredation while encouraging farmers to take measures to avoid losses by charging a premium that increases with risk (Nyhus *et al.*, in press). This approach seems appealing, but may not be appropriate for application to wild dogs. A scheme established for Amur tigers foundered because attacks were too rare to make it worth farmers' while to enrol in the scheme (Miquelle *et al.*, in press); since wild dog attacks are equally uncommon in mot areas, similar problems are to be expected.

A recent analysis of schemes which essentially 'pay for tolerance' has suggested that the simplest – paying local communities to conserve wildlife – may be the most effective (Nyhus *et al.*, in press). Payment of ranchers for evidence of successful denning on private land has played a role in wolf recovery in North America. A similar scheme was adopted, on a small scale, in the Ngamo region adjoining Hwange National Park, Botswana (Abstract 4.2), and might be a promising approach in particularly important areas.

3.3.4 Education

Education has a vital role to play in many aspects of wild dog conservation, and may be particularly important where wild dogs are in fact causing less livestock damage than perceived by farmers. It is important to note that education does not necessarily involve active 'teaching', and that projects' mere presence may be valuable. For example, fitting of coloured radiocollars to wild dogs in western Zimbabwe showed farmers that fewer wild dogs were resident on their land than they had assumed, and appears to have helped improve local attitudes (Rasmussen, 1997), perhaps even improving survivorship (Rasmussen & Macdonald, in review). Likewise, local people in northern Kenya appreciated being kept informed by research staff of the whereabouts of a stock-killing pack, and were very concerned when the sole radio-collared pack member was (illegally) shot (R. Woodroffe, unpubl. data).

3.3.5 Fences and biofences

It may not be sustainable to conserve wild dogs in all areas, and in some cases the most effective means to reduce livestock loss may be to exclude wild dogs from livestock areas. Fencing wild dogs is difficult and expensive, however; while fencing has been largely successful in the South African managed metapopulation, the frequency with which some of the wild dogs cross the fences originally intended to contain them demonstrates the potential difficulties (H. Davies-Mostert, unpubl. data). Moreover, physical barriers to wild dog movement will also affect multiple other species. When maintaining and re-establishing connectivity is a key goal for biodiversity conservation in many areas, the relative costs and benefits of breaking connectivity by fencing need to be assessed very carefully. Research is underway to determine whether wild dogs' own scent marking behaviour might be exploited to exclude them from specific areas (Abstract 2.3) by creating a 'biofence' that mimics natural territory boundaries. This research is at an early stage, and it is not yet clear whether the approach will prove effective.

3.3.6 Translocation and lethal control

If wild dogs cause persistent problems that cannot be resolved, the only solution may be to remove them. It is important to recognise that, as discussed above, removal may be a short-term measure as removed dogs are likely to be replaced by new immigrants unless measures are taken to prevent this. Hence the decision to remove a pack must be taken in the context of an overall local conservation plan with clearly defined objectives (see above).

Several translocations of whole packs have been carried out in Zimbabwe (Abstract 2.2), always as a last resort when other measures had failed. The effectiveness of translocation as a conservation tool depends upon having a secure place to translocate problem animals *to*. Problem animals are often inappropriate for reintroduction programmes because of the risk that they will continue killing livestock after translocation. Moreover, there are few areas of clearly suitable habitat that are not already occupied by resident packs. Translocation was successful in Zimbabwe (Abstract 2.2), but relocation of a group of livestock killing wild dogs from northern Kenya to Tsavo National Park ended in failure when the dogs left the park and were eventually killed outside (Kock *et al.*, 1999). The differential success may lie in the choice of release sites (Tsavo West sustains high lion densities) or perhaps in the pack structures or release protocols used. However there is no question that translocation is a difficult, labour-intensive and consequently expensive process. Moreover, translocation is a stressful procedure which entails mortality and welfare concerns for the dogs during capture, while held in captivity, and after release at the new site. Hence, translocation is appropriate for use only when (i) other measures have failed; (ii) the pack concerned is clearly resident and likely to continue depredation (dispersal groups may be likely to move on without intervention); (iii) a suitable release site is known to be available *before* problem animals are captured; (iv) experienced personnel and adequate funds and equipment are available to carry out all stages of the translocation process, and (v) affected farmers and wildlife managers fully understand and support the aims and objectives of the translocation as part of a regional conservation plan for wild dogs.

Translocation of problem wild dogs is not always an option, either because no suitable release sites are available or because it is impossible to capture entire packs. Under these circumstances, there may be a need to consider lethal control if removal of wild dogs appears to be the most appropriate action given local management goals. While lethal control is to be avoided unless absolutely necessary, failure to remove animals which are genuinely causing serious problems can alienate local people and greatly undermine conservation efforts (Woodroffe, Thirgood & Rabinowitz, in press-a). It is worth mentioning that, in remote areas with inhospitable terrain, lethal control of wild dogs may be extremely difficult, even if it is not (quite) as difficult as live capture. Lethal control of wild dogs may be precluded in some countries by the species' specially protected status.

If problem wild dogs can be captured, removing them into captivity may be an alternative to translocation or lethal control. This entails welfare concerns, however: free ranging adult wild dogs are unlikely to adjust well to confinement in captivity. Moreover, with space in reputable zoos extremely limited and little conservation justification for expanding the captive population (at least for dogs with southern African genotypes, Woodroffe & Ginsberg, 1999b), this solution will rarely be appropriate.

A final approach, which has been used occasionally in Botswana, is to remove the pups from denning packs which are resident in an area and causing serious problems (M. Swarner, unpubl. data). This appears to have been done once, illegally, in northern Kenya and did cause the pack to move elsewhere (R. Woodroffe, unpubl. data). This creates a problem, though, of what to do with the removed pups. One such litter was successfully fostered back into the wild in Botswana (J.W. McNutt, M.N. Parker & M.J. Swarner, unpubl. data) but an attempt to do this in Zimbabwe failed when the pups were chased away (G. Rasmussen, unpubl. data). The success of this approach is likely to depend on detailed information not only on the whereabouts of possible foster packs but also on the age of their own pups; hence it can only be seriously considered in areas where ongoing field projects are monitoring radiocollared packs. Elsewhere, removal of litters probably consigns pups to an uncertain future in captivity.

3.4 Do we know enough? What more do we need to know?

Very little research has been carried out on livestock depredation by wild dogs. Findings from northern Kenya and Zimbabwe suggest that coexistence of wild dogs and livestock farmers is attainable; the Kenya study suggests that conservation of wild prey and retention of traditional husbandry are the keys to such coexistence. However it is not clear to what extent these findings apply elsewhere, especially where livestock are not accompanied by herders (e.g. in much of southern Africa). Moreover, while additional experience and information exist, much of this has not been systematically analysed or written up, and this should be seen as a priority. Key questions for further study are listed below. It is important to mention, though, that since livestock predation is a threat that involves farming communities, actively involving local people in data collection is likely to be critical to the success – and acceptance – of further research.

3.4.1 What is wild dogs' true impact on livestock production, and how does this compare with farmers' perceptions?

This question is vital to understanding and resolving wild dogs' conflicts with livestock farmers. First, it helps to determine whether local conservation action should place greatest emphasis on reducing losses, or on addressing erroneous perceptions of loss. Second, it helps to identify levels of depredation that are locally 'acceptable', below which farmers are unlikely to engage in (legal or illegal) lethal control and, conceivably, above which wildlife management authorities might intervene. Third, it provides baseline information with which to compare the effectiveness of conservation interventions. The answers to this question will vary according to local conditions, but additional studies in new areas (e.g. in Botswana, Tanzania and Namibia) may build upon existing data from Kenya and Zimbabwe and help to detect general patterns.

Action: Assess wild dogs' true impact on livestock and compare with local perceptions
By: Matt Swarner, Robin Lines, Amy Dickman, other interested collaborators

3.4.2 Which approaches are most effective at reducing wild dog-livestock conflicts?

Preliminary work has identified several possible tools for reducing human-wild dog conflict (listed above) but there have been no opportunities to systematically evaluate or compare these approaches. This is mainly because too few data, from too few places, have so far been collected. The continuation of existing projects (in Zimbabwe and Kenya) and the establishment of new ones (e.g. in Namibia, Botswana and Tanzania) provides an opportunity to identify the most promising management approaches, especially because interventions happen rarely and no one project may amass sufficient data to draw general conclusions. Regular contact between projects and, where possible, use of consistent methodologies and data sharing will generate the most useful comparisons.

Action: Carry out systematic comparisons of the effectiveness of management activities such as husbandry, prey conservation and translocation, across multiple sites

By: Matt Swarner, Megan Parker, Robin Lines, Rosie Woodroffe, Greg Rasmussen, Amy Dickman, Karen Laurenson, other interested collaborators

3.4.3 Can wild dogs and livestock coexist successfully in areas where livestock graze unaccompanied by herders?

Answering this question requires the establishment of intensive studies of wild dog-livestock conflicts in areas without attentive herding. Such studies should include systematic monitoring of livestock attacks (including careful verification of reported attacks) and well-designed research to evaluate possible management solutions. Some work on this issue is in place in western Zimbabwe, commencing in northeastern Namibia, and planned for Botswana. Uses of consistent methodologies across studies and, where possible, data sharing would aid comparison and encourage meta-analysis.

Action: Establish and expand studies of wild dog-livestock conflicts in areas without attentive herding

By: Greg Rasmussen, Robin Lines, Matt Swarner, Megan Parker, other interested collaborators

3.4.4 Do wild dog packs become habitual stock killers, or is depredation an inevitable result of livestock and wildlife management in particular areas?

This question is important because it influences the extent to which conservation actions may need to focus on preventive measures (e.g. wild prey conservation) or reactive measures (e.g. translocation). The expansion of research on wild dog-livestock conflicts to new sites, and continued data collection at existing sites, will help to address this question. Once again, use of consistent methodologies (e.g. for estimating wild prey densities) and data sharing will encourage cross-site comparison and meta-analysis.

Action: Continue monitoring of prey relations of wild dogs inhabiting livestock areas and, where possible, expand this to new areas.

By: Rosie Woodroffe, Matt Swarner, Amy Dickman, Robin Lines, Greg Rasmussen, Alistair Pole, Kim McCreery, Bob Robbins, other interested collaborators.

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Chapter 4 – Resolving conflicts with game farmers

Summary
The expansion of game farming in Africa – especially southern Africa – represents both a huge challenge and a great opportunity for wild dog conservation. Wild dogs conflict with game farmers mainly because they are perceived to prey upon ‘game’ animals that are potentially extremely valuable for hunting and live capture. Lethal control, whether legal or illegal, may prevent wild dogs from living in game ranching areas and could even undermine the viability of nearby populations in protected areas. Conflicts with game farmers are difficult to resolve because it is near-impossible to prevent wild dogs from killing their natural prey. However studies indicate that game ranchers’ attitudes to wild dogs are improved when they have experience of coexisting with wild dogs, and when they form or join conservancies in which ‘game’ are free to move across property boundaries. Conflict on small, fenced, game farms can be severe, however. Encouraging the formation of conservancies is probably the most promising measure to improve wild dog population viability in game ranching areas. Additionally, more information is needed to determine:

- *the extent to which wild dog populations occupying game ranching areas are self-sustaining or inhabiting ‘attractive sinks’ which undermine the viability of source populations*
- *wild dogs’ true impact on ‘game’ populations in a range of ecosystems. This information will be crucial to allow managers and ranchers to make informed decisions about wild dog management.*
- *whether economic benefits can be realised from wild dogs inhabiting game ranches, e.g. through ecotourism. One key question is whether wild dogs’ presence affects hunters’ choice of destination and willingness to pay for a safari. If hunters appreciate having endangered species in the area, even if they cannot be hunted, this would improve game ranchers and professional hunters’ attitudes to wild dogs’ presence.*

4.1 Introduction

The expansion of game ranching as a land use in Africa – especially southern Africa – has profound consequences for the long term viability of wild dog populations. On the one hand, this massive change in land use potentially creates very substantial areas of new habitat for wild dogs: in South Africa alone, game farms cover over 80,000km^2 (Hearne & Mackenzie, 2000), and this area is expanding across southern Africa. Hence, game farming areas have the potential to support substantial populations of wild dogs and to establish and maintain connectivity between populations inhabiting protected areas. Reality may not be so rosy, however. Wild dogs may experience very severe conflicts with game ranchers, because they prey upon ‘game’ animals that are potentially extremely valuable. Such conflict has often led to (usually illegal) lethal control of wild dogs (Lindsey *et al.,* 2005b). Hence, far from being suitable habitat, game ranches also have the potential to become ‘attractive sinks’, areas which appear suitable (sustaining high prey densities and often reduced densities of competing predators) but in fact entail very poor survival. Such attractive sinks can drive extinction of source populations (Delibes, Gaona & Ferreras, 2001). If game ranches on the edges of protected areas act as attractive sinks for wild dogs, they could be more damaging than if those same areas were converted to other land uses, such as cultivation. Since the game farming industry has potential to impact wild dog conservation in such extremely positive and negative ways, there is a clear need to consider the extent to which wild dog conflicts with game farmers can be mitigated.

4.2 The nature of the conflict

Wild dogs come into conflict with game farmers primarily because they prey upon game animals which might otherwise be sold either for meat, for trophies, or as live animals to stock other game farms. Wild dogs also indirectly cause property damage by chasing their prey into expensive game fences and damaging them (Van Dyk & Slotow, 2003). Finally, game farmers also blame wild dogs for increasing wild ungulates' vigilance, making them skittish and more difficult to hunt. Such conflicts represent a problem for large carnivores the world over (Woodroffe, Thirgood & Rabinowitz, in press-b) and stem from a basic problem that, while measures can be taken to protect livestock from predators, there is very little one can do to prevent wild dogs from hunting impala, wolves from hunting elk, or tigers from hunting deer. Somewhat paradoxically, the current market in wild game in southern Africa means that wild ungulates may be substantially more valuable than livestock, so that wild dogs may have a greater economic impact when killing wildlife than when killing livestock (Abstract 7.1, Lindsey *et al.*, in press-a).

***Figure 4.1** – Wild dogs' natural prey may be highly valued 'game'. Photograph © Rosie Woodroffe.*

To date, only one intensive study of wild dogs in a game ranching area – the Savé Valley Conservancy in southeastern Zimbabwe (Abstracts 1.11 and 3.2) – has been completed although a second is in progress (in Venetia Limpopo Nature Reserve, South Africa; Abstract 1.3), and a third has just commenced (in dryland areas of northern Botswana; Abstract 1.7). At present, then, most of the available data on wild dogs' impacts on game ranches come from Savé. These data show that wild dogs select prey animals that are young and in poor condition, suggesting that their impact on 'game' populations may be smaller than it might appear to an angry rancher (Pole *et al.*, 2004). Indeed, in Savé's somewhat enlightened community of ranchers, wild dogs' beneficial role as predators of weak, sick and unfit animals is increasingly being recognised (Abstract 3.2), and increases in the wild dog population have not been accompanied by any measurable decline in the abundance of wild ungulates (A. Pole unpubl. data). Nevertheless, it is likely that wild dogs can have genuinely negative impacts on ungulate numbers locally, especially during denning (a single property on Savé recently had three packs den on it simultaneously, during hunting season). Wild dogs' impact on ungulate populations would also be expected to be greater inside smaller, fenced reserves, where populations are enclosed and where dogs can use (and damage) the fences themselves as an aid to hunting larger prey (Van

Dyk *et al.*, 2003). Work in progress at Venetia is investigating this issue (H. Davies-Mostert unpubl. data). Effects on ungulate vigilance might also be greater in small, fenced, game farms, since it is more difficult for prey to escape their predators.

Surveys of ranchers' attitudes indicate that the greatest animosity towards wild dogs comes from the owners of small farms that are isolated from their neighbours by game fencing; tolerance is much higher among members of conservancies such as Savé (Lindsey *et al.*, in press-b). Conflicts with game farmers in Namibia are likewise more severe on small, fenced properties (R. Lines unpubl. data). Unfortunately because wild dogs range widely, particular ranchers may have impacts well beyond their own properties. This has not been quantified for wild dogs, but one study of lions showed that a single 180km^2 property, which acted as a sink, influenced the viability of the lion population over more than 2,000km^2 (Woodroffe *et al.*, 2005a). Hence a few landowners, or hunt operators, sufficiently hostile to wild dogs to be willing to kill them, may affect wild dog populations over very large areas.

4.3 Possible solutions to wild dog conflicts with game ranchers

As mentioned above, wild dog conflicts with game ranchers are potentially difficult to resolve because there are very few technical measures that can be taken to dissuade a predator from hunting its natural prey. Here, we evaluate a number of technical, economic and land use measures that might be considered helpful in promoting wild dog conservation in game ranching areas.

4.3.1 Diversionary feeding

Diversionary feeding – providing alternative food to encourage animals to eat that rather than valuable game – has shown some promise in reducing wolf and bear predation on moose (Gasaway *et al.*, 1992), and hen harrier predation on grouse (Redpath, Thirgood & Leckie, 2001). Providing carcasses as alternative food would have limited value for wild dogs, since they rarely scavenge and, outside the denning season, are extremely difficult to locate. Diversionary feeding has been used occasionally, briefly, in South Africa (M. Hofmeyr & H. Davies-Mostert, unpubl. data) but would be very management-intensive and almost certainly unsustainable for use more widely. An alternative approach would be to consider stocking high densities of less valuable prey, such as duikers; however it is not known whether the wild dogs would select such animals over larger prey that might (depending upon the capture effort required) be more profitable (Creel & Creel, 1995).

4.3.2 Hunting wild dogs themselves

Sport hunting itself can be a powerful tool for conservation (Leader-Williams & Hutton, in press), which has been linked to improved tolerance for species as diverse as deer, elephants, foxes and lions. Could occasional, sustainable sport hunting of wild dogs themselves improve game ranchers' attitudes towards them? Available data suggest that wild dogs may not be an appropriate species for management in this way. First, there may be little demand, and hence only a small market, for sport hunting of wild dogs which have never been considered a 'game' species. Second, wild dogs are difficult to locate so that, even if a 'wild dog hunting safari' was sold, actually killing a wild dog could not be guaranteed (though this is also the case for some other predator species that are widely hunted, e.g. leopards). Third, wild dogs are specially protected in several African countries and could not legally be hunted. Fourth, wild dogs might be particularly sensitive to offtake if alpha animals were killed. And, finally, concern has been expressed that creating a market for wild dog hunts could help to fuel an existing low-level traffic of pups dug out of dens, for ‘canned’ hunting. Hence, it appears that hunting of wild dogs currently has little promise as a way of offsetting the costs, real or perceived, of wild dogs’ presence on game ranching land. However, ongoing research (P. Lindsey unpubl. data) will help to evaluate the demand for wild dog hunting.

