DRAFT 5 (1)

Proceedings of the first Tanzania Wild Dog Workshop

Tanzania Wildlife Research Institute
(TAWIRI)

18th - 19th February 2005, TAWIRI, Arusha, Tanzania

DARWIN INITIATIVE

ZSL LIVING CONSERVATION

TAWIRI Tanzania Wildlife Research Institute

WILDLIFE CONSERVATION SOCIETY

Proceedings of the first Tanzania wild dog workshop

Contents

1. Agenda

Day One

Time	**Event**	**Responsible**
8.30 - 8.45	Registration	Flora Kipuyo
8.45 - 9.00	Official opening	Dr. G. A. Sabuni
9.00 - 9.15	Self introduction	Facilitator/All
9.15 - 9.30	Meeting background	Dr. S. Durant
9.30 - 10.00	Agreement on the agenda	Facilitator
10.00-10.15	Group photograph	All
10.15-10.30	*Tea/Coffee break*	All
10.30-12.30	Wild dog distribution and abundance	All
12.30 -1.30	*Lunch*	All
1.30 - 3.00	Conservation threats	All
3.00 - 3.30	*Tea/Coffee*	All
3.30 - 4.30	Conservation threats	All

Day Two

9.00-10.30	Overall Priority Settings	All
10.30-10.45	*Tea/Coffee*	All
10.45-12.30	Site Based Issues	All
12.30–12.45	Closing	Mr. M. Msuha

2. SUMMARY

This report covers the proceedings of the First Tanzanian Wild Dog Workshop held in February 2005. The workshop brought together a group of key stakeholders to assess existing information and establish a consensus on priorities for research and conservation of African wild dogs *Lycaon pictus* in Tanzania. Tanzania holds an estimated one third of the world's remaining wild dogs, more wild dogs than any other country. In addition, the biggest surviving single population survives in Tanzania's Selous Game Reserve. All participants to the workshop were deeply proud of Tanzania's international status for wild dog conservation, however they agreed that there is an urgent need to obtain better information on the distribution of wild dogs across the country, as well as more detailed data within specific regions.

Wild dogs were known to occur to the east and south of the Serengeti, west Kilimanjaro and Longido, Manyara ranch, Tarangire and much of the Maasai steppe, Ugalla, Katavi, the Ruaha/Rugwa ecosystem, Rukwa/Lukwati, south east of Sumbawanga, Selous Game Reserve and Mikumi. However there was currently not a single region in the country with a good up to date estimate of wild dog population size and trends, and hence establishing minimal information for different regions was a key priority. Data needed could be broken down into distribution, population trends, density, demographic parameters such as survival and reproduction and ranging patterns. Different areas were thought to require data of different quality depending on what data already exists and likely threats. The group went through all methods currently available and summarized the type of data each method could generate, whilst also noting that not all methods would work in all areas. Only radio collaring generated data for all possible data needs. However other potentially worthwhile techniques included photo surveys using photographs from tourists, which can generate good information but is unlikely to be applicable in most areas because of a lack of visitors, and the use of working dogs, to locate wild dog scat, which shows much potential but is currently untested in Africa.

The group also discussed potential threats and agreed that persecution, habitat loss/change and disease were the three most important factors affecting wild dog conservation in Tanzania. However, there was a paucity of information on the impacts of any of these threats. The techniques suitable for gathering information on wild dog distribution and status discussed earlier were found to be also useful for collecting information about threats. For example a questionnaire survey could potentially provide information on persecution and land use change, and even on some easily recognizable diseases such as rabies, whilst spoor surveys, working dogs and camera traps can provide information on the other predators (and prey) in the ecosystem. Radio collaring, because it involves handling, has the potential to provide good information on many diseases if a blood sample is collected, and because it is easier to monitor individuals if they are collared, information on deaths due to disease, persecution, snaring, road kills and even interspecific competition.

Managers need information on the status and threats to wild dogs in their areas to plan management activities and to enable wild dog conservation, as well as assessing the impact of these activities on wild dog conservation. All participants wished to improve the standards of information on wild dogs across the country and their hard work in this workshop and report reflects this wish, and will hopefully provide wild dog research and conservation with a new impetus to address the identified priorities hand in hand with training and capacity building.

3. INTRODUCTION

The First Tanzanian Wild Dog Workshop was held from 18th to 19th February 2005 at the Tanzania Wildlife Research Institute (TAWIRI) headquarters in Arusha. The workshop was intended to bring together stakeholders to assess existing information and set priorities for conservation of African wild dogs *Lycaon pictus* in Tanzania. The workshop was attended by 14 participants from TAWIRI, Wildlife Division, Tanzania National Parks (TANAPA), Ngorongoro Conservation Area Authority (NCAA), Wildlife Conservation Society (WCS, US), Frankfurt Zoological Society (FZS) and Carnivore Disease Project (Appendix 1). TAWIRI through the Tanzania Carnivore Monitoring Project is collecting information on all carnivores in Tanzania including wild dogs with the ultimate objective of providing information that can be used in developing an action plan for carnivore conservation in the country. These proceedings will provide a draft chapter for the wild dog section in this plan. There is already an IUCN international action plan for wild dogs (Woodroffe, Ginsberg et al. 1997) and a more recent plan for canids (Sillero-Zubiri, Hoffmann et al. 2004), which includes a chapter on wild dogs (Appendix 2).

The African wild dog is one of the world's most endangered large carnivores. Wild dogs present a particular challenge for conservation because they live at low densities and range very widely These aspects of their ecology and life history mean that populations require vast areas to remain viable in the long term. Tanzania is internationally important for the conservation of the world's remaining wild dogs, as it holds one third of all wild dogs, including the single largest population in the Selous Game Reserve. However, despite this international importance, information on wild dogs in the country is still very limited, making it difficult to plan for the conservation of this species. This workshop therefore aimed to document what we currently know about wild dog status and conservation across the country and to set priorities for future research and conservation.

Fig. 1 Participants at the meeting

4. Wild Dog distribution and abundance

Despite Tanzania's importance for wild dog conservation, surprisingly little is known about the status of wild dogs within it's borders. There is no ongoing long term study in Tanzania, but there are such studies in Botswana, Zimbabwe and South Africa, and a relatively recent (5 year old) long term study initiated in Kenya. There is a need to readdress this balance and put Tanzania at the forefront of wild dog research and conservation, in reflection of its international importance for the conservation of the species.