4.3.3 Developing ecotourism in game ranching areas

Ecotourism is another way to realise direct benefits from wild dogs that may help to offset real or perceived costs of their predation on ‘game’ ungulates (Lindsey *et al.*, 2005a). Operators in both Savé and Venetia have marketed ‘wild dog weekends’, and these show promise as complementary uses of lands also used for hunting (A. Pole & H. Davies-Mostert, unpubl. data). However, the most reliable time to observe wild dogs is during the denning period, which happens to coincide with the hunting season in southern Africa. This creates difficulties in both directions since (i) the sound of gunshots may undermine tourists’ ‘wilderness experience’ and (ii) hunting in Savé was more lucrative than tourism, so tourist beds were reserved for hunters to maximise profits. Ecotourism in Savé has largely collapsed due to political instability in Zimbabwe. However, ongoing studies in Venetia will help to evaluate the extent to which ecotourism can offset costs of wild dogs’ presence and improve game ranchers’ attitudes. A questionnaire survey is also underway to investigate the extent to which presence of wild dogs and other non-hunted species influences foreign hunters’ choice of destination.

4.3.4 Performance payments

Rather than using wild dogs to generate income through hunting or tourism, they might generate income for ranchers through donor funding. Payment of ranchers for successful denning of wolves on their land has played a rôle in wolf recovery in North America (Nyhus *et al.*, in press) and could be worth considering for wild dogs. Analyses suggest that direct performance payments may be more effective conservation measures than compensation for losses (Ferraro & Kiss, 2002; Nyhus *et al.*, in press). This measure has not been used for wild dogs on private lands (but see section 3.3.3), but could have some value in particularly critical conflict areas.

4.3.5 Encouraging the creation of conservancies

The most striking factor associated with improved attitudes towards wild dogs is membership of a conservancy (Abstract 3.1, Lindsey *et al.*, in press-b). Such conservancies – blocks of private ranches managed collectively as wildlife areas with no internal fencing – are a very effective way of conserving wildlife and are also more profitable than isolated game ranches (Barnes & De Jager, 1996). Ranchers inside conservancies probably have better attitudes to wild dogs both because they are accustomed to the idea of wildlife moving between private properties and hence do not perceive every ‘game’ animal killed as a loss to themselves, and because the lack of internal fencing means that two major costs of wild dogs’ presence – hunting of large prey against fences, and consequent damage to game fencing – are substantially reduced (Lindsey *et al.*, in press-b).

Encouraging ranchers to form or join conservancies is beyond the capacity of individual wild dog advocates but could be fostered by governments and government agencies through legislation and even economic incentives. Since conservancies are more profitable than individual game ranches, there may also be a natural evolution towards the formation of conservancies and hence improved attitudes, as hunting for biltong is replaced by more profitable sport hunting (which involves a smaller offtake of high quality animals), and then by a combination of sport hunting and ecotourism (P. Lindsey, unpubl. data).

4.3.6 Education and project presence

Ranchers whose properties are regularly used by wild dogs are more positive towards the species, suggesting that personal exposure to wild dogs may help to dispel perceptions of their impact (Lindsey *et al.*, in press-b). This suggests that attitudes could be improved – and lethal control (legal or illegal) reduced – through education. Experience from Savé suggests that the simple presence of a project, and consequently the availability of somebody to listen to ranchers' concerns, has played an important role in improving attitudes (Abstract 3.2). The finding that wild dogs select weak and sick animals – *in Savé* – has undoubtedly encouraged the perception of wild dogs in that area as a potentially beneficial force that may 'keep herds healthy' and might even – potentially – maintain high trophy quality. Extension of these findings to other areas, as is ongoing in Venetia and Marakele, could help to improve ranchers' attitudes.

4.4 Do we know enough? What more do we need to know?

Findings from Savé, and increasingly from Venetia, demonstrate that wild dogs may be able to persist and even thrive in game ranching areas. However, it is not clear to what extent these findings can be extrapolated to other areas. Insufficient is known to determine (i) the extent to which game ranching, as currently practiced, may be influencing the viability of source populations and (ii) how the conversion of land across Africa to game farming can best be made an opportunity for wild dog recovery, rather than an obstacle. Future research needs to address the following questions:

4.4.1 *To what extent are wild dogs living in game ranching areas adjoining protected areas (e.g. in South Africa and Zambia) self-sustaining, and what is their impact on the viability of protected populations?*

Are wild dogs expanding onto game farms as land is converted from livestock farming? And, is this leading to an increase in the size and viability of wild dog populations, or are game ranching areas 'attractive sinks'?

Action: Foster establishment of one or more new studies of wild dogs in game ranching areas

4.4.2 *What is wild dogs' true impact on 'game' populations, in different ecosystems and also during and outside the denning period?*

Note that a first attempt to answer this question could easily be made in existing study populations, even if they are not in areas where hunting is practiced. Use of consistent methods across study areas would give best results and encourage meta-analysis; methods in place in Venetia would be a promising model to follow.

Action: Circulate Venetia protocols for measuring wild dog impact on prey populations
By: Harriet Davies Mostert

4.4.3 *Is it possible to realise economic benefits of wild dogs' presence in game ranching areas?*

While ranchers and hunting outfitters may perceive wild dogs' presence as only negative, there is a chance that they might in fact have benefits for marketing particular destinations, both to hunters and to ecotourists. If this was the case, it could greatly improve attitudes. A particularly important question is whether hunters are interested in seeing endangered wildlife such as wild dogs, even though they cannot be hunted, and whether this influences either their choice of destination or the amount they are willing to pay for a safari.

Action: Further work on ecotourism development in game ranching areas
By: Harriet Davies Mostert and other interested collaborators

Action: Questionnaire survey of hunter and outfitter attitudes
By: Peter Lindsey

4.4.4 *How can conflicts between wild dogs and game ranchers best be ameliorated?*

This combines aspects of 4.4.2 and 4.4.3 but builds on data and experience from multiple sites to determine the best approach or combination of approaches. It probably requires establishment of a new study population (as in 4.4.1), though it could also draw on data from Venetia and Savé.

Action: Expand work from Savé and Venetia to other game ranching areas
By: Peter Lindsey, Alistair Pole, Harriet Davies Mostert, Micaela Szykman, other interested collaborators

Contact people
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Alistair Pole
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Figure 4.2 *– Dr Alistair Pole presents results from Savé*

Chapter 5 – Reducing impacts of snaring

Summary
Snaring is a major threat to wild dogs across much of their geographic range. Wild dogs are very rarely the target for snaring, but are rather the by-catch of snares used to hunt bushmeat. Snaring is a major challenge for wildlife conservation in much of Africa, and considerable conservation effort is expended each year to control it. Hence, there is extensive expertise available on methods to limit snaring by antipoaching and diversification of local incomes. Experiences from Zambia and Zimbabwe in particular indicate that these general approaches can effectively reduce snaring risks to wild dogs. More intensive interventions such as removing snares from dogs and fitting of protective collars are also effective and may be of value in areas where dedicated wild dog monitoring programmes are in place, though they are probably too labour-intensive to be sustainable elsewhere. Since proven, effective measures are available to reduce snaring impacts on wild dogs, there is no pressing need for further research in this area, although continued conservation action does, of course, have a very high priority.

5.1 Introduction

The data presented in Table 2.2 highlight snaring as the single most important cause of wild dog mortality in the study areas considered. Snaring impacts can be locally severe. For example, in the Lower Zambezi National Park, Zambia, over a third of wild dogs carried cable snares and snare-related mortality was as high as 30% (Abstract 4.3), contributing to this population having the highest recorded adult mortality of any under study (Figure 2.7) and consequently having steadily declined in recent years (Abstract 6.2). Snaring of wild dogs is not a problem everywhere (deaths have not yet been recorded, for example, in northern Botswana or northern Kenya), but is widespread where local people hunt ungulates with cable snares (Figure 2.6), and has also been recorded more widely in areas where wild dogs are not monitored systematically (e.g. Breuer, 2003). Reducing impacts of snaring could improve the viability of several wild dog populations. Snaring is also a welfare issue for wild dogs (Figure 5.1).

5.2 The nature of the threat

Except in a few localised areas (Davies, 1998), snaring is very rarely targeted at wild dogs; most are captured in snares set to catch wild ungulates. Such snaring is often carried out illegally inside protected areas or on private land, but may also be a component of traditional hunting on communal lands. Snaring is not only a problem for wild dogs: it has serious impacts on most mammals large enough to be caught and is a major conservation issue across much of the world (Lewis & Phiri, 1998; Noss, 1998). Wild dogs do, however, appear to be particularly susceptible to snaring (as are hyaenas, Hofer, East & Campbell, 1993) and may be an indicator of snaring problems in an area. Persistent snaring, of course, will also deplete wild dogs' prey and may hence encourage livestock predation (Abstract 2.1).

Snaring is a widespread and popular method used to hunt wild ungulates requiring little specialised equipment except wire. Wire is widely available in some parts of Africa, particularly in Zimbabwe where political instability has led to fencing – including game fencing installed to conserve wildlife – being torn down to make snares. Snaring was also adopted by poachers in

Zambia in response to improved antipoaching activity, because it could be carried out silently whereas the sound of gunshots was found to attract park guards (K. Leigh unpubl. data).

Figure 5.1 *– Snaring is a welfare issue as well as a threat to population viability. Photos © Nick Greaves (above) and Kellie Leigh (right)*

5.3 Solutions to snaring

5.3.1 Direct removal from dogs

Wild dog projects in Zambia, Zimbabwe and South Africa have darted wild dogs to remove snares (Figure 5.2). All projects report surprisingly good survival of wild dogs even with quite severe injuries. However, while direct removal of snares is appropriate to deal with specific incidents involving animals under study, it is too labour intensive to be sustainable over wider areas. Moreover, both from a conservation and a welfare perspective, prevention is better than cure. Hence, activities should ideally focus on avoiding wild dogs being caught in snares in the first place.

5.3.2 Protective collars

The Painted Hunting Dog project in western Zimbabwe has reduced mortality of wild dogs caught in neck snares by fitting modified radiocollars specifically designed to protect them from snares (Figure 5.3). The collars weigh approximately 400g, about 1.6% of the bodyweight of an average wild dog in the area. Of 31 wild dogs fitted with these collars that became trapped in neck snares, 6 (19%) subsequently died, compared with 24 (83%) of 29 dogs caught in neck snares that were either not collared or wearing conventional radiocollars (2=21.6, df=1, p<0.0001, Rasmussen *et al.*, in review). Not surprisingly, the collars were less effective at preventing deaths from leg snares (none (0%) of 4 collared dogs caught in leg snares died, compared with 2 (22%) of 9 dogs not fitted with protective collars; $\chi^2=0.07$, d.f.=1, p=0.80).

Protective collars appear to reduce mortality and may be of value in areas where snaring is particularly intense or under ‘crisis’ conditions. However fitting them is labour intensive and costly. Moreover, past concerns about the effects of immobilization, handling and radiocollaring on wild dogs have led to a recommendation that radiocollars should only be fitted where there is the funding and infrastructure to monitor animals after collaring (Woodroffe, 2001). For both of these reasons, protective collars may only be appropriate for use where there is a dedicated wild dog monitoring and research project in place.

Figure 5.2 *– Following treatment wild dogs may recover from even quite severe wounds caused by cable snares*

Figure 5.3 *– Protective collar designed to protect wild dogs from snares. Photographs © Peter Blinston*

5.3.3 Antipoaching

The impacts of snares on wild dogs – and other local wildlife including wild dog prey – can clearly be reduced by improved antipoaching activities. The African Wild Dog Conservation programme in the Lower Zambezi National Park, Zambia (Abstract 4.3) worked with park officials and local organisations to assess the impacts of snares and to identify high risk areas. Preliminary results suggest that improved anti-poaching activities were highly successful with markedly fewer wild dogs being caught in snares. Further monitoring is planned to determine whether this translates into lower mortality and population recovery.

The Painted Hunting Dog project in western Zimbabwe has extended antipoaching operations beyond park borders, working with communities to limit snaring on communal lands where this has been banned by local chiefs (Figure 5.4). This has resulted in the collection of several thousand snares and has very likely substantially reduced snare threats to wild dogs.

<***Figure 5.4*** *– Staff of the Painted Hunting Dog project display snares collected from community lands in western Zimbabwe. Photograph © Peter Blinston.*

5.3.4 Limiting the availability of wire

In the longer term, snaring may be reduced by limiting the availability of wire that can be used to make snares. As mentioned above, political change in Zimbabwe has left thousands of kilometres of wire fencing – much of it game fencing – destroyed and available for conversion to wire snares. The Painted Hunting Dog project has worked with local communities to remove defunct fences. It is possible that some fencing materials (e.g. 'Veldspan' mesh) may be more difficult to turn into snares (because they are not constructed from single straight lengths of wire but from short strands that are kinked and knotted) and may be preferable to single-strand wires in areas where game fences must be constructed. However, such material can still be unpicked and straightened, so it only increases the effort required to make snares, without completely removing the risk.

5.3.5 Reducing dependency on bushmeat

Conservation efforts in several areas have effectively reduced snaring by diversifying local incomes and discouraging dependence on hunting wildlife for subsistence or small-scale trade. Perhaps the best documented such effort is the ADMADE programme in Zambia, which has successfully reduced snaring through a suite of community collaborations (Lewis *et al.*, 1998). Conservation efforts in the vicinity of Lower Zambezi National Park have given local communities a stake in wildlife conservation through tourism by donating a bed-night levy direct to communities and also by employing local people in safari camps. In Zimbabwe, the Painted Hunting Dog project has turned snares themselves into a source of income by developing industries creating art and curios from old snares.

5.3.6 Which approach is best?

Snaring is a major problem over much of Africa, for multiple species in addition to wild dogs, and substantial conservation effort is invested in measures to reduce this threat in and around wildlife areas. Conservation organisations, both governmental and non-governmental, have extensive experience of mitigating snaring impacts on wildlife through a combination of antipoaching patrols and, to a lesser extent, diversification of community incomes away from bushmeat hunting. Given this wealth of experience, conservation activities by wild dog advocates may often be best invested in highlighting areas where snaring is particularly problematic, and helping to raise funds by using wild dogs as a 'flagship' for antipoaching operations which will benefit whole communities of wildlife. More direct interventions, such as snare removal and fitting of anti-snare collars, may have value in circumstances where problems are particularly acute and where dedicated wild dog monitoring projects are in place. Programmes that discourage the use of snares, however, benefit a larger number of species, may be more likely to build community support by offering employment, and may also be more sustainable and cost-effective in the long term.

5.4 Do we know enough? What more do we need to know?

Reducing the impacts of snaring on wildlife has been the subject of substantial conservation effort worldwide, and extensive experience exists on effective methods. Implementation of anti-snaring operations in South Africa, Zambia and Zimbabwe (Abstracts 4.1, 4.2, 4.3) suggests that these measures are likely to be effective at reducing wild dog mortality if applied with sufficient rigour. More hands-on interventions such as snare removal and fitting of protective collars may also reduce mortality, and may play a role in restricted circumstances where dedicated wild dog monitoring projects are in place. Hence, we conclude that sufficient information is already available to reduce snare threats to wild dogs, and that this issue is not a priority for further research (though it is clearly a priority for continued conservation action).

Contact People

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Chapter 6 – Reducing impacts of road and rail accidents

Summary
Road and rail accidents can seriously undermine the viability of local populations where high speed roads and railways cross preferred wild dog habitat. Road designs to reduce impacts on wildlife are being developed in North America and Europe but are probably cost-prohibitive in Africa. Road signs, speed bumps and natural road disrepair may all help to slow traffic and reduce risks to wild dogs. Reflective collars have also been fitted to reduce road mortality, although such intensive management is probably appropriate only where dedicated wild dog conservation and management teams are resident. A characterisation of the sites where wild dogs are killed by road traffic would help to identify and target mitigation measures; however conservation efforts would be most profitably invested in advocating against building or improving roads that pass through, or close to, key wild dog areas.

6.1 Introduction

Road and rail accidents are a locally important cause of wild dog mortality (Table 2.2), with the capacity to seriously affect population viability where high-speed roads and railways traverse preferred wild dog habitats.

6.2 The nature of the threat

Wild dogs use roads as travel corridors and even rest sites (Figure 6.1), hence they are probably at greater risk from vehicle collision than otherwise similar species that ignore or avoid roads. Anecdotes suggest that some road 'accidents' represent deliberate attempts to kill wild dogs, but most road (and presumably all rail) impacts are probably unintentional. Impacts appear particularly serious where high-speed roads pass through or close by wildlife areas. For example, multiple wild dogs have been killed on paved roads that pass through Kafue NP, Zambia (A. Carlson unpubl data, Buk, 1994), and close to Mikumi and Hwange NPs, in Tanzania and Zimbabwe respectively (Drews, 1995; Woodroffe *et al.*, 1999a).

Figure 6.2 *– Wild dogs use roads to travel and even to rest, increasing risks of collision with vehicles. Photographs © Megan Parker (left) and Micaela Szykman (right)*

6.3 Possible solutions

Measures to reduce the impacts of roads on wildlife are receiving increasing attention in the developed world (Forman & Sperling, 2002). However, many of the approaches require large under- or overpasses and their use in Africa is probably prohibitively expensive. Clearly, the highest priority is to avoid routing of new roads and railways, or improvement of existing roads, through or in the vicinity of important wildlife areas, particularly national parks and reserves. Where high speed roads already exist, however, three approaches have been applied or considered specifically to protect wild dogs:

6.3.1 Road signs

Road signs warning motorists to slow down for wild dogs were erected in the early 1990's where the Bulawayo-Victoria Falls road adjoins the Hwange ecosystem in western Zimbabwe. While no quantitative comparison has been made, the impression is that these signs did help to reduce mortalities due to road accidents (J. Ginsberg & G. Rasmussen, unpubl. data), and will certainly have created local awareness of the problem.