4.1 What do we know: Summary of current knowledge.

The morning session summarized existing information on wild dog status in Tanzania, including distribution, density and trends. Mr. Alexander Lobora from the Tanzania Carnivore Project at TAWIRI presented a briefing on wild dog distribution across the country from the project's carnivore database compiled since 2002. The distribution pattern of wild dogs showed participants areas where wild dogs have been sighted and helped identify areas where there is no data on wild dog presence (Fig. 2). We have summarized the distribution within the regional sections below. However areas that are also potentially important for wild dogs but which lack even rudimentary sighting information include:

- Ugalla Game Reserve
- Rukwika-Rumesule Game Reserve
- Moyowosi
- Mkomazi Game Reserve
- Maswa Game Reserve
- Northwestern part of the country (Biharamulo, Burigi, Rumanyika etc.)

Whilst distribution information tells us where dogs are, it does not necessarily inform us about the relative importance of one area over another for wild dogs, or even the status of dogs in an area – such as whether they are increasing, declining or stable. Tanzania still lacks this type of data across much of the wild dog range. The only reliable estimates of density of wild dogs in Tanzania are from the Selous Game Reserve where the density was estimated at 4 adult wild dogs/100km^2 (Creel and Creel 2002) and the Serengeti National Park before the population disappeared from this area (Burrows 1995; Ginsberg 1996). Information on species density and status are needed for prioritizing between different areas and habitats, planning for long-term conservation and assessing the impact of conservation actions.

The following sections summarize distribution patterns grouped on a regional basis, approximately aligned to major ecosystems.

4.1.1 Northern Region (Serengeti National Park, Maswa Game Reserve, Ngorongoro Conservation Area and Loliondo Game Controlled Area)

Wild dogs apparently disappeared from the Serengeti National Park, Tanzania, 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, was definitely involved in the demise of a number of packs, although the reason for the final extirpation of the population was not established. 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, coincident with an apparent increase in wild dogs across the region. In 2004 there were 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-

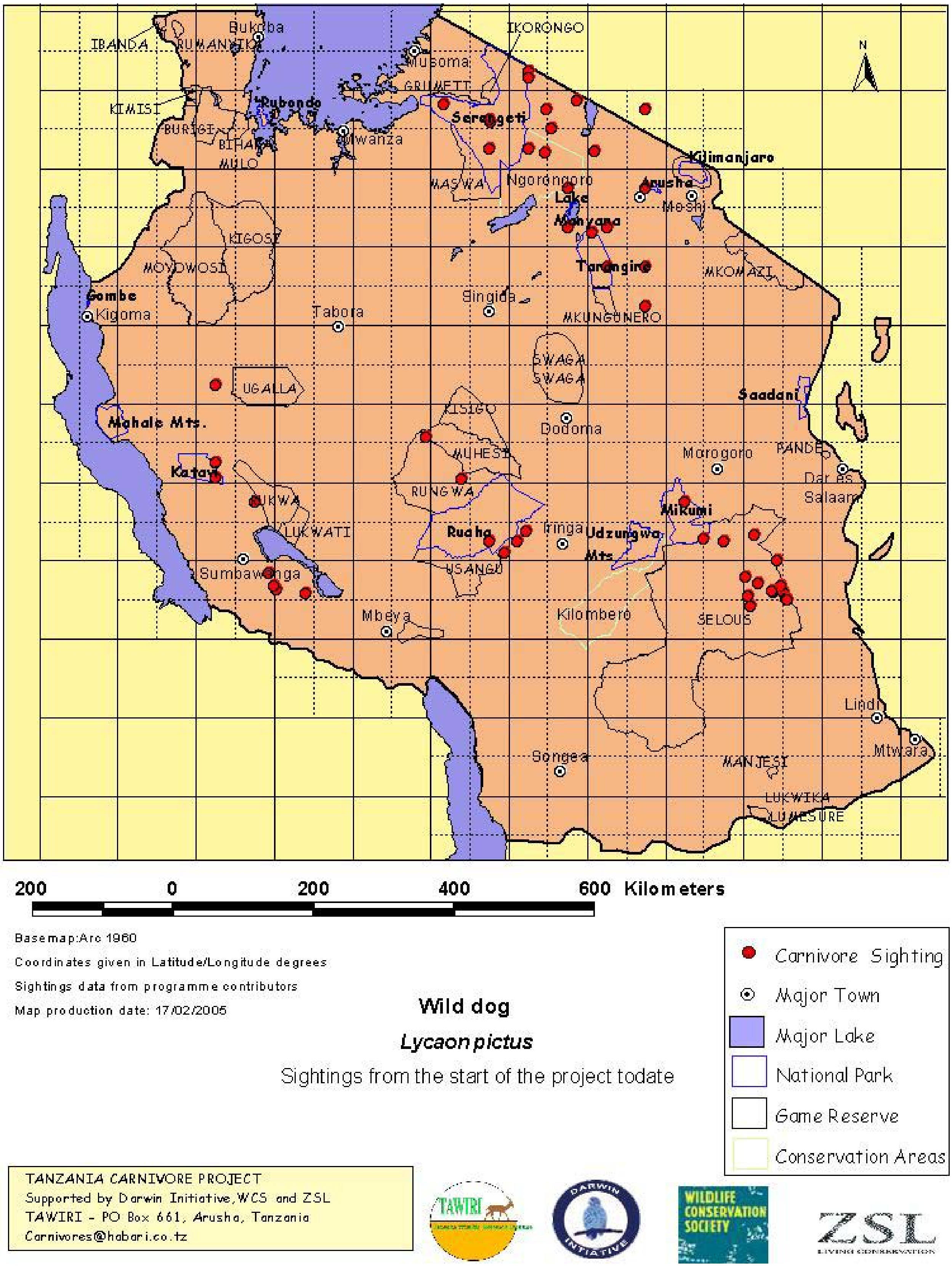


Fig. 2 Map of known sightings of wild dogs submitted to the Tanzania Carnivore Project since 2003 up until the time of the workshop. Data submitted is in two forms, either as direct GPS locations, or as a grid square as identified on the map. The former data type are plotted on the map directly, whilst the latter data type are plotted at the centre of the reported grid square.

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, south of the Makao open area. In summary, there could have been between 3-6 packs in the northeastern Serengeti/Mara in 2004, 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. In the Serengeti National Park, there have been only sporadic sightings in the last few years, with no resident packs. Whether this is due to the current very high density of lions in the park, or because wild dogs have not yet recolonised this area, is unknown, but may be more apparent in the future.

Since 2000, wild dogs have started to reappear across the entire region, from the Loliondo region, across the Serengeti National Park and in the NCA. The reason behind the reappearance of wild dogs is unknown, but one suggestion raised at the meeting was that the increase could be, at least in part, due to decreases in lion or hyaena numbers, however there is no data to support this conjecture.

4.1.2 Maasai Steppe (Tarangire and Manyara National Parks, Simanjiro plains, Mkungunero and Singida)

In this region very little information is available. From what we know, the status of wild dogs appears to vary greatly from one area to another. For example, in Manyara National Park and surrounding ecosystem, the population appears to be increasing, with packs being sighted regularly on Manyara ranch, while in Tarangire National Park the population seems to be relatively stable. At the beginning of 2000 the population of wild dogs in Simanjiro plains was thought to be increasing - however there is no reliable data to support this impression. In other areas e.g. Hanang, the central Maasai steppe, Makuyuni the population of wild dogs is probably decreasing due to conflict with livestock keepers. There are reports of poisoning, road kills and shooting of wild dogs in these areas.

4.1.3 North west and central region (Ugalla Game Reserves, Mahale Mountain National Park)

The population of wild dogs was thought to be probably reasonably good in this region, although there were little data to substantiate this. In the 1990s no wild dogs were seen in Ugalla Game Reserve, however wild dogs have since been sighted in 2000 and 2004, suggesting a recent range expansion. Livestock keepers around the reserve have been sensitized on how to live with endangered wild animals. Since wild dogs are shy it is relatively easy for people to chase them away from livestock should they approach, provided livestock are adequately attended. There is limited information from Mahale and so the status of that population is unknown, although there have been the sightings of wild dogs in Mahale. The limited information is due to a limited number of trained personnel in that region, which has contributed to a low feedback of data. There is no information for Moyowosi-Kigosi and Biharamuro-Burigi regions and surveys are needed for these areas.

4.1.4 Ruaha/Rungwa including Katavi National Park and Rukwa- Lukwati ecosystem

There is not much information available for this region, however the population of wild dogs is assumed to be stable due to relatively low numbers of lion and spotted hyenas outside protected areas which can impact wild dogs in other regions, and due to an extensive protected area system.

However as with the previous region, there is extremely limited information from this area, due to a combination of factors, including:

- Thick miombo forest vegetation.
- A network of swamps which make access to some areas difficult.
- Low number of visits from tourists.

WCS have surveyed a small area within the Rungwa-Ruaha ecosystems. Within this area, wild dogs are sighted almost every month, except denning months August- October. The main sources of data are photographs from tourists, lodges and Ruaha National Park (RUNAPA) questionnaire surveys. Sightings are few but most stakeholders report an overall decline over the last 10-15 years. Lions have not been systematically sampled, but their numbers appear to be increasing in Ruaha National Park. A joint database has been established by WCS and RUNAPA. More wild dogs are sighted outside RUNAPA, possibly as these areas may be more attractive to them, due to relatively high densities of lions and hyaenas within the park. Pack sizes appear to have increased from the year 2000. There is no information from Manyoni, Itigi thickets or Swaga Swaga Game Reserve, all of which may be important for wild dogs, and surveys are needed for these areas. At least two whole-pack die offs were recorded in the last 5 years, with canine distemper reported as the suspected cause.

4.1.5 Selous - Niassa ecosystem

Sightings have been reported in Mikumi over many years. However no information is available on trends. There is good information from the Selous due to a 6 year study of collared dogs in this area between 1991-1997 (Creel and Creel 2002). However there has been no information from the reserve since the end of the study which the group sees as a serious data gap, considering the global importance of this population. There is information from Pesambili, the Project Manager for Rukwika-Rumesule Game Reserve that there is a wild dog pack in the reserve. However, there is no information to the south of Selous Game Reserve which may be important for wild dogs and surveys are needed for these areas.

4.1.6 Coast, Mtwara, Saadani ecosystem

There is no information on wild dogs from the coast in Tanzania. A survey is urgently needed for this region.

4.2 How to get information on distribution and abundance: Available methods

There are several methods that can be used to survey large carnivores. Which method is selected for use depends on the questions that need to be addressed, and the suitability of that method for a particular region. Key methods appropriate for wild dog surveys identified in the workshop follow those identified by the International Cheetah Monitoring Workshop held in Tanzania in June 2004. They include spoor counts, radio collaring, tourist photos, working dogs, questionnaires, camera trapping and visual search. Each is discussed in detail below, with a list of their main advantages and disadvantages.

4.2.1 Radio collaring

With this method VHF, GPS or Satellite collars are fitted to one or more wild dogs in a pack. For most such collars, the collar allows subsequent relocation of the collared dog, due to a signal transmitted from the collar, either to a VHF receiver, or via a satellite. Some GPS collars do not transmit a constant signal, but store GPS reference points visited by the dog, at a set rate (once, twice or several times a day) and transmit a signal only when they drop off after a set time, to allow them to be located and the data retrieved and downloaded to a computer. In order to fit the collar the wild dog has to be immobilized, usually by darting. The method allows the collection of a huge amount of data, not just on the single wild dog collared, but, provided the dogs are relocated on the ground, on the entire pack. All the reliable density estimates for wild dogs result from radio collaring studies (Appendix 2).

Advantages:

- Can provide a huge amount of data, not only on population size, but also on disease monitoring, ranging patterns, identification of threats to the population and demographic information including birth and survival rates
- Relatively low manpower demands
- Relatively accurate

Disadvantages – only if using satellite and GPS collars:

- Satellite and GPS collars are expensive
- Makes use of relatively complicated technology – and hence implementation requires some training.

4.2.2 Questionnaires

Questionnaire surveys of residents within a region can be used to collect information on wild dogs in two key ways. Firstly as a simple presence absence survey, by gathering information from residents in an area on wild dog sightings. Secondly as an in depth survey to not only gather information on distribution, but also to assess levels of conflict with people and attitudes of residents to wild dogs in their area. All data gathered through questionnaire surveys needs to be interpreted with caution, as interviewees will not necessarily respond honestly and openly to questions.

Advantages:

- It is perhaps the only convenient and feasible method for mapping the distribution of wild dogs at a national scale
- It is relatively cheap
- It makes relatively low demands on manpower
- At a basic level, the method can be implemented by relatively unskilled field workers.
- Can provide extra information on potential threats – such as conflict with people.

Disadvantages:

- Provides only very coarse data, and is no use for detecting local changes in population density.
- Provides no information on other potentially important factors such as demographics, ranging patterns and disease.
- Requires highly skilled labour when combined within a GIS framework.

4.2.3 Working dogs

In this method highly trained domestic dogs are used to find scat of wild dogs, in much the same way as dogs are used by the police to find narcotics. Scat can either be counted in much the same way as spoor counts (see below) to give a density estimate, or DNA can be extracted and typed to provide a unique genotype that can then be used in a mark-recapture analysis framework to provide a more accurate estimate of density. The method has been used successfully in the US to estimate population densities of several carnivore species, including kit foxes and grizzly bears (Smith, Ralls et al. 2003; Wasser, Davenport et al. 2004), however, aside from a training program conducted by the Serengeti Cheetah Project in Laikipia in July 2004, is largely untested in Africa. The training program did demonstrate that it was possible to train Kenyan dogs to locate and distinguish cheetah and wild dog scat from other scat such as that from jackals.