6.3.2 Speed bumps

Zambian authorities are currently considering installing speed bumps where the Lusaka-Mongu road crosses Kafue National Park, with the intention of reducing impacts on wild dogs and other protected wildlife in the park (A. Carlson, unpubl. data). If sufficient speed bumps can be installed, this is likely to reduce risks to wild dogs. Of course, many parts of Africa have very poorly maintained roads which can be viewed as an inexpensive alternative to speed bumps.

6.3.3 Reflective collars

'Anti-snare' collars fitted to wild dogs in Zimbabwe (see section 5.3.2 and Figure 5.3) are also reflective with the intention of making animals more visible to motorists at night. It is difficult to distinguish possible benefits of these collars from effects of the road signs, but available data indicate that road mortality did decline after the two measures were introduced (Rasmussen *et al.*, in review). However, as was emphasised in discussing their use to reduce snare impacts, protective collars represent a labour-intensive, expensive approach which, given small but non-zero risks associated with immobilizing and handling wild dogs (as well as fitting collars which weigh approximately 400g), is unlikely to be appropriate except where dedicated wild dog conservation projects are resident.

6.4 Do we know enough? What more do we need to know?

Tools to reduce road impacts on wildlife are receiving increasing attention in the developed world, although many of the approaches being tried in Europe and North America are probably too expensive for use in Africa. Several more low-tech approaches have been tried, or planned, to protect wild dogs, with one or two showing at least some evidence of success. Hence, sufficient may be known to be able to advise conservation managers on avoiding or, where necessary, mitigating this threat although it would be beneficial to continue to monitor research findings from the developed world in case relevant new approaches emerge. In the meantime, characterising the sites where wild dogs are killed by road traffic could help determine where mitigation strategies might best be targeted. Perhaps the highest priority is to advocate against building or upgrading of new high speed roads and railways in and around key wildlife areas.

6.4.1 *What characterises sites where wild dogs are killed by road traffic?*

A multi-site analysis of the characteristics of roads where wild dogs are killed could help to identify the circumstances that cause the most problems, and may help to inform the design of mitigation strategies.

Action: Multi-site analysis of the characteristics of roads where wild dogs are killed

By: Anne Carlson and other interested collaborators

Contact People

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Photograph © Micaela Szykman

Chapter 7 – Understanding and reducing disease threats

Summary
The circumstances under which infectious disease threatens wild dog populations are poorly understood, but impacts can sometimes be severe, especially in small populations. Rabies and canine distemper virus (CDV) are the most acute threats although, for reasons that are unknown as yet, CDV sometimes causes high mortality but sometimes has no detectable population impact. Infectious disease may not be the most severe threat to wild dogs, but it is arguably the least tractable given the current state of knowledge. Workshop participants highlighted the need for research to:

- *evaluate disease threats to wild dog populations of different sizes and under different management conditions. All participants agreed to collaborate in such a study, protocols were discussed and a funding preproposal submitted in the course of the workshop.*
- *develop improved models of disease dynamics and risks to wild dog populations, ideally based on existing models developed for Ethiopian wolves*
- *test new recombinant rabies and CDV vaccines on captive wild dogs, for potential use on free-ranging dogs where appropriate*
- *investigate possibilities for oral vaccination of wild dogs that are not habituated to vehicles and inhabit inaccessible areas*
- *better understand the dynamics of rabies and CDV in wildlife areas*

7.1 Introduction

Infectious disease is a recognised threat to wild dogs, which has contributed to the extinction of at least one population and thwarted two reintroduction attempts (Gascoyne *et al.*, 1993; Hofmeyr *et al.*, 2000; Kat *et al.*, 1995; Scheepers & Venzke, 1995). The evaluation of mortality causes presented in Chapter 2 does not highlight infectious disease as a major cause of adult mortality, but disease effects may be under-estimated for two reasons. First, about 30% of adult wild dogs are recorded as having died of ‘unknown’ causes (Table 2.2), and a proportion of these may have died of disease. Second, disease epidemics are clustered in time and space, so they may not be detected without long term monitoring. About 20% of pup deaths are attributed to disease (Figure 2.10); again, this might be an underestimate.

At the Kruger workshop, there was substantial discussion about whether infectious disease should be considered a threat to wild dogs, or a process which causes natural population fluctuations which are themselves a component of biodiversity. A conclusion was reached that the risks of population extinction due to infectious disease are insufficiently known. In large, extensive populations, disease may have local effects on population dynamics but may not seriously threaten population viability. Small populations are expected to be more at risk than larger ones; however it is not clear at what size and extent of occurrence a population can be considered ‘safe’. Effects of infectious disease interact with other processes: for example, a population might be less resilient to disease if it was already suffering high adult mortality due to incidental snaring. Moreover, the capacity of natural metapopulations to withstand periodic local extinctions depends on connectivity of sub-populations, which is likely declining across much (though by no means all) of Africa.

Although disease may not be the most serious threat to the persistence of wild dog populations, it is arguably the least tractable. Past attempts to protect wild dogs from the two infections that pose the most acute risk – rabies and canine distemper virus (CDV) – have often met with failure (see below), with animals dying despite having been vaccinated both in the wild (Woodroffe, 1999) and in captivity (van de Bildt *et al.*, 2002). Vaccination of wild dogs against rabies in the Serengeti ecosystem in 1989-90 attracted a major international controversy (Burrows, 1992; Dye, 1996; Heinsohn, 1992; Morell, 1995) without preventing local extinction (Woodroffe, 2001) and, partly because this controversy effectively froze research in the area, tools for protecting wild dogs have not advanced far in the intervening decade.

7.2 Possible solutions

7.2.1 Vaccination of wild dogs themselves

Perhaps the most obvious solution to a disease threat would be to vaccinate wild dogs themselves. Vaccination of free ranging wild dogs against rabies has sometimes failed to prevent them from dying of rabies (Woodroffe, 2001), although isolation and vaccination helped to halt one rabies outbreak in Madikwe (Hofmeyr *et al.*, 2000), and vaccinated wild dogs survived a second outbreak (Hofmeyr *et al.*, 2004). Wild dogs appear to mount a poor immune response to inactivated rabies vaccines, with high rates of seroconversion only after 3-4 doses have been given (Visee *et al.*, 1998). Trials with modified live rabies vaccines (given orally) suggest that these are more immunogenic (Knobel, Liebenberg & Du Toit, 2003), although the duration of protection is not known. New recombinant rabies vaccines have not been tested on wild dogs, nor is it known how administration by hand, dart or in baits affects immune responses. A bait delivery system for oral vaccination has been developed (Knobel, du Toit & Bingham, 2002), but it depends upon being able to locate dens and visit them repeatedly without disturbing the dogs; opportunities for oral vaccination outside the denning season, or in areas where dens are inaccessible, are unknown but likely to be extremely limited.

Free ranging wild dogs have never been vaccinated against CDV. Inactivated vaccines appear ineffective in captivity (van de Bildt *et al.*, 2002), while some strains of modified live vaccine carry a risk of vaccine-induced distemper (Durchfeld *et al.*, 1990; McCormick, 1983; van Heerden *et al.*, 1989). New recombinant CDV vaccines have not yet been tested on wild dogs.

Equally seriously, it is not yet clear under what circumstances vaccination of wild dogs is warranted. Small populations are most at risk of extinction due to disease. However, the South African Wild Dog Advisory Group (WAG-SA) recently decided to halt vaccination of wild dogs in the South African managed metapopulation, on the grounds that local sub-populations are expected to go extinct periodically in a metapopulation, and can be restored by reintroduction. Elsewhere, however, it cannot be assumed that small populations can be restored, especially in West and Central Africa where there may be no source populations from which to draw animals for reintroduction. Vaccination could be carried out either proactively, or in response to known outbreaks; recommendations about which would be best require modelling, and also would depend upon the existence of sufficient monitoring to recognise the start of an epidemic, as well as on the ability to locate and vaccinate wild dogs in an emergency. This latter depends upon a combination of terrain, road access, degree of habituation of the dogs, and infrastructure. An added complication is that emerging data indicate that CDV does not always cause mortality, either in wild dogs or in other endangered canids, although it periodically causes very high mortality (Alexander *et al.*, 1996; van de Bildt *et al.*, 2002). The reason why the pathogenicity of CDV varies so widely is unknown, and makes it difficult to know when to intervene, especially as strains with low pathogenicity – which might be eradicated by vaccination – may provide better 'vaccination' than do man-made vaccines.

Despite these caveats, direct vaccination of wild dogs themselves may be the only option when infection cannot be controlled in the reservoir host, either because the reservoir is unknown, or because it is extremely difficult to vaccinate safely and effectively (e.g. if 'the reservoir' involves multiple wildlife host species, Haydon *et al.*, 2002a).

7.2.2 Vaccinating domestic dogs

Africa's domestic dog population is growing faster than its human population in some areas (e.g. Brooks, 1990; e.g. Kitala *et al.*, 2001), and domestic dogs are suspected to be the source of canid pathogens that may threaten wild dogs (Alexander & Appel, 1994; Cleaveland *et al.*, 2000; Kat *et al.*, 1995). Field studies show that domestic dog vaccination can reduce disease risks (Cleaveland *et al.*, 2003; Coleman & Dye, 1996), and modelling suggests that this is likely to reduce 'spillover' infections in Ethiopian wolves (Haydon, Laurenson & Sillero-Zubiri, 2002b). Of course, vaccinating domestic dogs will only protect wild dogs if domestic dogs are indeed the pathogen's reservoir host (Haydon *et al.*, 2002a). Some documented disease outbreaks in wild dogs have been linked to jackals, rather than domestic dogs (J.W. McNutt, unpubl data, Hofmeyr *et al.*, 2000; Scheepers *et al.*, 1995), and serological studies of CDV in hyaenas suggest that infections may not be acquired from domestic dogs (Harrison *et al.*, 2004). Hence, it is not clear to what extent domestic dog vaccination alone may influence the dynamics of infections that affect multiple host species. While domestic dog vaccination is likely to reduce the risks of disease transmission to endangered canids, it cannot eliminate it entirely: despite maintaining rabies vaccination coverage of domestic dogs over several years in the Bale Mountains region of Ethiopia, in 2003 a rabies outbreak occurred in Ethiopian wolves which threatened the viability of this most valuable population of Africa's rarest canid (Randall *et al.*, 2004).

***Figure 7.1** – Vaccination of domestic dogs has been an important component of conservation efforts for Ethiopian wolves. Photograph © Martin Harvey.*

Vaccination of domestic dogs against rabies has benefits for human and livestock health, as well as for wildlife. Hence, proactive rabies vaccination may often be an appropriate measure. In contrast, vaccination against other infections such as CDV and parvovirus may do more harm than good if this halts the circulation of less pathogenic strains which act as 'natural vaccines' and promote natural resistance. Vaccination of domestic dogs against such infections might still be appropriate in the face of a known outbreak of a pathogenic strain – but, once again, this would only be practicable where monitoring is sufficient to detect such epidemics.

7.2.3 Reducing contact between wild and domestic dogs

Reducing contact between wild and domestic dogs may be achievable inside protected areas, where there is no need to tolerate domestic dogs' presence. Outside protected areas, however, this is more difficult to achieve. People keep domestic dogs out of choice, as guards and cleaners of the human environment, and demand for puppies is often high (e.g. Kitala *et al.*, 2001; Laurenson *et al.*, 1997) – hence it may be difficult to reduce dog numbers without losing community support. Indeed, domestic dogs have been shown to benefit predator conservation by reducing depredation on livestock (Ogada *et al.*, 2003). Reducing their numbers may therefore be undesirable, even from a conservation perspective. Watch dogs can still function if tied up; however attempts to encourage this in Ethiopia by distributing collars and chains failed when people simply used the equipment for other purposes (Laurenson *et al.*, 2004). Studies are underway in Kenya to better understand the extent of contact between wild and domestic dogs (R. Woodroffe unpubl. data).

7.2.4 Increasing population size and connectivity

If small populations are most at risk, the most sustainable way to reduce disease threats is to turn them into large populations. Maintaining and (where possible) expanding the extent of wild dog habitat, and connections between patches, should be highly effective at both reducing the risks of local extinction due to infectious disease, and increasing the chances of natural recolonisation should extinction occur (Gog, Woodroffe & Swinton, 2002; McCallum & Dobson, 2002). It is important not to lose sight of this ultimate goal for wild dog conservation.

Figure 7.2 *– Ethiopian wolves were vaccinated against rabies in the face of an acute risk, a known outbreak in the only remaining population large enough to be long-term viable. Photograph © Darryn Knobel.*

7.3 Do we know enough? What more do we need to know?

The discussion above points to the many questions that must be answered before effective strategies can be developed to recognise and protect wild dog populations at risk of extinction due to infectious disease. The working group on infectious disease highlighted the following specific issues to be addressed:

7.3.1 Evaluate the safety and efficacy of recombinant rabies and CDV vaccines

New recombinant rabies and CDV vaccines have been developed that are expected to provide more protective immunity than killed (inactivated) vaccines and eliminate the risks of causing disease that are associated with modified live vaccines. These vaccines have been tested in a diverse group of carnivores without adverse reactions. Testing these vaccines on captive wild dogs will be valuable to improve protection of captive populations, and will also help to develop potentially effective tools to protect free-ranging wild dogs either proactively or in the face of an outbreak. The trial should ideally compare seroconversion (and, where possible, cellmediated immunity) in wild dogs vaccinated by hand, by dart, and by consuming vaccine-laden baits.

Action: Establish zoo-based vaccine trial, in collaboration with AZA and other zoos. First steps have already been taken

By: Cora Singleton, Bonnie Raphael, Pat Thomas, Jonna Mazet, Rosie Woodroffe and collaborators

7.3.2 Further test delivery systems for oral vaccines to free ranging wild dogs

Preliminary work has shown that free ranging wild dogs can potentially be vaccinated by consuming baits, but this depends upon being able to locate active dens and visit them repeatedly. Further work needs to evaluate (i) whether oral baits can be successfully delivered to wild dogs outside the denning season; (ii) whether baits can be successfully delivered to wild dogs that are not habituated to vehicles and/or den in inaccessible places; (iii) the extent to which baits are consumed by nontarget species (which may raise safety concerns both in terms of possible adverse reactions to vaccines and also attracting scavengers such as hyaenas to the vicinity of wild dog dens). While awaiting data on the safety and efficacy of recombinant vaccines, these trials should be carried out with baits *not* containing any vaccine, though biomarkers may be of value.

Action: Prepare protocols and seek funding to test delivery systems for oral vaccines

By: Rosie Woodroffe and any other field project keen to collaborate on this

7.3.3 Expand modelling of disease threats to wild dog populations under different scenarios

Decisions about whether, and how, to intervene to protect wild dog populations would benefit greatly from improved modelling. Existing models developed for Ethiopian wolves (Haydon *et al.*, 2002b) provide an ideal starting point, and show what can be achieved. Such a model would help to determine (i) what size populations are most at risk and hence most in need of intervention; (ii) vaccine coverages that would be most effective in reducing the risks of local extinction; (iii) the extent to which vaccination of wild or domestic dogs is most effective at reducing extinction risks.

Action: Expand modelling of infectious disease in wild dog populations (based on existing model structure developed for Ethiopian wolves)

By: Karen Laurenson, Dan Haydon and collaborators

7.3.4 Evaluate disease threats to wild dog populations of different sizes and management conditions by improved monitoring in existing populations.

A better assessment of disease risks to wild dog populations that vary in size, extent, and exposure to domestic dogs and other disease hosts, would greatly improve the basis for recommendations about when intervention is (or is not) appropriate. As discussed in Chapter 2, disease risks are unknown in many populations because monitoring is rarely set up in ways that allow accurate assessment of causes of mortality, or exposure to pathogens of possible concern. The workshop was used to propose a multi-site study of disease threats, based on collection and analysis of tissue and blood samples from wild dogs under study at all research sites. All workshop participants agreed to collaborate on this study, and were given training and equipment for collection of relevant samples (protocol at http://www.vetmed.ucdavis.edu/whc/pdfs/necropsy.pdf; Figure 7.3). A grant pre-proposal to fund this study was submitted in the course of the meeting. The study will use risk factor analysis to measure disease threats to different kinds of population, and will also establish a bank of samples that may be useful for future analyses.

Action: Establish multi-site collaborative study of disease risks to wild dog populations. Seek funding, and then develop and circulate guidelines for sample collection (including import/export permits)

By: All participants, but led by Linda Munson, Jonna Mazet & Rosie Woodroffe

Figure 7.3 *– Prof Linda Munson demonstrates necropsy techniques (left) and delegates display their newly acquired necropsy kits (right). Photographs © Rosie Woodroffe*

7.3.5 Carry out research to better understand the ecology of rabies and distemper in wildlife areas

Infectious disease threats are difficult to evaluate and manage mainly because we have only a very limited understanding of the ecology and dynamics of rabies and distemper in wildlife communities. How important are these viruses in influencing the dynamics of their host populations? Do they persist in particular reservoir host species, occasionally ‘spilling over’ into other hosts, or are all outbreaks transient? What role do domestic dogs play in infection dynamics? Why does CDV sometimes cause high mortality and sometimes cause no mortality? Is this due to strain variation, or do cofactors such as other pathogens make hosts more susceptible? Answering these questions requires long term study, probably at multiple sites. However, capacity to conserve wild dogs in the presence of infectious diseases will be severely limited unless these questions are addressed.

Contact People

Linda Munson
Karen Laurenson
Markus Hofmeyr
Jonna Mazet
Rosie Woodroffe
Pete Coppolillo

Chapter 8 – Reintroduction and metapopulation management

Summary
Releases of captive and wild-born wild dogs have been used to successfully establish and manage a metapopulation of wild dogs within South Africa. Hence, techniques for reintroduction and population supplementation are now well established. This approach has value in South Africa's highly fragmented landscapes, and the techniques developed may become applicable elsewhere if habitat fragmentation proceeds unchecked. However, in range states with potentially viable free-ranging populations, maintaining extensive wildlife areas, and promoting connectivity between them, is a far higher priority. Indeed, in these areas reintroduction efforts could distract attention and donor funding away from more beneficial conservation activities. The challenge in South Africa is increasingly turning from reintroduction to fostering expansion of sub-populations, and linkages between them, using private lands. This will inevitably require resolution of conflicts with game and livestock farmers. Techniques for resolving these conflicts are discussed in Chapters 3 and 4 and no additional research priorities are identified here.