Advantages:
- Potentially useful outside protected areas
- May provide genetic samples for individual identification of wild dogs and hence accurate monitoring
- Genetic samples can provide extra information – such as population structure
- Scat samples can provide extra information on diet
- Relatively cheap to implement (except when using DNA analysis).

Disadvantages:
- Method untested in Africa
- Requires training of both dogs and handlers
- DNA analyses currently expensive and labour intensive
- Would require a change in permit regulations to be used inside protected areas

4.2.4 Camera traps

For this method cameras are positioned along animal trails which show active use, and linked to a beam that detects any changes in infrared in front of the camera such as occurs when an animal moves along the trail. Whenever such a change is detected the camera takes a photograph, hence the expression 'camera trap', and in so doing produces a photographic evidence of the carnivore community in an area. Photographs of wild dogs can be used for individual recognition as each wild dog has unique black, white and tan markings. Once they are put in place, the cameras are generally left undisturbed for a minimum of 2 months, except for battery checks and changing film. Individual animals are recognized from their photographs and a library established of individuals within an area. Mark recapture analysis is then used to estimate population size. The technique has been very effective for surveying tigers and jaguars (Karanth and Nichols 1998; Silver, Ostro et al. 2004). However the method works best in forest and for species with relatively small home ranges.

Advantages:
- Useful in forested areas where visibility is poor and most of the other methods difficult to implement
- Can provide accurate density estimates when using individual recognition.
- Can provide useful other additional information such as the carnivore and prey community in an area.

Disadvantages
- method is untested for wild dogs
- Set up equipment is costly and can only be used in relatively secure areas such as protected areas, otherwise likely to be stolen.
- Generally works best for species with relatively small range sizes, unlikely it could be effective for a species with such a wide home range as a wild dog.

Proviso – the method could be a potentially non-intrusive means of identifying the composition of packs if camera traps are set up at den sites.

4.2.5 Tourist photos

This method relies on encouraging visitors to an area with wild dogs to send in photographs that they take of any wild dogs that they see. The photographs can then be used to individually identify wild dogs and build up a profile of population size and structure. The Tanzania Carnivore Project has such a scheme in place – the Wild Dog Watch Campaign, but to date has had little success in accumulating photographs. By contrast, the project's Cheetah Watch Campaign has had a good record for monitoring cheetahs on the Serengeti plains.

Advantages:
- Good for areas well visited by tourists

- Relatively easy to implement, provided an infrastructure exists.
- Has potential to provide good information on population size, demography and possibly pack structure.

Disadvantages:

- Not suitable for areas seldom visited by tourists
- Depends on promotion by tourism industry to be successful
- Requires active promotion e.g. production of promotional materials such as leaflets
- Can be time consuming to implement and requires reasonably well trained manpower.

4.2.6 Visual search

This method relies on an observer finding and following wild dog packs from a vehicle with no other aids such as radio collars. Since wild dogs range so widely and live at such low densities, relying on visual search is unlikely to generate sufficient information for monitoring.

Advantages:

- Can provide good information on the population, provided dogs can be located sufficiently often

Disadvantages:

- Requires highly skilled personnel able to locate and follow wild dogs.
- Extremely expensive in terms of money and manpower for relatively poor information reward.
- Very time consuming
- Highly labour intensive

4.2.7 Spoor counts

In this method a vehicle is driven at a slow speed along existing tracks with a dusty or sandy covering that has a good potential to show spoor. The vehicle should be mounted with a specially modified chair on which a skilled tracker can be seated. The tracker should record all spoor that is fresh (less than 24 hours old) seen on the track. This information is then used to generate a spoor frequency, i.e. the number of kilometers per spoor (Stander 1998).

Advantages:

- Relatively easy to implement
- Can provide presence or absence data
- Low technology
- Relatively cheap
- Trackers are in most cases available e.g. from hunting companies
- Can be used to estimate relative density of other carnivores in the area

Disadvantages:

- A suitable soil substrate is required to enable detection of spoor.
- Without special calibration the method cannot be used to compare densities between different areas
- Relatively poor data quality
- Relies on accurate identification of spoor – tracker needs to be sufficiently skilled to not confuse spoor with that of domestic dog.
- Relies on a good network of roads

4.3 Status Summary

There is obviously a need to gather information about the status of wild dogs across the country. Different regions have different specific needs, depending in part on what information already exists. The Serengeti region is relatively well known, however there is currently not a single region in the country with a good up to date estimate of wild dog population size and trends. Status can be broken into different levels depending on the quality of the data: distribution, population trends, density, demographic parameters such as survival and reproduction and ranging patterns. Different areas are likely to require data of different quality depending on what data already exists and likely threats. The methods available to gather relevant data on status are listed above and are summarized in table 1 according to the types of information they can potentially provide on wild dog status. Not all methods will work in all areas, for example photo surveys can only work in an area which is regularly visited by tourists and spoor surveys in areas with sufficient tracks and suitable substrate. Only radio collaring generates data for all the status categories. Other potentially worthwhile techniques include photo surveys, which can generate good information but are unlikely to be applicable in most areas because of a lack of visitors, and the use of working dogs, which shows much potential but is currently untested in Africa.

	Questionnaire	Spoor	Photos surveys	Working dogs	Camera Traps	Radio Collars
Distribution	Y	Y	Y	Y	Y	Y
Relative Abundance	Limited	Y	Y	Y	Unlikely	Y
Trend	Limited	Y	Y	Y	Unlikely	Y
Density	N	N (but can if calibrated)	Y	Y	Unlikely	Y
Ranging	N	N	N	N	Unlikely	Y
Demography	N	N	Poss but unlikely	Poss but unlikely	Unlikely	Y

Table 1. Data generated by the different methods covered in the sections above. Y indicates that the method could generate appropriate data, N the method could not generate appropriate data, and limited the method might generate some appropriate data, but is open to interpretation. Finally 'unlikely' indicates that whilst the method could theoretically generate the appropriate data, it is unlikely that sufficient data would be collected to fulfill the objectives.

5. CONSERVATION THREATS

After the thorough discussion of distribution and abundance, together with available methods for gaining more information, the group moved on to examine potential threats to wild dog conservation. The group identified the following threats:

- Disease
- Persecution
- Loss of habitat / land use change
- Snaring - by-catch targeted at game
- Road kills
- Ecological constraints - inter-specific competition

Each are discussed in detail below

5.1 Disease

Infectious disease is a recognised threat to wild dogs across Africa and has contributed to the extirpation of at least one population and has thwarted two reintroduction attempts in southern Africa. The importance of this threat is often difficult to assess especially as disease outbreaks are often part of a natural process causing population fluctuations. However, when disease is a consequence of manmade factors, there is an argument that it is not part of a natural process and intervention may be justified. Disease may have particularly severe consequences on population viability when populations are small, when other external factors are causing mortality, such as snaring or persecution or where the chance of recolonisation after extirpation are small, due to low connectivity with other sub-populations. Such situations strengthen the argument for intervention.