8.1 Introduction

To date, the only successful reintroductions of wild dogs have been in South Africa, where small (often single pack) sub-populations have been re-established inside fenced reserves to form a managed metapopulation (Mills *et al.*, 1998). This approach, though costly, was necessary in South Africa's highly fragmented landscapes. Thus far, this approach has not been considered appropriate in other countries since it has been suggested that conservation efforts would be better directed at existing populations (Woodroffe *et al.*, 1999b).

The Workshop presented an opportunity to review progress with the South African metapopulation, to discuss the appropriateness of the methods used and also the guiding philosophy for metapopulation management. These issues are also discussed regularly by the South African Wild Dog Advisory Group (WAG-SA) which oversees the management of the metapopulation. The workshop also allowed discussion of the relevance of the managed metapopulation approach to other range states.

8.2 Status of the South African metapopulation

The status of the metapopulation is described in Abstracts 1.3 and 1.2. In brief, establishment of the metapopulation has been successful, rising from 49 dogs in 2 sub-populations in 1998 to 147 dogs in 6 sub-populations in 2004. It was originally assumed that wild dog numbers would be limited by lion predation (Mills *et al.*, 1998) but this has not occurred and dispersers have instead been moving out of fenced reserves into neighbouring private lands, sometimes encountering problems there.

8.3 Reintroduction and supplementation methods

Methods used to reintroduce and supplement wild dog populations in South Africa have been very successful. The formation of new packs, both in captivity and in nature, is a complex process and there is a risk that inappropriate management could lead to stress and even fatalities (Abstract 7.3). However such problems appear not to have occurred in South Africa and survivorship (Figure 2.7) and reproductive rates have been high. Hence the techniques used in

South Africa would clearly be appropriate for use in wild dog reintroductions or population augmentations considered for other areas.

8.4 Guiding principles for metapopulation management in South Africa

The South African managed metapopulation was formed to conserve wild dogs and biodiversity more widely. Hence, the aim should be to conserve not only enough wild dogs to form a viable population, but also the ecological processes of predation, competition and parasitism that influence, and are influenced by, a large mammalian predator. It is to be expected that wild dogs inhabiting small, fenced reserves may depress their prey populations. Likewise some wild dogs may be killed by lions, and some die from infectious diseases. None of these is necessarily grounds for intervention. Nevertheless, in managing the metapopulation it is important to bear in mind the availability of source animals to restore subpopulations that might become extinct (e.g. through rabies outbreaks as have occurred twice at Madikwe).

Some wild dog reintroductions have provided commercial benefits through increased ecotourism. This ability of wild dogs to potentially 'earn their keep' is extremely encouraging for their long term conservation (Abstract 7.1). However, some sub-populations have been managed with tourism, rather than conservation, in mind. For example, at least one 'sub-population' currently contains only males since presence of a breeding pack was perceived to risk over-population and consequent depletion of valuable 'game' species. Such management contributes little, if anything, to conservation; it would be greatly preferable for commercial tourism income (and certainly donor funding) to be directed to sites which are contributing effectively to wild dog conservation.

As the sites available for wild dog reintroduction in South Africa become smaller, it may become more difficult for them to support breeding packs without unacceptable (and probably unsustainable) depletion of prey species. Hence, metapopulation management must increasingly focus on creating opportunities for wild dogs to move between reserves and, potentially, to recolonise surrounding private lands. Such efforts have begun in Zululand (Abstract 1.2).

8.5 Relevance to other countries

The system of land use and land tenure within South Africa is unusual within Africa. Most other range states either retain free-ranging wild dog populations in reasonably extensive wildlife areas (with or without protected area status), or have lost their wild dogs with little hope of restoration in the near future since remaining wildlife areas are small, isolated, and largely unfenced (Woodroffe *et al.*, 1999b). Hence, the managed metapopulation model currently appears most appropriate for use within South Africa.

South Africa's efforts to restore a second viable population locally are to be applauded. Moreover, the techniques developed in South Africa may become more relevant in other range states in future, if habitat fragmentation continues unchecked. In the short- to medium-term, however, where potentially viable wild dog populations remain, maintaining or extending large wildlife areas, and promoting connectivity between them, has the highest priority for wild dog conservation. Indeed, concern was expressed at the meeting that attempts to emulate the South African model in countries such as Botswana, Namibia and Kenya could be detrimental, because they risked drawing attention and donor funding away from potentially viable free-ranging populations with substantially greater conservation value. For this reason, the consensus among Workshop participants was that the managed metapopulation concept was currently most applicable within South Africa, with little value – given current conditions – in other countries.

Workshop participants also discussed a proposal to augment the wild dog population in Lower Zambezi National Park, Zambia, where a study population of 37 was reduced to nine related individuals, primarily through chronic problems of incidental snaring (Abstracts 4.3, 6.2). Intensive anti-poaching efforts appear to have reduced the immediate threat to the population (Abstract 4.3) but recolonisation is considered unlikely because of the area's geographical isolation from other populations (Abstract 1.13). Hence, augmentation of this population has been proposed as part of a conservation programme which also includes establishment of a dispersal corridor linking Lower Zambezi to South Luangwa National Park where another population occurs (Abstract 6.2). Discussion of this proposal cantered on whether augmentation was necessary, or whether natural immigration might occur.

8.6 Do we know enough? What more do we need to know?

Successful reintroductions and augmentations in South Africa demonstrate that techniques for wild dog releases are well-established. The use of such methods outside South Africa is currently considered low (even very low) priority. The emerging challenges within South Africa are to understand wild dogs' impact on prey populations inside fenced reserves (a subset of a research question already identified at 4.4.2), and to foster safe passage for wild dogs dispersing naturally between sub-populations or setting up residence in neighbouring private lands. This will necessarily require resolution of conflicts with game- and livestock farmers; these issues have already been discussed in Chapters 3 and 4. No further research priorities are identified.

Contact People

Since extensive experience with wild dog reintroduction and metapopulation management resides within the South African Wild Dog Advisory Group (WAG-SA), Workshop participants recommended that members of this body act as the contact point for advice on these forms of wild dog management. Contacts include Harriet Davies-Mostert, Pat Fletcher, Markus Hofmeyr, Gus Mills and Micaela Szykman.

Figure 8.1 *– Wild dogs immobilized for release in Madikwe, South Africa. Photograph © Gus Mills*

Chapter 9 – Further Needs and Future Directions

Summary
This report summarises the state of knowledge concerning effective tools for wild dog conservation. Where lack of information hinders successful conservation, we have identified critical questions and nominated individuals to take the lead on gathering the necessary data. Most of the priority questions identified can be addressed at existing sites; however because most studies take place inside protected areas, key information on conflicts between people and wild dogs can be obtained only by establishing new studies in livestock- and game-farming areas.
The next steps for planning effective wild dog conservation are
- *to identify priority areas for conservation action*
- *to engage with local managers and regional policymakers to plan implementation of conservation activities*
- *to establish protocols for surveying and monitoring wild dog populations, particularly emphasising noninvasive techniques*

These activities are probably best pursued in parallel, particularly because involvement of local decision-makers and managers at the early stages of planning (including priority setting) is most likely to foster well-planned and effective conservation on the ground.

9.1 Introduction

This report reviews available tools for the management of African wild dogs, and highlights gaps in knowledge that currently hinder effective conservation throughout the species' range. In this final chapter, we briefly summarise these important unanswered questions, discuss how they can best be addressed, consider other questions raised by the workshop process, and outline plans for future conservation planning.

9.2 Information needed to develop or improve tools for wild dog conservation

Table 9.1 summarises the questions raised in Chapters 3-8. These are placed in the order in which they arose, and neither the number of questions identified, nor the order in which they are presented, should be taken to reflect the priority attached to a particular threat or question. At the workshop, a decision was taken not to rank the threats identified, for the simple reason that threats vary substantially between the sites where wild dogs have been studied. Hence, no meaningful ranking could be identified that would apply across the species' range. The number of questions identified reflects lack of knowledge about solutions to particular threats, rather than the importance of the threats they address.

9.3 How to address the priority questions identified here

9.3.1 Task leaders and topic coordinators

Recommendations are rarely followed unless people with the power to implement them are involved in the planning process. Wherever possible, when we have identified a priority question for further research, we have also identified an individual, group of individuals, or organisation that has expressed willingness to take the issue forward. In addition, since many of the outstanding questions require collaboration across multiple sites, for most issues we have identified a volunteer 'coordinator' who will take the lead on fostering collaboration. These

Table 9.1 – Priority questions raised at the meeting. The order in which questions appear, and the number of questions, should not be taken to reflect their relative priority (see text)

Threat: conflicts with livestock farmers

3.4.1 *What is wild dogs' true impact on livestock production, and how does this compare with farmers' perceptions?*
This is a key question to direct conservation action, but the answers are likely to vary with local conditions

3.4.2 *Which approaches are most effective at reducing wild dog-livestock conflicts?*
Existing projects in Zimbabwe and Kenya, and new projects in Namibia and Tanzania, provide opportunities to compare management approaches and identify the most promising.

3.4.3 *How can wild dogs best coexist with livestock farmers in areas where livestock graze unaccompanied by herders?*
This is likely to require establishment of one or more new study areas, most likely in southern Africa. Suitable study areas are known to exist in Botswana and Namibia.

3.4.4 *Do wild dog packs become habitual stock killers, or is depredation an inevitable result of livestock and wildlife management in particular areas?*
Continued monitoring in livestock areas of Kenya and Zimbabwe can address this question

Threat: conflicts with game farmers

4.4.1 *Are wild dog populations in game ranching areas self-sustaining, or are they 'attractive sinks'?*
This question requires establishment of one or more new study areas, or expansion of existing study areas onto neighbouring game ranches. Opportunities for this exist in South Africa, Botswana, Namibia, and Zimbabwe.

4.4.2 *What is wild dogs' true impact on 'game' populations, in different ecosystems and also during and outside the denning period?*
While this question concerns conflicts with game farmers, it can be addressed, at least in part, by gathering information from study populations in other land uses, including protected areas.

4.4.3 *Is it possible to realise economic benefits of wild dogs' presence in game ranching areas?*
This is being addressed through fieldwork in South Africa, and could be replicated elsewhere if new study areas were established. Questionnaire surveys to hunters, tourists, and hunting and tour operators could also be informative.

4.4.4 *How can conflicts between wild dogs and game ranchers best be ameliorated?*
This needs to extend experiences from Venetia and Savé to more typical (possibly more hostile) game ranching areas. Suitable study areas exist in South Africa, Namibia and Botswana.

Threat: road accidents

6.4.1 *What characterises sites where wild dogs are killed by road traffic?*
This can be addressed by comparison across existing study areas.

Threat: infectious disease

7.3.1 *Test the safety and efficacy of recombinant rabies and CDV vaccines*
This should be carried out on captive populations in the first instance.

7.3.2 *Further test delivery systems for oral vaccines to free ranging wild dogs*
This can be carried out in existing study populations. Preliminary work has already been carried out in Kruger and Madikwe; further studies are needed on unhabituated animals outside protected areas, e.g. in Kenya or Zimbabwe.

7.3.3 *Expand modelling of disease threats to wild dog populations under different scenarios*
This is a desk-based study drawing upon data from existing study populations.

7.3.4 *Evaluate disease threats to wild dog populations of different sizes and management conditions by improved monitoring in existing populations.*
This can be achieved by collaborative study across multiple existing study areas.

7.3.5 *Carry out research to better understand the ecology of rabies and distemper in natural ecosystems*
This can be pursued in existing study areas

coordinators are named at the end of each relevant chapter, and their contact details are given in Appendix 2.

9.3.2 Do we need to establish additional study areas?

Establishing new study areas for wild dogs is extremely labour intensive (fitting the first radiocollars typically takes 6-18 months) and is hence very expensive. Fortunately, many of the questions raised in this report can be addressed in established study areas, either by continued monitoring or through additional research. Other questions do not require collection of field data. However, because most existing study areas fall inside reserves, some of the questions do require the establishment of new field studies, particularly on private and communal lands. Table 9.1 indicates whether particular questions require establishment of new study areas.

It is important to bear in mind that all existing studies of wild dogs have been carried out in southern and, to a lesser extent, eastern Africa. Hence, the conservation requirements of the few wild dogs remaining in West and Central Africa are virtually unknown. Investigating the possibilities for establishing projects in these areas (e.g. in Sénégal, northern Cameroon or possibly southern Chad) is an additional priority (see also section 9.4.1 below).

9.4 Priority questions not addressed at the Workshop

Several important issues for wild dog conservation arose in the course of the Workshop or preparation of the report, but have not been adequately addressed.

9.4.1 Where to focus conservation action for wild dogs?

Effective tools for wild dog conservation are being developed, but it would be very helpful to identify, in the near future, the areas where such conservation activity should best be focused. Such a priority-setting exercise would need, for example, to balance the likely success of conservation action (influenced by population size, and the size and protection status of the lands inhabited, amongst other factors) against measures of the population's intrinsic value (e.g. genetic or ecological distinctiveness). A protocol for such rangewide priority setting has been developed within the Wildlife Conservation Society (Sanderson *et al.*, 2002) and would be very appropriate for use on wild dogs. Conservation problems and ecological processes affecting wild dogs are very similar to those affecting cheetahs; hence it would be appropriate to plan for the two species together.

9.4.2 Understanding connectivity between sub-populations

The long-term viability of wild dog populations will likely depend in part upon their connectivity with other populations. Natural recolonisations (e.g. in the Samburu-Laikipia, Savé, and Serengeti ecosystems; Abstracts 1.11, 1.17, 1.18), and wild dogs' occasional appearance in *countries* where they have long been extinct (Fanshawe *et al.*, 1997) are testament to the species' dispersal capabilities. However, as human populations expand in much of Africa, old connections are likely to be lost, while conversion of farmland to wildlife uses may establish new connections. Identifying priority areas and activities for wild dog conservation requires understanding whether populations are linked, and how lost linkages might, where appropriate, be re-established. Insights into which land uses constitute effective barriers to wild dog movement, and which are readily traversed, will be extremely valuable in understanding and predicting potentially critical linkage points. Such information is readily obtained by appropriate analysis of telemetry data (especially from GPS collars), which may already be available.

9.4.3 *Surveying and monitoring wild dog populations*

Surveying and monitoring are crucial components of conservation. Some areas (e.g. northern Cameroon, Chad, southern Sudan, Mozambique, northern and eastern Kenya) may support crucial populations of wild dogs, but their status is virtually unknown and surveys are badly needed. Likewise, without monitoring, potentially devastating population declines may go undetected until they are irreversible.

Despite these needs, surveying for wild dogs, and monitoring them, is made difficult by their rarity. Most of the data presented in this report come from populations that are intensively monitored using radio-telemetry. This approach is, however, extremely costly, labour-intensive, and might even involve some welfare costs for the dogs involved. Photographic surveys (Abstract 8.3) are useful non-invasive tools for surveying and long term monitoring of population numbers and trends in areas where there is sufficient tourist traffic and good road networks. More ‘low-tech’ approaches, such as use of trackers and detection dogs (Abstracts 8.1, 8.2), may be more appropriate in less accessible areas, especially outside reserves.

All of the methods for surveying and monitoring must be implemented and analysed according to consistent, statistically robust, protocols if they are to be meaningful. Such protocols have been developed recently for cheetahs, and will be published shortly (Durant et al. in prep); these will likely form a very valuable model for the development of similar protocols for wild dog surveys. Developing these methods and protocols is an important task for wild dog conservation, that was not addressed at the workshop and requires attention.

9.5 Policies for wildlife management and land use – key components of wild dog conservation

Several of the threats to wild dog populations identified in this document cannot easily be addressed through local action by wildlife managers. Many threats will be most effectively mitigated through national or regional policies. These include, for example, the reduction of conflicts with game ranchers by encouraging formation of conservancies (Section 4.3.5), and the routing of high-speed roads away from wildlife areas (Section 6.3). More local threats to specific populations may also demand action in the policy arena: for example, construction of veterinary fences and water extraction policies around the Okavango ecosystem may profoundly influence a critically important wild dog population (Abstract 1.7). The key goal of maintaining and, where possible, expanding, the area of wildlife-friendly habitat available to wild dogs clearly requires engagement with policymakers, often across international borders. This process of engagement at national and international levels is a vital next step in planning for wild dog conservation.

9.6 Framework for next steps

This document summarises a substantial body of data and experience on the effectiveness of various tools for wild dog conservation. For some issues (e.g. snaring, road accidents) sufficient information is already available for managers to have a reasonable expectation of improving the viability of wild dog populations. For others (e.g. conflict with ranchers, infectious disease) only partial solutions are available and further research will doubtless improve the likely success of any conservation activities. Nevertheless, tools for wild dog conservation have developed substantially since the IUCN Action Plan was published in 1997, and capacity for making informed management recommendations is improving. Next steps are therefore to

- identify priority areas for wild dog conservation
- engage with local managers and regional policy planners to encourage and plan implementation of wild dog conservation activities
- continue to pursue research prioritised here, to define the most effective and appropriate conservation activities
- develop tools for surveying and monitoring wild dog populations, targeting these activities to priority areas

These four activities are probably best pursued in parallel, particularly because involvement of local decision-makers and managers at the early stages of planning (including priority setting) is most likely to foster well-planned, effective and sustainable conservation on the ground.

Plans to fill the remaining information gaps are presented in this document, and working group participants are committed to pursuing the necessary research. Indeed, some of the projects recommended have already commenced since the workshop took place. The rangewide priority setting, and regional conservation planning, require new initiatives to be commenced over the next two years. These will involve continued collaboration between the IUCN/SSC Canid Specialist Group and the Wildlife Conservation Society, but will also require extensive engagement with conservation managers and policymakers within range states. This process may eventually culminate in an updated IUCN Action Plan for African wild dogs. However, as action planning is a necessarily dynamic process, interim findings and reports will be disseminated widely, most immediately via a dedicated website.

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Appendix 1 – Abstracts of Workshop talks

Session 1 – Project and Area Overviews

1.1 Demography and population dynamics of wild dogs in the Kruger National Park

Gus Mills

The number of wild dogs in packs in the Southern District of the Kruger National Park fluctuated widely between 1990 and 2001. Mean annual pup survival was 0.35 (95%CI 0.29 – 0.42) and mean annual yearling survival was 0.45 (95% CI 0.34 – 0.57). On average only 16% of pups born survived to two years of age. This was offset by high adult annual survival (usually over 70%), high mean litter size (9.4±0.7) and high age-specific female fecundity. The number of wild dogs in the sub-population varied from 59 – 154 with the number of pups making the biggest contribution to this fluctuation. The mean number of dogs over one year of age was 55.9 ±11.6 and the mean number of pups 36.1 ±20.2. (Coefficient of Variation – adults *vs* pups F = 7.415; p = 0.0024). There was a weak relationship between pack size and the number of pups produced, but a stronger inverse relationship between annual rainfall and the number of dogs in the population ($r_s = -0.741; p < 0.01$). Stochastic population projections suggest that the demography of wild dogs in Kruger (very poor juvenile survival offset by high fecundity among old females) produces volatile population dynamics. This is further borne out by the wide fluctuation in numbers recorded in the overall population from a high of 434 in 1995 to a low of 177 in 2000. The data show that the Kruger wild dog population fluctuates far more than was realised. This fluctuation is believed to be due to natural causes. Pack size may be a factor in pup survival, but it is not the only variable and rainfall may be more important through its effect on prey and hunting conditions.

1.2 The wild dogs of Zululand

Micaela Szykman and Michael Somers

African wild dogs were last seen in the South African province of KwaZulu-Natal (KZN) in the 1920’s. Since then, they have been reintroduced into Hluhluwe-iMfolozi Park several times since the 1980’s. Hluhluwe-iMfolozi Park (HiP) is a medium-sized (960 km^2) fenced game reserve that is characterized by a highly heterogeneous savannah, with areas of varying rainfall and vegetation structure that range from open grasslands and riverine areas to dense forests. Management of the Park takes a very hands-on approach, with yearly prescribed burning and regular ungulate removal (through capture and culling). Currently, there are three breeding packs of wild dogs in HiP with a total of 30 adults and yearlings plus 23 new puppies. These packs are tracked on a daily basis to obtain information on pack demography, movements, breeding, hunting and hormone physiology via non-invasive fecal sample collection. Tourism is an important component for wild dog conservation in the area and we have initiated education and outreach programs to inform local communities, farmers and tourists about wild dogs. The greatest challenges to wild dog conservation in KZN are highways running through and along protected areas and conflict with livestock and game farmers. The next step in wild dog conservation in KZN involves expanding populations of wild dogs to additional protected areas, reintroducing new packs onto both state and privately owned reserves, as well as ensuring safe passage for dispersing dogs traveling between protected areas.

1.3 Status of the South African Wild Dog Metapopulation: 1998-2004

Harriet T. Davies-Mostert

The established of a second viable wild dog population in South Africa was identified as a conservation priority at a wild dog population and habitat viability assessment workshop held in Pretoria, South Africa, in October 1997. Large tracts of land (~10,000 km^2) are required to contain viable wild dog populations and as no such areas exist outside the Kruger National Park (KNP), the concept of a managed metapopulation comprising several smaller isolated populations was developed. It was recommended that the metapopulation should ultimately comprise at least 9 wild dog packs, that wild-caught individuals be used as source of founders for at least the first 5 years, and that artificial dispersal among subpopulations should mimic natural processes of immigration and emigration. Potential reintroduction sites would be identified on the basis of 29 criteria important to the survival and persistence of wild dogs.

By August 1998 - the date of the first Wild Dog Advisory Group meeting - the metapopulation contained only two existing subpopulations at Madikwe Game Reserve (MGR) and Hluhluwe-iMfolozi Park (HIP). Between August 1998 and October 2004 four new subpopulations were established at Pilansberg National Park (PNP), Venetia Limpopo Nature Reserve (VLNR), Marakele National Park (MKNP) and Tswalu Kalahari Reserve (TKR). Subpopulation augmentations were carried out at HIP (March 2001 and March 2003), PNP (December 2001) and MKNP (March 2004). The metapopulation grew from 49 individuals in August 1998 to 147 in September 2004 – a mean annual rate of increase of 0.20 (range: -0.44 to 0.92). As subpopulations grew in size, the management of dispersing individuals became an increasingly pressing issue.

A number of smaller reserves (<200 km^2) in South Africa have introduced wild dogs, primarily for the income they generate from tourism. In most cases these areas are too small to support viable wild dog packs and these populations have been excessively managed. It is argued that such management curtails natural ecological processes and such populations should not comprise part of the national metapopulation.

1.4 Wild dogs outside protected areas in South Africa: current conservation status and future potential for conserving wild dogs on game ranchland

Peter Lindsey

At present, a single viable population of endangered African wild dogs occurs in South Africa, in Kruger National Park. Current conservation efforts focus on reintroducing wild dogs into a series of fenced reserves, thereby creating a metapopulation in which sub-populations are actively managed to conserve genetic diversity. Additional options exist for conserving wild dogs outside of protected areas. We attempt to assess the numbers of wild dogs remaining outside protected areas as a precursor for conservation planning and show that they form a more significant component of the national population than previously recognised. Total numbers outside protected areas in South Africa are estimated to have fluctuated between 42 and 106 animals during 1996-2002. Of these, 25-67 individuals were thought to be resident outside protected areas during this period, with an extent of occurrence of 43,310 km^2 and an area of occupancy of 17,907 km^2. Sightings were most frequently reported from the western border of Kruger National Park, the Limpopo Valley, and northern KwaZulu-Natal. Most wild dogs occur on game ranches with unmodified land cover and low human densities, close to source populations. Significant scope for distribution expansion exists in Limpopo and North West Provinces. However, efforts aimed at changing landowner attitudes towards wild dogs are necessary to improve the conservation status of the species outside protected areas.

1.5 Namibia Overview

P.E. Stander (presented by Robin Lines)

Namibia has been monitoring their African wild dog (AWD) population via the Carnivore Atlas programme since 1999 through a collaboration between the Ministry of Environment and Tourism and Predator Conservation Trust. While it is acknowledged that AWD data are limited in relation to Namibia's other large carnivores, baseline information indicates a viable population of 300-600 animals covering an area of *c*.170,000km^2. Their range encompasses a matrix of wildlife and livestock farming areas across both communal and commercial land tenure systems. The population is largely connected and 95% of the distribution falls outside protected areas. Sightings of AWD extend to Etosha NP in north central Namibia, and continue to be reported through the central regions (Otjiwarongo District) and south to Aminus.
Historical research, conducted in Tsumkwe District (Stander, 1996 unpublished data), indicates extensive ranging ecology (*c*. 1800-4300km^2, n = 4 packs). Tsumkwe District, together with the adjacent southern Kavango and north east Otjozondjupa Regions, are considered the core range of AWDs in Namibia covering *c*.40,000km^2 of unfenced communal land with low human population density (average <0.5km^2) and low livestock numbers. Transboundary movement has been recorded along a 75km stretch of the Namibia-Botswana border adjacent to Kaudom NP and Tsumkwe District.
Considerable human-wild dog conflict exists at the interface between land managed for wildlife and rangelands managed for livestock and game farming. At this stage it is unknown how significantly direct persecution (shooting & road accidents) affects the viability of the AWD population. Snaring appears limited and data on disease impacts are limited.
The Ministry of Environment and Tourism, Predator Conservation Trust and Namibian Wild Dog Project are currently developing a National Management Plan for the AWD focusing on (1) Maintaining and expanding AWD range in large continuous tracts of land managed for wildlife; (2) Improving the AWD's image via environmental education & other outreach initiatives; (3) Establishing a metapopulations in smaller areas to develop and promote their economic value; (4) Improving and standardizing conflict mitigation measures.

1.6 Namibian Wild Dog Project

Robin Lines

The Namibian Wild Dog Project (WDP), initiated in January 2002, is a 3 year multidisciplinary undertaking designed to investigate threats to AWD conservation in the eastern communal lands and examine opportunities for mitigating these threats in the context of the National Community Based Natural Resource Management Programme. Core study areas encompass the dominant

OvaHerero livestock farming communities in the south-central districts of Otjozondjupa and the minority hunter-gathering San (Bushman) communities to the north where the predominant land use is wildlife-based.
Objectives include investigating human-wild dog conflict in communal farming areas, developing educational and awareness initiatives reducing human-wild dog conflict, collecting baseline data on other factors effecting AWD conservation and collaborating with stakeholders to develop tourism-based AWD incomes.
Initial results indicate that while the OvaHerero communities believe the AWD impacts significantly on their livelihoods, livestock depredation from AWDs results in a small impact on income (2%) in relation to stock theft (30%), disease (18%), poison plants (13%) and birthing problems (17%). It should be noted that isolated incidents of livestock predation by AWDs can be severe. This is aggravated by ineffective livestock management practices that are the norm. Persecution of AWDs is limited to occasional incidents of poisoning and disruption around dens. A trend towards increasing human population, livestock density and associated reduction in wild prey in these areas is predicted to increase edge effects around the core population, although source-sink dynamics are little understood in arid regions with no surface water. While livestock densities are significantly lower in the San communities to the north, no incidents of AWD predation have been recorded in 8 years and conflict is minimal. AWD losses have been restricted to a handful of deaths through road accidents.
In contrast the WDP has opportunistically collected evidense of human-induced persecution on the commercial farms bordering 150km of the communal lands and records indicate 3 AWD deaths from drowning in an artificial canal and at least 18 deaths from shootings in 2 years.

1.7 African Wild Dogs in Botswana – A Brief Overview of the Botswana Wild Dog Research Project 1989-present

J.W.McNutt

The Botswana Wild dog Research Project was started in 1989 following a region-wide survey to estimate the African wild dog population in northern Botswana. The survey conducted by John Bulger consisted of interviews and questionnaires and produced a minimum estimate of approximately 400 wild dogs in northern Botswana in 42 packs. McNutt began a detailed study within a sample area (approximately 2600 km^2) with the aim of monitoring a sample of the entire population. Objectives within the overall context of monitoring an endangered species were to determine population characteristics including: reproductive rates; age structure; dispersal; and exposure to and impacts of diseases. In recent years in addition to ongoing population monitoring the project has included assessing the degree of conflict between wild dogs and humans.
A comparison between Bulger's earlier survey and McNutt's detailed behavioural research monitoring illustrated the value of survey methods to provide only a minimum population estimate. Where the survey results indicated a likely six packs, detailed monitoring consistently includes an average of nine packs – a survey underestimate of between 30-40% in the number of wild dogs. A minimum population estimate based on sightings in Kruger National Park similarly underestimated the actual wild dog population. Estimates based on monitoring research, and the distribution of reports outside the study area provide an estimate of 78-88 packs or 702-792 wild dogs in northern Botswana.

Northern Botswana has an extensive freshwater wetland system of approximately 14,000km^2 with the Okavango Delta and the northern Kwando-Linyanti. The remainder of northern Botswana (approximately 75,000 km^2) is comparatively dry and is associated with the Kalahari Desert. Density estimates for northern Botswana take into account these coarse habitat types (0.035wd/km^2 (wet) and 0.005 wd.km^2 (dry)) and provide a population estimate of 865 wild dogs in northern Botswana.
All human/wildlife conflict occurs widely throughout the dry habitats of central and western Botswana. The recent addition of 260 km to the already extensive government fencing across central Botswana is intended to decrease human/wildlife conflict. A study of impacts of this newly constructed fence and the management issues relating to free-ranging wild dogs is beginning in October 2004 as part of the Predator Conservation Program.

1.8 Livestock-related conflict and wild dog ecology in the central Kalahari

Matthew J Swarner

As a new project starting in Ghanzi District, Botswana, my PhD research will focus on livestock conflict and the ecology of wild dogs in the Kalahari. Several characteristics of Ghanzi recommend it as a research site: low human (0.21 people/km^2) and lion densities, the 55,000 km^2 Central Kalahari Game Reserve and adjacent Wildlife Management Areas, and a record of livestock attacks by the entire predator guild since 1994. In Botswana, farmers can report wildlife conflict incidents to the Problem Animal Control (PAC) division of the Department of Wildlife and National Parks and receive compensation for a select group of species. Although not compensated for, wild dogs are the second most reported predator, behind leopards, and compose 16% (n=169) of all livestock attacks in Ghanzi. Analysis of the PAC data will evaluate the spatial clustering and seasonal pattern of incidents as well as the effect of wild prey. Subsequent fieldwork will investigate how PAC reports compare to confirmed livestock attacks, identify any biases, and quantify the extent of actual livestock loss due to wild dogs on communal and commercial ranchland. I also plan on investigating the diet and spatial requirements of wild dogs in the Kalahari, elucidating the ecology, for the first time, of a potentially substantial and important population.

1.9 Wild dogs in Hwange National Park, Zimbabwe

Kim McCreery and Bob Robbins

Hwange National Park (14,600 km^2) is the largest park in Zimbabwe. About one half to two thirds of the park is waterless during the dry season (April-October). Perennial water sources are primarily provided by dams and pumped pans found mostly in the northern and eastern sections of the park. Because prey species are most abundant in these areas, dog densities should be highest. Information on the Hwange wild dog population has been largely extrapolated from the northeastern and eastern portion of the park and adjacent farmlands. From 1992-2001, a study of pack dynamics and social behavior was conducted in the north central subregion and the adjacent Deka Safari Area (ca. 2,200 km^2). Relatively small pack sizes (mean pack size: 5.2 ± SE .36, n = 11 in 25 pack years, range = 3–7) were the rule. Population density was an estimated 9.5/1000 km^2 (adults and yearlings), which is lower than 15/1000 km^2 reported for the Hwange population. Pack density was 1.8/1000 km^2. Mean litter sizes were 7.3 ± SE .62 (n =1 1, range = 4-10).

Overall pup mortality was 55-64%. Nineteen cases of mortality were documented (males, $n = 9$; females, $n = 10$). No significant differences were found between the number of documented deaths due to natural versus anthropogenic causes. Lions were the leading cause of natural mortality. Inadvertent snaring was the leading anthropogenic cause. At least four of the five deaths due to snares occurred near the safari area boundary. The Hwange population may be vulnerable to edge effects with the greatest potential threat to dogs being anthropogenic. Notwithstanding socio-political and economic conditions, however, spatial and temporal variation in population dynamics may sustain the Hwange population.

1.10 Research and conservation of *Lycaon* outside protected areas in Zimbabwe

Gregory Rasmussen

Following a survey by Sue Childes in 1988 the Zimbabwean population was estimated at an all time recorded low of approximately 300 - 350 animals, with populations outside protected areas being "destroyed through the absence of adequate legal protection and public education". Subsequently, research identified a strong vacuum effect created by anthropogenic mortality attributed to cars, snares and shootings, and which accounted for 93% of all mortality to packs resident near the boundary of Hwange National park. This effect was demonstrated to destabilise the population inside the reserve. A combination of outreach, anti poaching and law enforcement enabled focussed protection of the packs outside the sanctuary of the park. Focal efforts were directed at smaller packs that research showed had a higher risk of extirpation. Conservation efforts included hands on strategies such as protective anti-snare collars, anti-poaching units, and veterinary attention to injured animals, law enforcement and den protection. The latter was kept remote, as post mortems demonstrated that as a consequence of even minimal disturbance, packs moved, and consequently in the process pups sometimes died of exhaustion. As the study demonstrated the dogs to be territorial, these packs essentially maintained a bio-fence thus keeping packs inside the park and safeguarding the integrity of the park population. The cumulative result of this work resulted in both a reduction in the movement of the territorial drift of packs inside the park, and a slow expansion of packs outside the park into areas the dogs had formerly occupied 100 years ago, with dispersers now probably linking the three main populations namely Hwange, the Zambezi Valley and the Lowveldt. With an expanded Lowveldt population into the Savé conservancy the Zimbabwean dog population is estimated at 750 dogs and the species has recently had its protected status renewed by statutory instrument 80 of 2004.

1.11 African Wild Dogs on Savé Valley Conservancy, Zimbabwe

Alistair Pole

The Savé Valley Conservancy (SVC) is situated in the south east lowveld of Zimbabwe, just north of Gonarezhou National Park. It comprises 22 individual management units that were formerly engaged in cattle ranching. The total area is 3400km^2. Mean annual rainfall is 300 – 500mm with a large coefficient of variation. Altitude ranges from 480m asl in the south to 620m asl in the north west. The topography is characterised by undulating land with large, broken granite outcrops, some reaching over 200m high. The SVC is deciduous woodland savanna dominated by *C. mopane, Acacia sp.* and *Combretum sp.* woodland.

The SVC was officially established in 1991 and due to a severe drought in 1991/92 when all livestock had to be removed, is now exclusively wildlife based. As a result of current political instability, invading settler farmers have entered the conservancy with a recent air survey estimating 8269 huts. These are all in the south of the conservancy and currently affect about 30% of the total land area.

There are 10 known packs of African wild dogs, *Lycaon pictus*, on SVC with an estimated 190 individuals. Of these, 128 are adults (< 1 year) and 72 are pups (> 1 year). The adult density of wild dogs on SVC was estimated to be $0.012km^{-2}$ in 1996 and has been steadily increasing to its current estimate of $0.038km^{-2}$.

A total of 77 dead wild dogs have been located since 1996 with the cause of death, when known, giving an indication of the factors affecting the population on SVC. Snaring and road kills accounted for 11 deaths each (14%). The majority of the road kills occurred on the Masvingo - Mutare tar road forming the northern boundary of the conservancy. Nine wild dogs (12%) were reported to have been killed by humans, mostly at den sites. Natural causes accounted for 12 deaths (16%) with lion causing the majority of these (7) and others including other wild dogs (2), crocodile (1), hunting injury (1) and suspected old age (1). 34 deaths (44%) were of unknown cause.

The wild dog population on SVC is currently being monitored by the Lowveld Wild Dog Project which is funded by Zoo New England.

1.12 Conservation of African Wild Dogs in Kafue National Park, Zambia

Anne A. Carlson, Ron S. Carlson, Hugh Webster, and Fred B. Bercovitch

In 2003, the Zoological Society of San Diego began a conservation and research project on African wild dogs in Kafue National Park (KNP) in Zambia. KNP is an enormous park (22,500 km^2), believed to contain a large, but unstudied, population of wild dogs. Two years into the project, we estimate that that at least nine packs of wild dogs reside in the Northern Sector of the park (120 adults), while a minimum of six packs live in the Southern Sector of the park. Mean pack size is estimated to be 11.6 animals (range= 5-25; n=9). Initial assessments of risk to this population indicate that habitat loss is not a problem within the park. Human densities in the eight, multi-use, game management areas (20,000 km^2) surrounding the park are increasing rapidly, however, which could lead to the loss of an important buffer zone. The 130-kilometer-long highway bisecting KNP is a significant source of annual mortality for carnivores and ungulates, but we expect decreases in mortality after the upcoming installation of speed bumps on the road. Illegal off-take of meat has resulted in a critical shortage of prey animals in the Southern Sector of KNP, although the Northern Sector still supports abundant and diverse populations of ungulates. Funding for anti-poaching patrols by Zambia Wildlife Authority game scouts increased substantially in 2004, allowing more frequent and wide-ranging patrols throughout the park. Human-carnivore conflict became a problem in 2004 because wild dogs in the prey-depleted Southern Sector began to capture and kill goats and chickens in nearby villages; similar problems have not been reported near the Northern Sector. We are currently evaluating the importance of other risk factors (such as disease, snaring, predation by lions and spotted hyenas, etc.) to the long-term persistence of the wild dog population in KNP.