5.1.1 Rabies

Rabies is thought to be a potential threat to wild dog conservation and has certainly caused mortality in wild dogs populations in a number of countries. Rabies has been endemic in domestic dog populations in Tanzania for several decades: for example areas around RUNAPA have been under quarantine since 1960s. Ring vaccination of domestic dogs around Serengeti shows promising results for the control of rabies in dog and human populations with preliminary results suggesting that rabies cases in wildlife have also declined, in line with the hypothesis that domestic dogs are the reservoir of infection. However, the proportion of dog populations vaccinated must be maintained at around 70% in such cordon sanitaires around core wildlife areas, and also be of adequate width in order to prevent breakthrough of rabies from more distant dog populations Transmission to wild dogs need not be direct: chains of spillover transmission through other wild carnivores such as hyaenas and jackals can occur. With domestic dog populations increasing across rural Tanzania, the threat rabies poses to wild dogs will not reduce unless rabies is controlled at the local, national or regional level.

5.1.2 Canine distemper

Although canine distemper can cause significant mortality in wild dog populations, it can also exert no detectable impact on populations. For example, 49 out of 52 wild dogs in a semi-captive population in Mkomazi died due to a CDV outbreak in 2000, whereas in other populations, CDV antibodies have been detected in healthy dogs, indicating prior exposure, but no deaths have been recorded The effect of CDV on wild dog population therefore varies with ecological and epidemiological circumstances, and there is a clear need to understand the epidemiology of canine distemper and monitor its status in Tanzania.

5.1.3 Anthrax

Anthrax has been reported in Selous Game Reserve, and at least two outbreaks have been recorded in RUNAPA. Wild dog pups have been once affected by the disease. However, there is not much information available countrywide.

What more do we need to know?

Priorities are to assess the level of threat that disease poses in Tanzania and then to develop cost-effective tools, should intervention to reduce this threat be required

- Determine importance of rabies and CDV as a threat to wild dog populations across wild dog range in Tanzania by monitoring the status and dynamics of disease in domestic dogs, wildlife and wild dogs
- Improve understanding of rabies and CDV dynamics and reservoirs
- Determine the safety and efficacy of modern rabies and CDV vaccines for wild dogs, particularly oral vaccines
- Develop delivery systems for oral vaccines to wild dogs, particularly less habituated packs

How do we find out?

A disease monitoring scheme should be developed to collect baseline data and establish the impacts of the different diseases on wild dog populations in the long term. Post-mortem samples, particularly brain samples, should be obtained systematically from all carnivores found dead, as these will indicate whether the animal had died from a disease and, if so, identify the pathogen responsible. Serological sampling can be used to ascertain the status of CDV in domestic and wild carnivores, whereas examination of hospital and veterinary office records and questionnaires in rural populations will help determine the prevalence and patterns of rabies infection. More detailed information on sampling techniques are available both in the Canid Action Plan and at the following website (http://www.vetmed.ucdavis.edu/whc/pdfs/necropsy.pdf)

The Carnivore Disease Project is currently carrying out these researches and monitoring activities in the Serengeti region, in combination with rabies and CDV control campaigns.

5.2 Persecution

We have little information on the importance of persecution to wild dog conservation. However we do know that wild dogs do occasionally kill livestock and conflict does exist in some areas. Dr. Sarah Durant reported that in 1998 she found two wild dog yearlings on the road close to Makuyuni. She took these dogs to the VIC in Arusha for a post mortem. Their subsequent report disclosed that the dogs had been clubbed and then dumped on the road. Some communities are also known to use poisons on carnivores (Maddox 2002), whilst snaring is coming in many areas. Veterinary officers in Iringa also report attempts to poison wild dogs outside Ruaha, though it is not known how successful these attempts were. The group agreed that basic information on the impact and extent of persecution is lacking.

What more do we need to know?

- Relative importance of persecution to the conservation of wild dogs
- Why does persecution happen – uncovering the reasons for persecution e.g. conflict due to depredation of livestock
- Establishing livestock management techniques that reduce livestock depredation
- Assessing perception against reality – verification of reported depredations by wild dogs.
- Ecological circumstances in which conflict and hence persecution occurs – e.g. around denning sites?

How do we find out?

- Questionnaire surveys to assess perceptions of conflict
- Assessment of livestock management techniques and their relationship to livestock loss.
- Incident reports
- Rapid follow up of reported incidents
- Establishment of an effective reporting system

4.3 Habitat loss / land use change

Habitat loss and land use change put extra pressures on wildlife, particularly species like wild dogs that live at low densities and range across vast areas. Ensuring that sufficient habitat remains and that corridors between protected areas are maintained are a priority. TANAPA and the Wildlife Division are in the process of accumulating information on all wildlife corridors in Tanzania. However this analysis has largely focused on movements of large ungulates, and hence needs to be readdressed for wild dogs. There is currently little information on wild dog distribution and movement patterns between areas.

What more do we need to know?

- Threats to corridors
- The use of corridors by wild dogs

How do we find out?

Geographical Information Systems (GIS) provide a very useful mechanism to allow us to review all corridors and investigate their potential suitability for the movement of wild dogs

- Identification of potential threats along corridors.
- Movement patterns of wild dogs – assessing whether wild dogs make use of corridors.

5.4 Snaring

Wild dogs can be caught in snare lines laid out for game to be used for meat. Wild dogs are frequently attracted to such snare lines due to the presence of trapped game in these areas. However the impact on snaring at the population level is not well understood. The presence of snares and the species of animals caught in snare lines are recorded during anti-poaching patrols by rangers and game scouts working for TANAPA and WD.

What more do we need to know?

- Snaring is probably of particular importance in western Serengeti and Ugalla where snaring is relatively common. There is a need to establish whether it has an impact on wild dogs in these areas.

How do we find out?

- Review existing information from anti-poaching patrols

5.5 Road kills

Wild dogs have been reported as being victims of road kills particularly on the main road going through Mikumi National Park. Road kills are also a potential problem on the Arusha-Nairobi and Arusha-Dodoma roads. However, apart from these specific areas, road kills are probably currently of limited importance to wild dog conservation due to the lack of tarmac roads across the country.

What more do we need to know?

- Identify trouble spots for wild dogs on the roads so that mitigation action can be taken – e.g. the placing of speed bumps.

How do we find out?

- Obtain GPS locations of all road kills to enable mapping of trouble spots.