1.13 African Wild Dog Conservation (AWDC), Lower Zambezi National Park, Zambia

Kellie Leigh

The Lower Zambezi National Park contains a small and geographically isolated population of African wild dogs. AWDC carried out a site-specific assessment over a five year period, to identify and prioritize the threats to the population.

Research was undertaken to investigate the interactions of anthropogenic and non-anthropogenic impacts on the African wild dog population, including: a) population edge effects; b) inter-predator competition with sympatric carnivores (*Panthera leo* and *Crocuta crocuta*); c) disease exposure and interaction with domestic dogs; and d) direct anthropogenic impacts including illegal poaching activities. A detailed behavioural study was also carried out to evaluate inter and intra-pack dynamics, hunting success, and patterns of prey density and habitat utilization.

Genetic samples were obtained via opportunistic collection of faecal samples. Mitochondrial DNA control region sequences are being analyzed to compare Zambian population genetic diversity to populations in other geographic regions, and to supplement previous research on the phylogenetic history of African wild dogs. Microsatellite loci are being used to investigate the incidence of inbreeding and multiple-paternity in litters within the population.

Several threats to the Lower Zambezi wild dog population were identified. Wire snares from illegal poaching were a major cause of adult mortality in the first four years of the study, although this threat has now been mitigated. A lack of successful dispersal and immigration was a significant contributor to population decline, compounded further by a recent increase pup mortality from predation by spotted hyaenas.

The study is producing management recommendations aimed at increasing the long-term viability of the population.

1.14 African wild dogs in Mozambique

Jean-Marc André

The vast wilderness of Mozambique provides potential habitat for African wild dogs, allowing for a more or less continuous range between eastern and southern Africa's populations. Wild dog reports from Mozambique date back to the 1970s, with more recent reports available from Niassa and Cabo Delgado provinces alongside the Tanzanian border. We are currently surveying an area of 50,000km_ in central Mozambique which includes 40% of protected areas and hunting blocks. The area is typically open woodland (73%), with some forest (21%) and grasslands (6%). Interviews in 59 out of 200 local settlements present in the area returned data on 85 reported sightings of African wild dogs and their interactions with people. Some 300km of transects have been surveyed to assess the abundance of potential prey species and calling stations used to survey large predators. The areas surveyed present relatively good prey biomass (chiefly red duiker and suni), low human density, few roads, no cattle and low spotted hyaena/lion presence, suggesting good potential for wild dogs. From the emerging data we estimate that at least one pack of up to 25 dogs is resident in central Mozambique, in the North of hunting reserves 12 & 11 (near the settlement of Cine). A second group of up to seven dogs is also reported, and may represent a dispersing group from the Cine pack. We observed three dogs killed by a vehicle collision on the main road near Cine. Road kills and human activities such as snaring and persecution are the main threats we have identified so far to this dog population.

Wild dog records have also been collated from Cabo Delgado and western Tete provinces. No data exist from southern Mozambique. Questionnaire work continues in Nampula, Zambezia and Manica provinces and we plan to extend fieldwork to Niassa and Cabo Delgado. We propose the development of a wild dog conservation programme in Mozambique to develop additional field surveys, and education campaign, deploy road signs and continue cooperation with safari operators, responsible for large tracts of wild dog habitat in the country.

1.15 Status of wild dogs in Tanzania

Maurus Msuha

Tanzania is critically important for the conservation of remaining wild dog population in the world, yet little is known on the distribution and abundance of this threatened species in the country. In 2002 the Tanzania Carnivore Monitoring Project was started with the objective of collecting information on the distribution and abundance of wild dogs and other carnivores and ultimately develop a national action plan for carnivore conservation. Individuals interested in wild dog conservation are requested to send sightings of wild dogs across the country. These sightings are then incorporated into a GIS to produce distribution maps. Tourist photographic surveys are also being carried out through Wild dog Watch Campaign in order to identify and monitor individual wild dogs as well estimating population size of the species. No population estimate has been done yet since data collection is on going.

1.16 African wild dogs in the Rugwa-Ruaha ecosystem, Tanzania

Peter Coppolillo

Very little is known about the Rungwa-Ruaha wild dog population. Preliminary observations and anecdotal data suggest the following:

- The population is potentially very large, since it appears to occupy nearly all of the 41,000 km^2
- However, the population may have recently declined sharply, since no dogs were observed for over 18 months.
- The population has been exposed to canine distemper and rabies, though the fates of exposed individuals and packs are unknown.
- Dogs have been observed using large areas outside Ruaha National park, particularly to the south.
- Lion numbers in Ruaha National Park are at an all time high, suggesting that the areas outside the Park are important for wild dogs in this landscape.

The Rungwa-Ruaha Living Landscapes Program will focus on: establishing a baseline for monitoring wild dog numbers and disease, identifying other threats to wild dogs, and mitigating their effects.

1.17 Serengeti Wild dogs

Karen Laurenson, Sarah Cleaveland, Matt Walpole, Yannick Ndoinyo

Wild dogs apparently disappeared from the Serengeti National Park, Tanznia, the Masai Mara National Reserve, Kenya and their immediate environs in the early 1990s. Although data are sketchy, a 30 year-decline had been coincident with an increase in lion numbers. Disease, particularly rabies, undoubtedly killed a number of packs although the reason for the final extirpation of the population will never be known. Although dogs, possibly emigrant groups, were very sporadically sighted in the 1990s, sightings have increased outside the protected areas, particularly to the east in Masai pastoralist area, since 2000. In 2004 we have reports that at least 2 packs bred in Loliondo District (one of ~8 adults, with up to 20 dogs reported in the other breeding pack, including pups), and regular sightings of further groups both in the Loita Hills in Kenya and north-western Loliondo. Sporadic sightings have been reported in the Aitong area to the north of MMNR, throughout Ngorongoro and Loliondo and also more regular reports at the very south of the Ecosystem to the south of the Makao open area. In summary, there could be between 3-6 packs in the northeastern Serengeti/Mara, but further intensive monitoring is required to improve estimates. Livestock predation is also reported of goats and even cows and this became a particular problem for villagers in Sonjo between April and June 2004, when a pack denned in an area that was depauperate of wild prey. Further work is required to investigate these problems and implement conflict mitigation techniques.

1.18 Wild dog coexistence with people in northern Kenya

Rosie Woodroffe

The 1997 Action Plan recognised the importance of human impacts on African wild dogs, but was able to make only very general recommendations concerning how to mitigate these impacts. The Samburu-Laikipia Wild Dog Project was established in 2001 to evaluate whether, and how, wild dogs could coexist with people and their livestock. The study area lies entirely outside government protected areas, and encompasses a mosaic of commercial ranches and pastoral community areas. Wild dogs were extirpated during the 1980's but recolonised naturally around 2000 and now number over 150. People do have direct impacts on wild dogs through lethal control, but this is uncommon, probably because depredation on livestock has occurred much less frequently than expected. Wild dogs' principle prey in the region are dikdiks; this is especially the case in community lands where larger prey are depleted. However, the reproductive success of wild dogs on community lands is as high as, or higher than, that of wild dogs inhabiting commercial ranch land. Infectious disease has thus far killed more dogs than have people; however to date this has mainly involved sporadic deaths from anthrax, a naturally occurring infection not linked to people. Serological screening revealed little or no exposure to canine distemper virus (CDV) prior to 2003, and widespread exposure thereafter, including one seroconversion and exposure of yearling animals. This suggests that a CDV outbreak occurred between 2002 and 2003, although no deaths were recorded. Seroprevalence among domestic dogs, lions and hyaenas did not change in the same period. The data indicate, thus far, that wild dogs do not require wilderness to survive, and can coexist with people under the right circumstances. However, the population has been extirpated once and it is too soon to be confident it will persist in the long term.

1.19 Community-based study of the conservation status and ecology of wild dogs in southeastern Kenya

Bob Robbins and Kim McCreery

A community-based wild dog project is being launched in the Ijara and Lamu Districts, inclusive of the northern coastal forests of the Eastern Arc Mountains and Coastal Forest Biodiversity

Hotspot, of southeastern Kenya. Hosted by local community representatives, we conducted a preliminary field survey of *Lycaon* in 2003, and, thereafter, requested additional information from people working in the Biodiversity Hotspot. It was confirmed that wild dogs are widely distributed in the region. Although this population may serve as important link for the metapopulation in the Horn of Africa, virtually nothing is known about its conservation status and ecology. This largely unprotected region is ethnically diverse, with seven tribal groups. It is also home to the last known viable population of the Critically Endangered hirola, a potential prey species. The goals of this long-term project are to collect baseline biological data and build local capacity. Project objectives are to: 1) collect data on the abundance and distribution of wild dogs, prey preferences with special reference to hirola and livestock, habitat use, demographics, genetics, and disease, 2) train locals in applied field techniques, 3) conduct trend surveys of attitudes toward wild dogs and other large carnivores, 4) identify and prioritize threats to wild dogs, and 5) assist a CBO in wildlife conservation education. Expected deliverables are to: 1) develop a wild dog conservation action plan in partnership with local, national, and international stakeholders, 2) establish a monitoring program, 3) build a database for large mammal sightings, and 4) co-create a community-driven education program. The project is building partnerships with plans to interact in a number of ways from providing logistical support and data sharing, to collaborating on epidemiological studies and broader community-based initiatives.

1.20 Status of African wild dogs in Ethiopia

Claudio Sillero, James Malcolm and Guy Dutson

Early records give the impression that wild dogs may never have been widespread in Ethiopia. At present, Ethiopia harbours several relict populations of wild dogs over large parts of the country, but they seem to be uncommon everywhere. Most wild dog reports collated come from areas around the Ethiopian highlands. This volcanic plateau lying mainly above 2000m forms the spine of the country, and it has been extensively deforested and cultivated, particularly in areas north of the Rift Valley. Prey for wild dogs, other than domestic stock, is very scarce. Although wild dogs are officially protected in Ethiopia, they are persecuted and killed by pastoralists. Recent sightings improve existing distribution knowledge and extend the known distribution of the species in the country. Records are lumped into six major areas. In the West dog sightings come from Yabello, and it seems likely that some wild dogs survive along the western edge of the country and that this population extends into Sudan (with a sighting in Dinder NP). In the South dogs are reported sporadically in Omo, Mago and Nechisar National Parks, encompassing vast areas of grassland. In the Rift Valley dogs have been reported regularly for the Awash plain, and a few dogs appear to be surviving in the Central Plateau nearby in Mehal Meda, on the eastern edge of the northern highlands. It is unknown if dogs survive in the remote northwest regions of Ethiopia or in Eritrea, where existing records date to the early part of last century.
In the South-East repeated reports of small numbers in the Harenna forest in Bale Mountains National Park are from the atypical habitat of montane wet forest, suggesting that the forested Ethiopian highlands might have supported good populations in the past. To our knowledge, these are the only wild dogs known to inhabit a high altitude montane forest. Interviews of 90 Harenna residents of 20 parishes and drivers regularly crossing the area investigated the knowledge and attitudes to wild dogs of the local people. Sightings were reported throughout Harenna, between the lower forest boundary at about 1,400m and an upper altitudinal limit of 2,000-2,400m, and dogs have been occasionally reported as high as 4,000m in Afroalpine grassland. The dogs were

reported to be in decline, and results suggest that there may be only one large pack of 30 wild dogs. The maximum extent of suitable forest habitat in Harenna is about 1,500km_, and several mid-size prey species preyed were present at reasonable density. Harenna dogs are threatened by disease (rabies was reported in domestic dogs and jackals); encroachment and loss of suitable forest habitat; decline in prey species through competition with livestock; persecution by pastoralists; and occasional road casualties.

Our data suggest that a large area in southern and eastern Ethiopia currently supports wild dogs. This population may extend into Kenya to the south and Somalia in the east. There may be as much as 2,000,000km^2 of suitable dog habitat in the Horn of Africa, providing a very important refuge for the species in east Africa, but information on distribution is slim and data on densities and prey abundance non-existent.

1.21 African wild dogs in West and Central Africa

Claudio Sillero-Zubiri

Most data on the status of African wild dogs in the northwestern end of their distributional range are anecdotal, and early records suggest that wild dogs may never have been widespread in West Africa. At present, the only known wild dog population appears to survive in Senegal's Niokolo-Koba NP, with regular reports available since the 1970s, and occasional sightings in hunting areas to the East and in Guinea-Konakry to the South, in total an area encompassing 25,000km_ of Sahelian woodland reaching the Mali border. We searched for wild dogs in Niokolo-Koba, totalling 24,153km and 1,447 hours of active search during 1996 (and a similar search effort in 1997). This returned only three dog sightings (1,1,2), at a rate of 0.0125 encounters per 100km or 0.002 per hour, indicating their low density and high search effort required to survey them. We concluded that there may be 50-100 wild dogs using the area, threatened by a widespread decline in prey species and road casualties on a high speed tarmac road crossing the park. Persecution by pastoralists and domestic dog presence was relatively low.

Niokolo represents the westernmost, and (most likely) northernmost wild dog population in the continent. There have been unconfirmed reports from Gambia/central Senegal in the 1990s and more recently from a large transfrontier protected area in Benin, Niger, Burkina Faso and Togo, deserving further field surveys. We propose to seek out suitable counterparts in West Africa range countries to continue to collate wild dog presence data, and to reestablish contact with park management in Niokolo – Badiar in order to monitor wild dog status there.

West Africa's wild dogs are most likely isolated from Central Africa's, where there are few data, with the exception of a report by Thomas Breuer from northern Cameroon. Breuer surveyed an area including three national parks (Benoue NP, Bouba Ndjida NP, Faro NP) and 28 hunting areas totalling over 30,000km_ of mainly Sudanian woodland savannah. Wild dogs were seemingly present, though at low density, over the whole protected area network of northern Cameroon, mainly concentrated in the north of Faro NP and south-east of Benoue NP. Dogs were also present in Gashaka Gumti NP across border in Nigeria. Observed wild dog group size varied from 1 to 15, and the density and pack size in Faro had reportedly declined in the last three decades conceivably linked to a recent rabies outbreak on domestic dogs. The currently wild dog population in the area was estimated at 50-100. Habitat loss, loss of prey and direct persecution by Bororo herdsmen have been the major causes for wild dogs' decline. Additionally, cable snares, road kills, infectious diseases (rabies and canine distemper) in domestic dogs and competition with large carnivores, especially lions were cited as possible threats. Highest priority for wild dog conservation in northern Cameroon is to maintain contiguity of wildlife areas and there is a plan to establish a trans-boundary protected area joining Gashaka-Gumti in Nigeria with Faro and Tchabal Mbabo in Cameroon. Further surveys are needed to assess the status of other relict dog populations, particularly in Central African Republic. A conservation project is recommended for Cameroon to reduce human induced mortality, involve local people and promote wildlife conservation in general.

Session 2 – Resolving conflicts with livestock farmers

2.1 Solutions to livestock depredation in northern Kenya

Rosie Woodroffe

Lethal control by people is a major threat to wild dogs in some areas, and a major reason for this is that wild dogs are, or are perceived to be, a threat to livestock. Systematic reporting by livestock herders to trained field scouts, and analysis of wild dog diet through scat analysis, gave independent measures of wild dog predation on livestock in northern Kenya, and both confirmed that depredation is a very rare event in most areas. However, individual attacks may have serious consequences for the farmers involved, as wild dogs kill 3.2 sheep or goats per attack on average, costing about 2 months' income for the average rural Kenyan. Moreover, depredation can be a serious problem in localised areas; while the average cost of tolerating wild dogs is just $3.40/dog/year across most of the study area, in the Churo area on the edge of the Rift Valley this cost is $389/dog/year. A case-control study of the husbandry of herds experiencing wild dog attacks has not yet amassed sufficient data to make recommendations, although the persistence of traditional intensive herding practices in the area is almost certainly critical to the coexistence of wild dogs with livestock. Comparison of areas with and without problems of chronic or sporadic livestock depredation shows that wild dogs tend to kill livestock where wild prey are severely depleted. The threshold prey density to avoid depredation appears remarkably low, suggesting that wild dogs have a strong preference for wild prey over (far more abundant) livestock. Hence, community conservation initiatives which are establishing small areas devoted to wildlife on community lands, with the intention of encouraging tourism, will likely encourage conservation of wild dog prey and avoid development of depredation problems. Wild dog conservation may perhaps be unsustainable, however, in areas where local communities actively hunt wild dog prey.

2.2 Solutions to conflict with livestock farmers in Zimbabwe

Gregory Rasmussen

The advent of colonialism in Africa brought with it a bounty scheme targeting all predators to include *Lycaon*. This scheme, which commenced in 1904, continued until 1988 when it was recognized that Lycaon was not only at risk of extirpation, but was not a threat to the cattle industry. Public perceptions however did not change, with dogs still being regarded as ruthless cattle killers. The resurgence of Lycaon into the cattle ranching regions of Nyamandlovu Zimbabwe in 1993 revived the conflict and resulted in both a better understanding of the situation as well as a protocol for dealing with the situation. Essential ground-truthing highlighted the fact that perception rather than financial loss was the most significant factor influencing ranchers prejudice, for the impact of the dogs was minimal with management losses being far more significant.

Decisions to resolve the issue revolved around the safety and welfare of the dogs concerned, as well as their ability to contribute to the wild population via dispersals. The latter was also balanced by public opinion and the essence of maintaining the most realistic '*entente cordiale*' with all stakeholders and in particular the ranching community as a whole and not just affected ranchers. Based on this axiom, policy was decided upon to translocate only resident dogs after the maximum delay whilst at the same time, ensuring their safety. Capture was effected by helicopter assisted boma capture and safe snares, though significantly greater hyperthermia and times to ataxia were noted using the helicopter method. As these different results were deemed a product of stress, safe snares were latterly adopted as method of choice, though boma capture using fladry rather than a helicopter is currently being investigated.