5.5 Ecological constraints to wild dog conservation

Whilst interspecific competition is natural and an inherent component of functioning ecosystems, it can be a major constraint to the effectiveness of conservation. Of particular importance to wild dogs are the relative densities of lions and spotted hyaenas in a region. Wild dogs are vulnerable to competition from lions and spotted hyaenas, which can take their kills and kill pups and occasionally adults, and hence their numbers in protected areas are likely to be limited by these species. Lions are thought to pose the biggest threat to wild dogs, and have been reported as killing both adult and young wild dogs. In Kruger National Park for example, lion predation accounts for 39% of natural pup deaths and 43% of natural adult deaths, and hence is likely to have a major impact on wild dog populations (Mills and Gorman 1997).

What more do we need to know?

- Investigate the importance of interspecific competition across a range of different habitats
- Can lion hunting be a management option for wild dog conservation?

How do we find out?

- The group agreed that there was a need for cross habitat/site comparisons and in hunted and unhunted areas.

5.6 Summary

The group in general agreed that persecution, habitat loss/change and disease were the three most important factors affecting wild dog conservation in Tanzania. There is a paucity of information on the impacts of the threats discussed, with the exception of the Serengeti Carnivore Disease Project which is gathering relevant information about the impacts of disease in the Serengeti ecosystem. The techniques discussed in section 4.2 for gathering information on wild dog distribution and status are potentially also useful for collecting information about threats (Table 2), and hence the choice of a particular technique might depend on what other information the technique might additionally provide. For example a questionnaire survey could potentially provide information on persecution and land use change, and even on some easily recognizable diseases such as rabies, whilst spoor surveys, working dogs and camera traps can provide information on the other predators (and prey) in the ecosystem. Radio collaring, because it involves handling, has the potential to provide good information on many diseases if a blood sample is collected, and because it is easier to monitor individuals, information on deaths due to disease, persecution, snaring, road kills and even interspecific competition. It can also be used to locate individuals for in depth behavioural observation which might provide additional information about the impacts of interspecific competition. Radiocollared animals are also more likely to be detected quickly after death and thus an accurate diagnosis is more probable. Finally, although radio collaring itself is not appropriate for assessing the direct consequences of land use change, it can provide information about how it affects ranging patterns of wild dogs.

	Questionnaire	Spoor	Photos surveys	Working dogs	Camera Traps	Radio Collars
Disease	Rabies	N	N	N	N	info on CDV - but more likely to pick up dead individuals in disease outbreaks..and hence greatly increases chances of identifying cause of death
Persecution	Y	N	N	N	N	More likely to get direct evidence of deaths
Land use change	Y	N	N	N	N	N
Snaring	N	N	N	N	N	Possible due to close monitoring of packs
Road kill	N	N	N	N	N	Possible due to close monitoring of packs
Interspecific Competition	N	Y	N	Y	Y	Y

Table 2. Data on threats generated by the different methods for investigating wild dog status covered in 4.2. Y indicates that the method could generate appropriate data, N the method could not generate appropriate data.

6.0 CONSERVATION AND RESEARCH PRIORITIES

In this last part of the meeting the group discussed priorities for wild dog conservation and research in Tanzania. The inputs from the management authorities from WD, TANAPA and NCAA were particularly important for this session. The group agreed that there was currently very little information on wild dogs, and that there was an increasingly urgent need to gather data relevant to wild dog conservation across the country. The group also agreed that conservation action should be implemented wherever there are clear indications that such action is necessary. Overall the group felt that there were four major national priorities:

- To obtain baseline information on the distribution of wild dogs in Tanzania - additional information on trends and abundance can follow later
- To provide training to wildlife stakeholders in survey techniques e.g. game scouts
- To set priorities for wild dog conservation in the country
- To identify threats

However there were also regional differences in specific information and conservation needs, and hence the group addressed these needs in detail for each of the major regions in section 4.1. Needs were divided into two sections: status (wild dog distribution, demography, ranging patterns and density – see section 4) and threats (information needs and management priorities – see section 5). Agreed regional priorities are summarized in table 3 and are described below.

Wild dog status was separated into 5 components ranging from broad distribution data, through information on trends and density, to detailed information on demographic parameters (such as survival and reproduction) and ranging patterns. Appropriate methods used to gather this information are covered in section 4.2. All participants felt that information on ranging patterns was particularly useful. Ranging patterns were important to TANAPA to show how often dogs leave protected areas and how far they travel from them and to WD and NCAA to alert them to potential conflict situations with local communities. Information on ranging patterns combined with good information on threats can also help identify specific threats to which a pack might be exposed over an annual cycle. The only method that can be used to estimate range size is radio collaring (Table 1), and so areas where ranging patterns are deemed as a priority should also regard the implementation of a radio collaring study in these areas as a priority. Radio collaring studies are currently also the only suitable method to gain good data on density and trends. Other methods, such as spoor counting, can be used to monitor density within areas, but not between areas, and hence can be useful for trends. Photo surveys, which can potentially supply very good information, are unfortunately only effective in areas with a lot of visitors. The use of working dogs can potentially provide good information on distribution, trends, density and demography across a wide range of habitats however the method is as yet untested in Africa.

Threats represent the main means through which people have an impact on wild dogs, and hence also are the main means through which managers can have an impact on wild dog conservation. Their importance should thus be viewed in terms of both gathering information (threats, like wild dog status, should also be monitored), but also in terms of activities that can reduce each threat, such as management, education or policy changes, which can be adapted as more information about each threat is accumulated. Monitoring threats to wild dogs were agreed to be as important as monitoring status, and should be a component of any planned survey.

Threats were divided into the 6 broad headings as outlined in section 5, however threats were further broken down to include specific issues. Disease was broken down into the two key diseases outlined in section 5.1, rabies and CDV, with rabies as probably having the greater impact. CDV was seen to be potentially important, however there is a need for further information in order to assess whether it has a real impact. Any effective disease monitoring should not be limited to wild dogs but should also include domestic dogs and wildlife to gain a full understanding of routes of transmission and hence potential means of control. Disease monitoring will necessarily involve handling, as blood needs to be collected to ascertain exposure to disease, and a good reporting and collecting system for dead animals to enable quick recovery and subsequent post-mortem and tissue collection. In the Serengeti ecosystem information about both rabies and CDV is relatively advanced, and there is already a program run by the Serengeti Carnivore Disease Project determining disease reservoirs and the effectiveness of ring vaccination for both rabies and CDV. Such a program has been shown to be effective for controlling rabies in wildlife, however the epidemiology of CDV is less well understood. The group agreed that such a program, although expensive, should be considered where possible for other areas, as it provides a management option for disease control. As part of an overall vaccination strategy, the group agreed that there was a need to explore alternative delivery systems for vaccination, particularly oral vaccines. An effective bait delivery for oral rabies vaccines has been developed in South Africa, where chicken heads proved to be the bait of choice for wild dogs. However, further work is required, particularly where dogs are not well habituated, to ascertain the most effective system to maximise pack vaccination coverage and whether oral vaccination provides a cost-effective method of reducing disease, particularly rabies, threats to wild dogs.

Persecution was agreed to be a relatively high priority threat as it is known to be an issue around the Serengeti ecosystem and in the Maasai steppe. Management responses to persecution issues depend on the impact of persecution on the population and the reasons for persecution – e.g. livestock predation or a perceived disease threat will require different management responses. In addition, local livestock management practices might contribute to livestock depredation and hence persecution, and modifications to existing practices should be fully explored. Reports of depredation should also be validated to ascertain whether perceptions reflect reality. Very often perceived depredation by predators is higher than the reality. Persecution issues are probably generally best addressed through outreach and education programmes in problem areas, and through establishing good livestock management practices, the details of which will depend on regional circumstances.

Habitat loss and land use change were seen to be a medium priority threat throughout the country. All regions of the country are affected by these processes which are likely to have an impact on wild dog conservation. The group agreed that the best approach to minimize their impact is the establishment and maintenance of effective corridors between protected areas, and hence recommended a review of the TANAPA/WD/FZS corridor analysis with respect to wild dogs, to identify and map corridors for the species. Landscape genetics was seen to be a potentially important tool in this process, as genetic differentiation between different sub populations of wild dogs can demonstrate the extent to which subpopulations mix with each other.

Of the remaining threats, snaring was thought to have local importance only around the Maswa Game Reserve and Ugalla. The group agreed that it was important to review information collected on animals caught in snares collected by game scouts and rangers in routine patrols in these areas. Road kill was deemed to have a relatively low impact everywhere except Mikumi, where there was a need to improve reporting procedures, in order to identify potential trouble spots (see section 5.5). Interspecific competition was judged to be of a low priority except in the Ruaha/Rungwa region where a simultaneous study inside and outside the PA was deemed to be of a medium priority, to demonstrate the relative importance to wild dog conservation of areas where lions are hunted, and hence the possibility of using lion management as a tool for wild dog conservation.

Conservation and research priorities are reviewed region by region below. It should be remembered that all priorities in table 3 are based on current information and educated guesswork, and will need to be reviewed and updated as more information is gathered.

6.1 Northern region

Information on distribution, population trends and ranging patterns of wild dogs were agreed to be of a high priority in this region, whilst information on density and survival were agreed to be of medium priority. Comprehensive data such as this can only be gathered through radio collaring (Table 1). Of the threats, disease and persecution were deemed to be of the highest priority. There is already an ongoing extensive study of rabies and CDV in the ecosystem conducted by the Serengeti Carnivore Disease Project, which includes a ring vaccination program, and hence the region is fortunate that this project is currently addressing many of the information needs regarding disease, however the wealth of data already accumulated suggests that this region could also be a priority area for the investigation of vaccination delivery methods for wildlife and domestic dogs. A new project funded by FZS aims to investigate the reasons underlying conflict with wild dogs to the east of the Serengeti National Park, this study is being conducted under CIMU. Habitat loss and snaring were agreed to be of medium priority in the region, and there was a particular need to assess the impact of snaring in the Maswa Game Reserve. The likelihood of road kill was thought to be low whilst the impacts of interspecific competition probably also low, as the areas where wild dogs occur are outside the Serengeti National Park and hence have relatively low densities of lions and hyaenas.

6.2 Maasai Steppe

Information on wild dogs in the Maasai steppe is currently very poor, and hence the group agreed that the first priority for this region should be to gather basic distribution data. Information on ranging patterns were also agreed to be a high priority as the region is largely unprotected. Such information would inform managers of protected areas about where wild dogs go when they leave the areas under their jurisdiction. Information on trends were judged to be a medium priority, whilst information on density and survival of a low priority at present. There is currently very little information about threats to wild dogs, although there is reasonably good information about other wildlife in Siminjaro. The group felt that of all the threats, persecution is probably of the highest priority, whilst disease and habitat loss of medium priority. Snaring, road kill and interspecific competition were relatively low priorities, pending further information, the latter principally due to the low numbers of lions and hyaenas outside the protected areas. The high priority information needs for this area could be addressed by implementing a questionnaire survey combined with a radio collaring study.

6.3 Selous/Niassa

The Selous/Niassa region contains the largest and most important population of wild dogs in the world, and the group agreed that because of its global importance, long term monitoring of wild dogs in the region should be a priority. Information on distribution and trends were agreed to be high priorities for the region, whilst information on ranging patterns medium priority, although these priorities might increase if a high degree of conflict were to be uncovered in the region. Information on density and survival were deemed to be of relatively low priority, partly due to the comprehensive study carried out by Scott Creel in the 1990s (Creel and Creel 2002). It should be noted however, that given the existence of the previous study, the easiest means of uncovering trends in the region is likely to be through a (less detailed) replicate study to that carried out by Creel & Creel.

Only one threat was judged a high priority in the region, road kill, due to a number of known incidents of wild dogs being killed on the road through Mikumi National Park. Further information as outlined in section 5.5 should be gathered to address this issue and implement speed bumps where necessary. Persecution was agreed to be a potential problem of medium priority in the region, but the group recognized that little information currently exists on the existence or impacts of persecution on wild dogs in the region, and there was a need to determine the status of this threat. Such information could be gathered through a questionnaire survey of areas around the game reserve. Disease was thought to be of medium priority, but again, there is very little information on disease in the region and the group agreed that a disease monitoring program should be implemented prior to any intervention. Habitat loss and land use change were agreed

Status					
	Northern region	**Maasai Steppe**	**Selous/ Niassa**	**North west and central**	**Ruaha/ Rungwa**
Distribution	High	High	High	High	High
Trends	High	Medium	High	High	High
Density	Medium	Low	Low	Medium	High
Demography	Medium	Low	Low	Low	Medium (pending distribution and disease data)
Ranging	High	High	Medium (depending on conflict data)	Low	Medium (pending distribution and disease data)
Threats					
	Northern region	**Maasai Steppe**	**Selous/ Niassa**	**North west and central**	**Ruaha/ Rungwa**
Disease	High	Medium	Medium (monitoring)	Medium	High
Persecution	High	High	Medium (importance, spec. Mikumi)	Low	Medium (assess importance)
Habitat loss/land use change	Medium	Medium	Medium	Medium	Medium
Snaring	Medium (particularly Maswa)	Low	Low	Low	Low
Road kill		Low	High (Mikumi)	Zero	Low
Interspecific competition	Low	Low	Low	Low	Medium (simultaneous study inside and outside PA)
Rest of country - Information needs limited to preliminary distribution assessment:					
Sadani, Mkomazi, Mozambique border, Bihalo Mulo/Burigi and the northern limit of the western distribution					

Table 3. Information priorities for the major regions for where dogs are known to occur categorized into low, medium and high priority. The table is divided into two sections according to information needs regarding status and threats. The group prioritized the list of areas at the bottom of the country for obtaining information on distribution as there is currently no information on wild dogs in these areas.

to be of medium priority. GTZ have an ongoing project in the region mapping elephant corridors, which could provide important baseline information. The routes used by elephants in the region uncovered by this study should be investigated for their appropriateness for wild dogs. Snaring and interspecific competition were judged to be of low priorities, the latter partly because Creel's study demonstrated that the Selous population of wild dogs was of high density despite the presence of spotted hyaenas and lions in the game reserve.