Results form the policy of translocation were positive from the point of view of both the dogs that survived and bred at all their new locations, as well as produced long distance dispersers from the translocation site, with one individual at least, eventually ending up in South Africa at Messina. Furthermore an '*entente cordiale*' was maintained with the ranchers to the point that when as expected, dogs filled the vacuum caused by the relocation and recolonised the original area, they were again tolerated for three years after their detection until they were moved again. Translocation is therefore seen as a valuable solution that maximizes on dog potential, whilst at the same time minimising conservation costs.

2.3 Scent marking behavior and chemistry for conservation of African wild dogs.

Megan Parker

To determine behavioral and spatial aspects of how wild dog packs range and what tools may be developed to help limit ranging behavior, this study was initiated in northern Botswana. It was necessary to determine how wild dogs occupy their home ranges and whether they are territorial in this area. GPS collars were deployed on contiguous packs to collect contemporaneous movement data to examine if they maintain territorial borders. Combined with remote sensing, we conducted behavioral observations to determine who, how and when wild dogs scent mark. These temporal and spatial data, combined with extensive observations reveal that wild dog packs adhere to strict boundaries and are highly territorial in this population. Where overlap does occur across territorial boundaries, observed behavioral interactions are able to explain spatial overlap, which does not mean temporal overlap. At least four instances of inter-pack mortalities occurred during border disputes, highlighting the importance of territorial maintenance in wild dogs.

Because wild dogs do not vocalize over long distances, chemical communication must be an important aspect of maintaining territories. Fecal scent marks were collected over the last five years, during scent marking bouts along borders. Chemical analyses, including Gas Chromatography and Mass Spectrometry reveal in initial analyses that profound differences occur between dominant / subordinate animals and between genders. Further analyses are attempting to determine whether a "no trespassing" signal may be chemically present in scent marks at boundaries versus interior scent marks.

Manipulating scent marks from one pack's boundaries to another pack's boundaries is the third aspect of this research. We have moved five fecal scent marks per manipulation, always including the dominant, overmarked pair's scent marks. These manipulations are ongoing but to date, packs do respond by investigating and immediately moving away from non-self scent marks placed near boundaries. This may prove a useful tool in managing wild dogs for conservation by limiting pack movements into livestock, village or other areas where mortality risks are high.

Session 3 – Resolving conflicts with game farmers

3.1 Attitudes of game and cattle ranchers towards wild dogs

Peter Lindsey

In South Africa, wild dogs are limited to a single viable population in Kruger National Park. The focus of current conservation efforts is to develop a metapopulation, through the reintroduction of wild dogs into fenced reserves. However, significant potential also exists for conserving naturally occurring wild dogs *in situ* on ranchland. This study represents an assessment of the attitudes of southern African landowners towards wild dogs to determine the scope for conserving them on private land, and to identify the conditions under which conservation efforts might succeed. Over half of ranchers indicated that they would like to have wild dogs on their property, and younger ranchers were more positive than older ranchers, suggesting that traditional prejudices against wild dogs are fading. Attitudes were generally negative where ranches are game-fenced, and where cattle or consumptive wildlife utilization dominate land use. Negative attitudes were typically related to economic costs associated with wild dogs, and conservation initiatives aimed at reducing costs or creating benefits from the species represent the most direct way to improve attitudes. Many ranchers recognized the potential ecotourism value of wild dogs, and attitudes were most positive where ranches belong to conservancies, and where ecotourism-based land uses predominate. Similar relationships were found between ranch/rancher characteristics and attitudes towards most large carnivores, and the findings of our study have general applicability for large carnivore conservation on private land in southern Africa. Encouraging the formation of conservancies should be a priority for carnivore conservation efforts on ranchland, to reduce conflict and promote coexistence between people and predators.

3.2 Co-existence of wild dogs and game farmers in the Savé Valley Conservancy

Alistair Pole

The prevailing attitude of the members of Savé Valley Conservancy (SVC) towards African wild dogs, *Lycaon pictus*, is positive. A number of factors are thought to influence this attitude. The SVC represents a truly extensive game ranching operation in which the average management unit size is 15,500 hectares (38,000 acres). Also, there is no internal fencing within the Conservancy allowing the free movement of the wildlife populations throughout. Although each property has demarcated boundaries, there is not a strong culture of ownership of individual animals as they move from one property to the next. The impact of the wild dogs is, therefore, not seen as being so dramatic.

The ownership of land within the conservancy is also important. Foreign and local investors form 68% of the membership. These owners have generally bought into the conservancy more from a love of 'the bush' than as a serious investment from which they are expecting a quick and significant return. The attitude of these owners is generally very positive towards the wild dogs as they enjoy the aesthetic value of seeing wild dogs on their properties.

The perceived value of African wild dogs to the members of SVC is limited to three factors (1) the aesthetic value of having wild dogs (2) the promotion of a strong ‘conservation image’ for the conservancy and (3) the ecological role of wild dogs taking unfit animals from prey populations. Significantly, there is no direct economic value to having the wild dogs for the members of SVC due to the lack of photographic tourism. The promotion of a strong conservation image is particularly important given the prevailing political climate within Zimbabwe, in which support from international organisations is essential. The role of wild dogs in policing prey populations by taking the weak and the sick is increasingly seen as a benefit by members.

The main perceived problems associated with the wild dogs are (1) that they have a large impact on certain rare antelope populations such as nyala and bushbuck, (2) that they chase game so that it leaves an area or property and becomes skittish (this is particularly prevalent during the denning season) and (3) that it can lead to negative relations with neighbours when the dogs leave the conservancy and kill livestock.

Having an *in situ* project specifically monitoring the wild dog population is thought to have a large influence in creating a more positive attitude towards the wild dogs. The project has been involved in educating game farmers and staff about wild dogs, carrying out applied research and dealing with issues relating to ‘problem’ wild dogs. Most important is thought to be the ‘presence’ of having the *in situ* project, allowing game farmers to discuss wild dogs and often to vent their frustrations when they feel the wild dogs have been detrimental to their operations.

Session 4 – Reducing the impacts of snaring

4.1 Snaring of wild dogs in Kruger National Park

Gus Mills

No detailed records of snaring incidents in the Kruger Park have been kept. Some anecdotal accounts are presented, showing how on occasions snares can seriously compromise dogs. Most snares are apparently set along the boundaries, but because Kruger is long and narrow over most of its area and dogs have large home ranges, most packs come into contact with the boundary and therefore with snares.

5/27 (18%) of known causes of mortality from monitored wild dogs were as a result of snaring. However, this is probably biased as it is easier to document snaring mortality than other more acute causes. Therefore, it is difficult to assess the impact of snaring on the population, but it is believed to be more of an animal welfare issue than a conservation one.

4.2 Methods to mitigate snaring to *Lycaon* in Zimbabwe

Gregory Rasmussen

In Zimbabwe, snaring presents a major problem to all wildlife, though in general the dogs are not regarded with such irrationality and animosity in the communal lands as they are in commercial farmland. Consequently, unless the dogs are being trapped for traditional medicine, which is not the rule, they are victim as a by-catch of the bushmeat trade. Unfortunately due to their peripatetic habits, they are disproportionately vulnerable to being caught in snares set for antelope species. Exacerbating the problem, in a study of 11 packs, 70% alpha males were snared versus 40% of the packs showing other individuals with evidence of snaring. In the three recorded occasions of den snaring for ‘muti’, n=23 adults, the alpha female was caught in every instance with a total of 61% of individuals being caught.

Options to reduce snaring include ‘cure’ via snare removal from individuals caught, which though a welfare obligation, is time consuming and costly. Prevention via anti-poaching units is the most effective as it not only reduces mortality and suffering to *Lycaon*, it also assists target wildlife species. In three years the painted dog anti poaching unit removed 8,000 snares with it being estimated from carcasses found in snares, 6-10% of snares set result in a catch. Continued anti-poaching effort showed a 78% reduction in snaring over a three year period as well as served as a means of community outreach/awareness and so served to do more than simply putting a ‘sticky plaster on an abscess’.

Protective radio collars (Figure 5.3) were also utilised and reduced mortality of dogs caught in neck snares. Of 31 wild dogs fitted with these collars that became trapped in neck snares, 6 (19%) subsequently died, compared with 24 (83%) of 29 dogs caught in neck snare that were either not collared or wearing conventional radiocollars ($\chi 2=21.6$, df=1, $p<0.0001$). These collars fitted as standard, cost US$20 more per collar and functioned as a visibility aid when the dogs were on the road. As alpha males were deemed more vulnerable to snaring, these were targeted for collaring.

In order to protect dens in vulnerable areas, a reward of US$ 60 was paid to those who located a den with a further US$60 being paid if the den remained undisturbed. In essence poachers, who often were those that found the dens, became custodians.

Overall, the combined effort increased the persistence time of target packs on the boundaries of protected areas, ensuring that a number of packs remained resident inside the park rather than becoming victims of the ‘vacuum effect”.

4.3 Impact and Management of illegal poaching on the African wild dog in the Lower Zambezi, Zambia

Kellie Leigh

The impact of illegal poaching was observed to be a major cause of adult African wild dog mortality in the Lower Zambezi. The main threat to African wild dogs and other large mammal species, particularly predators, was indiscriminate snaring carried out by commercial meat poachers both within the National Park and outside its borders.

The annual adult wild dog mortality attributed to snares was observed to be as high as 30%. The full extent of wild dog mortalities due to snaring was difficult to determine as carcasses were often not found. However, circumstantial evidence, based on the numbers of surviving wild dogs observed carrying snares (over 33%) and increased disappearance rates during times of increased poaching activity, suggested this was the main cause of adult mortality in the population.

The snaring threat was addressed in several ways. Firstly, monitoring individual animals and removing snares was thought necessary as the study population was small and therefore particularly susceptible to the effects of increased adult mortality. Secondly, the wild dog project worked closely with the local authorities and anti-poaching organizations to identify high-threat zones; due to their large ranges covering remote areas the wild dogs picked up snares more frequently than most predators and proved to be good indicators of the snaring threat in an area.

Thirdly, a community education campaign was initiated to reduce direct persecution of wild dogs that range outside protected areas.
Ecotourism also plays an important role in the area. Levies for each visiting tourist staying in the safari camps go directly to the local community, thereby encouraging community ownership of natural resources and conservation efforts. The wild dogs have become a flagship species for the area, attracting international visitors and thus playing an important role in ecotourism, as well as raising awareness of the African wild dog's conservation value amongst the local community.

Session 5 – Understanding and mitigating disease risks

5.1 Using epidemiology to determine health threats in endangered wildlife populations

Jonna Mazet

Evaluating population health in wild carnivores can be very difficult because of the paucity of information available on the species and ecosystems of concern and the difficulties associated with logistics in the field. Using a proactive, epidemiologic approach can help to improve data quality and the ability to make health evaluations and recommendations for recovery of endangered species. The first step in this approach is often physical examinations of multiple individuals in the population, most often captured for other reasons such as radiotelemetry, and serological evaluation of endemic pathogens in the population. Serology also allows minimally invasive monitoring of high-risk, potential pathogen cycling; may provide an indication of population immunity; can identify spatial and temporal patterns of pathogen cycling; and may provide information on pathogen virulence when combined with pathology and demography. However, some cautions must be kept in mind when interpreting serology: closely related agents may be detected by the same test; sensitivity and specificity for most tests are unknown for wildlife species; results from different laboratories may not be comparable; and seropositive pups may be result of maternal exposure rather than infection with a pathogen. The next steps involved in evaluating population health include: determining proportional causes of mortality, evaluating spatial and temporal mortality patterns, identifying risks for population-limiting causes of death, and detailed investigations of specific health problems. These follow up steps require close collaborations of field researchers with pathologists and epidemiologists. It is also important to remember when collecting mortality data that intensive follow-up on causes of mortality is not possible unless there is access to "normal" tissues in adequate sample sizes for comparison; therefore all available carcasses should be examined, even if the cause of death (e.g. hit-by-vehicle) is known. The existing interest in collaboration among African wild dog conservation projects indicates that this species may benefit in the short-term from a multi-site health evaluation that will assist in identifying on-going risks to population recovery.

5.2 Disease and Ethiopian wolves

Karen Laurenson, Deborah Randall, Darryn Knobel, Tony Fooks & EWCP

The Ethiopian wolf is found only in the highlands of Ethiopia, with some 500 adult animals distributed across 7 isolated populations. Disease is the most immediate threat for Ethiopian wolves. Mathematical modelling of population viability suggests that smaller (25-50) populations are particularly vulnerable, but that direct vaccination of wolves, or a reduction in the incidence in the reservoir species, will improve persistence probabilities. Two rabies outbreaks have occurred in the largest population in the Bale Mountains. In 1990/91, ~2/3 of the then study population in the Web Valley and Sanetti Plateau died. Another outbreak occurred in 2003. 38 wolves died and 36 disappeared in the Web Valley (~95 wolves) and rabies virus was diagnosed from 13 samples. Sequencing of the N-gene revealed that all were identical and of the rabies canid 1-a virus type found throughout north and central Africa. All available evidence suggest that domestic dogs are the reservoir for rabies and case traceback suggested rabies was brought into wolf habitat by an unvaccinated immigrant dog accompanying people and livestock searching for seasonal grazing. The Ethiopian Widlife Conservation Department took the decision to intervene to try to limit the outbreak. As oral rabies vaccines are not licensed for use in Ethiopian, wolves adjacent to the core area were trapped and vaccinated with an inactivated rabies vaccine. Over 70 wolves were vaccinated and a sub-sample of 19 wolves was recaptured 30 (+/-5) days later to determine the extent of antibody response to vaccination and to administer a further 1ml booster vaccine. All these 19 wolves sero-converted following vaccination, but there was no difference in titres between those vaccinated with 1 or 2ml. The rabies outbreak did not spread into adjacent subpopulations. Intensive post-vaccination monitoring was instigated and current analyses suggest that handling and vaccination did not increase mortality rates.

5.3 Investigating Causes of Mortality in African Wild Dogs

Linda Munson

African wild dog populations may be vulnerable to catastrophic losses from infectious disease because they are susceptible to the pathogens of domestic dogs that encroach upon their habitat, and have social behaviors that promote direct transmission of infectious agents among pack members. Whether infectious diseases pose a serious risk to AWD survival is not clear because the historic and current ecology of pathogens in wild dog habitats have not been determined. Presumably AWD populations have co-existed with endemic infectious diseases for centuries, and some disease mortality would be sustaintainable; but anthropogenic influences may be increasing their risk. Over the last five decades, infectious disease has been suspected as the cause of several AWD populations declines and extinctions. Some population extinctions have been confirmed to be due to infectious disease because carcasses were retrieved and thorough pathology studies were performed. In other cases, serosurveys have disclosed seropositive animals, indicating infectious diseases are not always fatal to AWD.

In 1989, rabies was determined to be the primary or proximate cause of death of most AWD in the Masai Mara National Reserve. Lesions typical of rabies infection were found in many carcasses by histopathology, and the presence of rabies virus confirmed by immunohistochemistry and PCR. Interestingly, some mortalities were caused by intraspecific trauma, presumably incited by the neurological effects of rabies. Canine distemper virus (CDV) infection has also been suspected as causing extensive mortalities in AWD populations, but proof was lacking until a carcass was retrieved during an epidemic in Botswana. Typical lesions of CDV were found by histopathology and CDV infection was confirmed by immunohistochemistry, corroborating the observed clinical signs of infection. Though CDV appeared fatal in this population, it may not always be deadly in AWD, because populations with high CDV seroprevalence have been identified indicating infection and survival. Anthrax is endemic in most AWD habitats, and usually predators have innate resistence. However, several AWD deaths from *Bacillus anthracis* infections have been confirmed, contradicting this prevailing theory, yet other populations of AWD had evidence of exposure without mortalities. A better understanding of what factors cause high mortalities in AWD during infectious disease epidemics will be essential to make informed decisions regarding the necessity of intervention strategies.

More comprehensive pathology studies are needed to move beyond conjecture as to the role of disease in wild dog population dynamics. The cause of about a third of all AWD deaths have not been determined, and these data are essential for developing effective conservation strategies. A long-term pathology survey of AWD throughout their range would be invaluable in determining causes of mortalities and putting recent epidemics in perspective. Identifying risk factors for infection and pathogenicity would provide the information needed to assess the benefit/risks of interventions. Recommended actions for AWD conservation include 1) opportunistic collection of serum or tissues from all AWD that are handled or die, 2) centralizing sample analysis and databases, and 3) forming multidisciplinary teams of field biologists, ecologists, pathologists, and epidemiologists to mine data bases for risk analyses.

Session 6 – Reintroduction and metapopulation management

6.1 Principles for managing wild dogs within the South African metapopulation

Gus Mills

The wild dog metapopulation should promote the conservation of the wild dog and biodiversity. This incorporates both the presence of wild dogs in an area and the restoration of their ability to interact with other species. In wild dog metapopulation reserves management should attempt to simulate the natural conditions for wild dogs as closely as possible. The long-term viability of the dogs in each reserve by maintaining their genetic status and reproductive activity should be the guiding principle. Prey numbers will be affected by the introduction of wild dogs onto a reserve, but wild dog predation is strongly focussed on the more common and less valuable species and in removing the least fit members of prey populations. However, being opportunists, they use fences as an aid to hunting which makes small fenced in areas less suitable for them than larger ones. Wild dog populations may fluctuate rapidly through variable pup survival. When numbers are high managers tend to want to remove dogs because of a perceived threat to prey, but the impact of predation is often tied to ecological conditions. When single sex groups break away from their pack, they may leave the reserve, even if it is fenced, especially if the reserve is too small for the formation of another pack. One solution is to remove dogs before they break away. The difficulty is to decided which dogs to remove and when. It is preferable to allow natural selection to decide this and to translocate break-away groups. A reserve should not produce pups if the pups can not be absorbed into the wild, nor should it need regular topping up from other reserves merely for the sake of ecotourism. The closer the reserve complies with biodiversity and ecosystem principles the more valuable it becomes for conservation. Because of the high ecotourism potential of wild dogs, the costs incurred in managing them could be partially covered by revenue generated from ecotourism programs.

6.2 The role of reintroduction in wild dog recovery in the Lower Zambezi.
Kellie Leigh

This workshop on wild dog research provided a valuable opportunity to circulate a newly developed African wild dog research proposal for endorsement, and to receive feedback and recommendations from other researchers on setting priorities for research and conservation.
The project proposal aimed at developing and assisting with the implementation of conservation recommendations from previous research results, to stabilize the Lower Zambezi wild dog population and increase its viability. The immediate objective was to stabilize the Lower Zambezi population by re-stocking. The threats to the population have been largely ameliorated through increased anti-poaching activities. However, the population was reduced by more than 50%, to two related packs which are unlikely to inbreed, and has therefore declined to an extent where natural recovery is improbable. Although unfenced, the area is effectively geographically bordered by a large river and a mountainous escarpment, and contains high prey/low lion densities. All of these factors create favourable conditions for wild dog reintroduction.
Another significant factor underlying population decline was the disappearance of emigrating dogs from the study population and a corresponding lack of immigration into the area. The proposal therefore incorporated a long-term wildlife corridor concept which allocates increased resources to protect Game Management Areas (GMA) that continuously adjoin the study area with a second National Park containing a larger wild dog population. The GMA corridor follows a natural river valley and would provide an extensive protected area to allow for successful dispersal between the Lower Zambezi population and a potential source population.
The proposal also aimed to develop the local capacity for wild dog conservation by training local counterparts to eventually take carriage of the project, and an extended community outreach and education programme to reduce persecution of wild dogs outside protected areas.

Session 7 – Other conservation interventions

7.1 The potential for ecotourism related benefits to contribute to wild dog conservation
Peter Lindsey

African wild dogs are endangered, and in South Africa as elsewhere, they inhabit a fraction of their former range. In this study, we assessed the potential for economic benefits derived from ecotourism to offset the costs of four wild dog conservation options using a contingent valuation study of the willingness of visitors to four protected areas to pay to see wild dogs at the den – within a viable population in a large protected area (Kruger National Park), through reintroduction into nature reserves, through the conservation of wild dogs occurring on ranchland *in situ*, and through the conservation of wild dogs occurring on communally owned land in Kenya. Results indicated that tourism revenue from wild dogs in large protected areas is more than sufficient to offset the costs and could potentially be used to subsidise wild dog reintroductions or the conservation of wild dogs *in situ* on ranchland. On ranchland and for reintroductions, tourism revenue was generally predicted to offset most of the costs of conserving wild dogs where predation costs are low, and to exceed the costs where willingness to pay is high, and/or where the costs of predation by wild dogs are zero. On communal land in Kenya, ecotourism benefits from pack are potentially sufficient to offset the costs of high levels of livestock depredation by 3 – 14 packs. Conservation efforts should facilitate the derivation of ecotourism-related benefits from wild dogs on communal land, on ranchland and in private reserves to create incentives for wild dog conservation. Ecotourism should be part of a multifaceted approach to wild dog conservation which also includes education and awareness campaigns, and efforts to encourage landowners to cooperate to form conservancies.

7.2 Methods to reduce road mortality

Gregory Rasmussen

Road traffic accidents (RTA's) are notorious sinks for most species with the impact on *Lycaon* being no exception. Data from the Painted hunting dog research project showed 31% of all mortality attributable to RTA's with packs having a major road through their territory losing 10% of the adults and 35% of pups (J. Ginsberg pers.comm). In this study deliberate killing (admitted by some ranchers) was recorded four times as evidenced by tyre skid marks and multiple kills on opposite sides of the road. In a number of species, varied efforts to mitigate RTA mortality have included car limiters in the form of speed limits and physical barriers such as humps and rumble strips, to road signs, to ideas directed at facilitating the animals to avoid the hazards. The latter traditionally have included bridges drift fence and tunnels, to alerts fitted to cars to alert the animals to the approaching hazard.

Research from this study highlighted the importance of individuals within packs for processes to include group defence, reducing chase distances, ensuring pup guarding and overall contributing to pup survival. Furthermore the loss of key individuals was deemed causal to the collapse of packs. Consequently when considering reducing road mortality, the project adopted an 'individuals matter as much as a pack approach', with methods adopted being road signs, educational outreach, and retro-reflective collars. Data showed mortality hotspots and signs were placed at these locations. Though the signs themselves served as outreach material, efforts through radio and published media contributed significantly to highlight the problem. Retro-reflective collars (which also served as a research tool) significantly increased the visibility of the individuals, with feed-back from motorists indicating that they were useful.

Whether causally linked, results post efforts showed a significant reduction in losses, with pup mortality attributed to cars for packs that had a main road through their territory being reduced to 12% and adult losses being 4%. Irrespective of these data, visible campaigns to reduce mortality serve the dogs well from a public relations perspective and thus are highly recommended.

7.3 Pack formation *in-* and *ex situ*

Kim McCreery and Bob Robbins

The long-term survival of wild dog populations depends on the formation and maintenance of packs. This talk focused on an ongoing collaborative study of pack formation *in-* and *ex situ*, and its potential contribution to wild dog conservation. Packs are artificially selected for metapopulation management in both the wild (i.e., translocations and re-introductions) and captivity. Soft releases and zoos share similar challenges: how to minimize stress, reduce the risk of physical injury (and fatalities), and facilitate social integration when male and female groups are introduced to one another in an enclosure. During a nine-year study of pack dynamics and social behavior of known individuals in Hwange National Park, Zimbabwe, the formation of 10 new packs was documented. Four succeeded, four failed, and the outcome of two was unknown.

Results from this study and anecdotal observations in Serengeti National Park show that: 1) interactions in newly formed packs differ from established packs, 2) behavior differs depending upon sex, 3) social integration between sexes does not necessarily occur rapidly, if at all, and 4) mate choice (group compatibility) may influence pack formation success. These findings suggest that *a priori* knowledge of pack structure and behavior patterns associated with successfully integrated newly formed packs may facilitate the formation of artificially selected packs. A collaborative project endorsed by the American Zoo and Aquarium Association was launched with member zoos to investigate social interactions during captive pack formation for comparative analysis with data collected in the wild. Objectives of this study are to provide a scientific basis for establishing introductory protocol guidelines to minimize stress and physical injury, and facilitate integration, and to identify possible behavior patterns in newly formed, artificially selected packs that can predict future risk of pup mortality due to aberrant behavior. The participation of additional collaborators *in*- and *ex-situ* was encouraged.

7.4 Community conservation: Changing attitudes and providing alternatives in Zimbabwe

Gregory Rasmussen

Though the reasons for the decline of Lycaon have been multi-factorial, historically the most consequential factor has been persecution by man. From the turn of the century the dogs were slaughtered throughout Africa, to the extent of being eradicated from National Parks. Continuing in this vein, anthropogenic mortality dominated in the Hwange study with 93% of the recorded mortality being attributable to man.

In South Africa and Botswana, efforts to give the species a value have hinged upon ecotourism, and the role of this is currently under study. In Zimbabwe the focus is on “conservation from within” and has adopted a ‘hands on’ approach with rural communities. Public rural appraisals of how best the Painted Dog Conservation project could meaningfully assist the communities with whom the dogs interacted, highlighted aspirations for schooling, adult education, recreation and skills needs. The same appraisal also highlighted that tourism did not fulfil the needs of the community, for whilst it benefited the few fortunate enough to get employment, the majority saw no benefit. Negative comments highlighted that tourism concessions, excluded communities from traditional areas and often sacred sites, with ‘village visits’ being seen as demeaning with very little return from tour operators.

Consequently Painted Dog Conservation developed a new model for the species’ conservation by providing training, and starting an environmentally friendly art and crafts project utilising poachers snares and scrap industrial wire to create sculptures. As it is an axiom that the project is not to be dependent upon tourism, all products are marketed abroad. To fulfil the educational role and a better value for conservation a childrens’ bush camp serves to provide a five day conservation education experience which is free for children who live in areas the dogs utilise. Projected is a community education and interpretive centre which will provide for all stakeholders in the area. Currently the Painted Dog Conservation project is the largest private employer, and touches the lives of the majority of the community, whilst at the same time has served to provide a tangible link and value for the target species.

Session 8 – Research techniques for wild dogs

8.1 Following Wild Dogs using Traditional Foot Tracking

Alistair Pole

Traditional Hunters have been tracking and interpreting spoor (tracks) for thousands of years. It is a skill that has been used surprisingly little by field biologists. At the start of my field research I employed an experienced tracker who was familiar with much of the study site I was working in. The intention was to put radio collars on as soon as possible and to follow the wild dogs by telemetry. This did not happen for over 14 months by which time I had employed another two trackers. The team of three trackers proved invaluable in following the wild dog packs, interpreting the number of individuals, which pack we were following and the activity of the pack as we tracked.

The accuracy of the trackers in identifying the spoor of different predators, the number of predators in a group and for wild dogs, which pack, was assessed by taking them to tracks where I had observed the animals without the trackers being present. They proved to be extremely accurate and reliable in interpreting the spoor presented to them. The only errors being when determining the exact number of individuals in a group.

It became very apparent that radio telemetry and traditional foot tracking had strengths and weaknesses in very different areas when collecting data on the behaviour and ecology of the wild dogs. By foot tracking wild dogs and interpreting the spoor we were able to get good information on the movement of the wild dog packs in relation to habitat type. We were also able to interpret the spoor to investigate habit use when hunting. The habitat use of wild dogs when hunting was also recorded when using radio telemetry but there was a strong bias in these data towards the more open habitats where it was easier to observe wild dogs hunting. We were also able to locate a significantly higher number of kills than if we had just been using radio telemetry.

I am confident that a combination of traditional foot tracking and radio telemetry produced a much more robust and unbiased data set with which to investigate aspects of the behaviour and ecology of African wild dogs in a wooded habitat.

8.2 Using detection dogs for increasing wildlife samples

Megan Parker

Detection dogs have proven successful at locating wildlife samples in order to increase sample sizes of scats, live animals, or other sign for which they are specifically trained. Establishing the presence, or increasing sample sizes of wildlife, especially rare or hard to detect species, enables researchers and managers to better estimate population size and structure and to estimate changes in a population.

Because dogs have excellent olfactory abilities and are able to discriminate between species, genders, and individuals, they can be used as a tool in conservation research and management. Conservation detection dogs are typically used to survey or monitor populations in a non-invasive manner, and are trained to ignore or avoid distractions, dangerous animals and game. Secondary measures may be necessary to effectively use scats as an index for species abundance or relative abundance of several species in an area. Fecal DNA extraction allows fine resolution for population structure by employing mitochondrial DNA, or up to individual identification if extracting microsatellites. Photographic surveys and camera traps also allow for individual identification and can be used as an index of abundance with scat collection. Mark recapture analyses allow for robust population estimates with photographs or fecal DNA. Alternatively, the literature may provide indices of abundance for dung counts, along with passage rate information for some species.

Conservation detection dogs have been used successfully to detect scats from various species, ranging from bears, wolves, cougars, whales and kit fox to live animals such as black-footed ferrets, desert tortoise and brown tree snakes. Dogs have been trained in trials to detect cheetah and wild dog scat and will be used to survey for a suite of carnivores in livestock conflict areas of Tanzania in 2005. Dogs have proven 100% accurate in discriminating between species' scat which people are unable to vidually distinguish and offer cost-saving benefits for many studies.

8.3 Photographic techniques for censusing wild dogs

Gus Mills

Three wild dog photographic surveys have been conducted in Kruger National Park. The fourth has recently been commenced. The surveys rely on photographs taken by tourists, park officials and the research team. Identification of individual wild dogs is done by visual examination of coat patterns. Posters advertising the projects are displayed in the media and at entrance gates and tourist rest camps and entry forms are handed out to visitors at reception desks. Sponsored prizes are given to encourage people to take part. Rarefaction was used to determine the ideal sample size of photographic entries and to provide confidence limits for the survey data. The rarefaction program randomises the input data and generates a curve of the expected number of individuals represented by a random number of sightings. Asymptotes start to form around the number of sightings that are necessary to detect 95% of the dogs. These points may be used as confidence limits (_ = 0.05) and aid in estimating an adequate sample size. A curve that shows a clear asymptote indicates extensive sampling in the region, while a linear relationship suggests that more sampling is required. To estimate adequate sample sizes required to complete a survey the rarefaction method may be used in a reversed fashion. Extrapolation of a linear regression comprising all asymptote points calculated in previous surveys could predict the adequate number of sightings needed during a survey. It is planned to also analyse the data by means of one of the capture-recapture models which, if successful, could greatly cut down the time period needed for a survey.

8.4 Use of Hoo Call Playbacks in Wild Dog Conservation

Bob Robbins and Kim McCreery

Over the course of a nine-year study in Hwange National Park, Zimbabwe, a protocol using playbacks of long distance hoo calls was developed to facilitate wild dog radio-collaring operations and data collection. An audio recorder was attached to a 12-volt mobile amplifier in turn connected to two horn speakers facing in opposite directions and mounted on the roof rack of a Land Rover. The protocol included specific features designed to maximize approach frequency. Calling trials (n=32) were conducted when wild dogs were known to be in an area and most likely to be active. Acoustic fidelity appeared not to be paramount because low quality tapes posed no impediment to eliciting approaches. In a few trials, human simulations were used with comparable results. Dogs approached calling stations in 84% of trials (11 packs and one group) from distances up to 2 km. Mean time to approach was ca. 13.9 ±2.6 min. (n =11 trials, range 1–56 min). A species specific pack/group approach response coupled with a high frequency of approaches across seasons made acoustic stimulation particularly effective. When dogs hooed (n=18; eight packs and one group), they approached stations in 94% of trials indicating that evoked hoos can serve as useful cues to researchers that approaches are probable, allowing time to prepare for targeted operational objectives. Findings here demonstrate that playbacks are an effective conservation tool particularly where road networks are limited or seasonally inaccessible, dense habitat restricts off-road driving, and tourist sighting information is low. Potential application lies in snaring operations and translocations, and in facilitating finding packs in new wild dog studies. This technique, in conjunction with other methods, may also prove useful in population surveys.

8.5 A brief report on the use of GPS collars on wild dogs in Botswana

J.W.McNutt and Megan Parker

Since the beginning of the Botswana wild dog research project in 1989, data acquisition has depended on VHF radio telemetry technology. In 2001 we decided to implement a relatively new technology using GPS engines in wildlife radio collars. The following report is an account of our experiences with this important new technology for wildlife research in our ongoing monitoring of African wild dogs in Northern Botswana.

Swedish company TELEVILT convinced us that they make a GPS collar of suitable weight and sufficient battery life (and data capture) to justify a trial on wild dogs. The ‘Posrec’ system differs from some earlier GPS collars because it does not have remote upload/download capability, storing all data on board. The collar must be recovered from the animal and returned to TELEVILT for data capture and refurbishment. The cost of these units came to approximately US$1900 per collar (including shipping to Botswana). Estimates given at that time for refurbishment of these collars was about US$400.

All four collars were deployed on neighboring packs in February2002. One collar broke off nine days after deployment. A second GPS collar broke off after three weeks. A third collar broke off a week later and the fourth collar, the first deployed, dropped off after 104 days when the battery ran low. We modified the three broken collars and redeployed them. Table 1. gives a summary of our collar performance.

Table 1. Performance of TELEVILT POSREC GPS collars on African wild dogs in Botswana.

		Battery life (days)			Fixes per day		Total locations		
Trial	No. collars	Expected	Actual mean (range)	%	Expected	Actual	Expected	Actual mean (range)	%
First	4	210	88.25 (61 -115)	42	12	8.63	2520	779 (329-1227)	31
Second	4	240	115 (20 -158)	48	10	8.05	2400	911 (189-1424)	38
Third	3	240	72.33 (32 -100)	30	10	8.30	2400	591 (288-892)	25
Fourth	1	310	174	56	6	5.40	1860	939	50

Our initial experiences with GPS collars on wild dogs resulted in several problems with the mechanical functioning of the securing mechanism. These were addressed in reconfiguring the four collars for a second round of deployment. In the second round, one collar again broke off the wild dog after 22 days. The others remained intact for the life of the batteries, dropping off when these were running low. Average battery life of these three collars was 146 days (115d including the 22d broken collar), better than the first round which averaged 88 days. However, a third deployment of the refurbished collars resulted in decreased performance (average= 72 days) excluding one that failed and was lost. One unit configured to store a lower number of fixes per day (6) lasted the longest (174 days, 56% of expected) and gave the best performance (50.5% of locations) of all collars and configurations tried. The overall performance of these collars added to unsatisfactory communications, escalating prices and poor service from TELEVILT has resulted in our discontinuing use of their collars. Other manufacturers now provide several alternatives. These vary in weight, performance and price. We have decided to invest in two units from New Zealand company SirTrack which we will deploy early next year.

8.6 Conservation endocrinology of African wild dogs

Micaela Szykman and Anne Carlson

The use of non-invasive tools for monitoring the health of wildlife populations has many benefits. One technique used to evaluate the endocrine physiology of animals is through the extraction of steroid hormones from feces. Fecal sample collection does not disturb study animals, provides repeated measures for individuals over long periods of time and supplies a great deal of information on wild populations, including evaluating individual breeding physiology and stress. Non-invasive fecal hormone monitoring is particularly interesting and appropriate for African wild dog packs because of their highly social organization and cooperative breeding. Research questions that will be addressed through this technique include (1) measuring stress and reproductive hormones before, during and after a dispersal or translocation event to gain a better understanding of which dispersal conditions and translocation practices are the least stressful; (2) examining the incidence and characteristics of subordinate breeding; (3) evaluating stress in wild populations to determine if human land use practices and/or artificially high competitor densities impact wild dog health and reproductive success; and (4) understanding patterns of helping behavior and its corresponding hormone profiles. These methods have already been validated for African wild dogs and require collection of fresh fecal samples from known individuals. Almost 300 samples from 40 known wild dog individuals have been collected in Hluhluwe-iMfolozi Park (South Africa), over half of which have already been analyzed for stress and reproductive hormones by M. Szykman at the Smithsonian’s National Zoological Park Conservation and Research Center (USA). In 2005, we hope to add additional sites to the study, including Kafue National Park (Zambia), Moremi Game Reserve (Botswana), two additional representatives of the South African metapopulation (Venetia-Limpopo Game Reserve and Marakele National Park, both of which have already begun fecal sample collection), and newly translocated packs of wild dogs into KwaZulu-Natal.

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