6.4 North west and western central region

This region is very little developed with limited agriculture. There is very little information about wild dogs in the region and so, as with the Maasai steppe, basic information on distribution was agreed to be of the highest priority. Information on trends were also agreed to be of a high priority and density a medium priority. Information on survival rates and ranging patterns were agreed to be of relatively low priority, pending further information. Of the threats, the group thought that this population was probably not greatly threatened by the listed threats, with the most important threats likely to be disease and habitat loss. Persecution was deemed to be a relatively low priority in the region. However there was so little known about this region, the region itself should be a priority for a basic survey, and a further refinement of priorities might be necessary pending further information. Distributional data and information on some threats could be addressed through a well designed questionnaire survey throughout the region.

6.5 Ruaha/Rungwa

The group felt that the Ruaha/Rungwa region had great potential for wild dogs, possibly second only to the Selous in terms of overall importance, but there was a paucity of information from the region. As such the group agreed that this region should be of a particularly high priority, and information on distribution, trends and density of wild dogs were all judged to be high priority, as such data would inform the wildlife authorities about the relative national (and global) importance of the region for wild dogs. Information on survival and ranging patterns were agreed to be of medium priority, however further information on distribution and disease might change this priority level. For example, if diseases were found to be widespread in wild dogs and surrounding wildlife and/or domestic dogs, ranging patterns would indicate whether wild dogs come into contact with wildlife or domestic dogs carrying the disease whilst survival and reproduction data would indicate whether these diseases had real impact on overall numbers of wild dogs in the region.

Disease was agreed to be a high priority threat to the wild dogs in this region, whilst persecution and habitat loss and land use change were judged to present a medium priority threat. However because there was a lack of information on persecution the group agreed that there was a need to reassess its importance prior to any management interventions. Interspecific competition was thought to be of medium priority due to the high densities of other large carnivores in protected areas in the region and the wide extent of these protected areas. The group agreed that this region presents a good opportunity to assess the relative importance of interspecific competition and the impact of lion hunting on wild dog populations by initiating a simultaneous study of wild dogs inside and outside protected areas. Snaring and road kill were deemed to be of low priority by the group.

6.6 Other areas

There was very little information about the rest of the country, although there were almost certainly wild dogs in areas outside the regions outlined above. The group therefore prioritised areas where basic distribution data should be gathered to establish the presence and distribution of wild dogs. Priority areas were as follows: Sadani, Mkomazi, the Mozambique border, Biharamulo/Burigi and establishing the northern limit of the western distribution of wild dogs. This would be best addressed through a series of questionnaire surveys.

7.0 THE WAY FORWARD

There is an urgent need to get better information on the distribution of wild dogs across the country, and TAWIRI, through the activities of the Tanzania Carnivore Project, will continue to gather this information, targeting areas with data deficiencies. There is also a need to gather more detailed data targeted at specific regions. In particular, all the management authorities required information on trends and ranging patterns and potential threats for wild dogs in many areas. The priorities listed in Table 3 provide a useful tool for planning specific research and conservation activities on wild dogs. High priority activities should focus on those priorities judged as high by the group, and medium priority activities on priorities identified as medium. Tables 1 and 2 list the methods available for obtaining information to address these priorities. Many of the recommended information priorities by the group involve handling of wild dogs. All present agreed the conservation gains by such interventions outweighed any possible negative impacts - which were deemed to be small. Only one other technique identified in section table 1 has the potential to provide data of the detail and quality of that provided by radio collaring, that using of working dogs, but this technique has as yet not been fully tried in Africa.

Managers need information on the status and threats to wild dogs in their areas to plan management activities and to enable wild dog conservation, as well as assessing the impact of these activities on wild dog conservation. All participants are deeply proud of Tanzania's international status for wild dog conservation, and wish to improve the standards of information on wild dogs across the country. The hard work that participants put into this workshop and report reflects this wish, and will hopefully provide wild dog research and conservation with a new impetus, to address the identified priorities hand in hand with training and capacity building.

References

Burrows, R. 1995. Demographic changes and social consequences in Wild Dogs, 1964-1992. Pages 400-410 in A. R. E. Sinclair, and P. Arcese, editors. Serengeti II: Dynamics, management and conservation of an ecosystem. University of Chicago Press, Chicago.

Creel, S., and N. M. Creel 2002. The African Wild Dog: Behavior, Ecology, and Conservation. Princeton University Press, Princeton.

Ginsberg, J. 1996. Survivorship in African Wild Dogs. Conservation Biology **10**:313-314.

Karanth, K. U., and J. D. Nichols. 1998. Estimation of tiger densities in India using photographic captures and recaptures. Ecology **79**:2852-2862.

Maddox, T. 2002. The ecology of cheetahs and other large carnivores in a pastoralist-dominated buffer zone. Anthropology. University of London, London.

Mills, M. G. L., and M. L. Gorman. 1997. Factors affecting the density and distribution of wild dogs in the Kruger National Park. Conservation Biology **11**:1397-1406.

Sillero-Zubiri, C., M. Hoffmann, D. W. Macdonald, and t. I. S. C. S. Group 2004. Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland.

Silver, S. C., L. E. T. Ostro, L. K. Marsh, L. Maffei, A. J. Noss, M. J. Kelly, R. B. Wallace, H. Gomez, and G. Ayala. 2004. The use of camera traps for estimating jaguar Panthera onca abundance and density using capture/recapture analysis. Oryx **38**:148-154.

Smith, D. A., K. Ralls, A. Hurt, B. Adams, M. Parker, B. Davenport, M. C. Smith, and J. E. Maldonado. 2003. Detection and accuracy rates of dogs trained to find scats of San Joaquin kit foxes (Vulpes macrotis mutica). Animal Conservation **6**:339-346.

Stander, P. E. 1998. Spoor counts as indices of large carnivore populations: the relationship between spoor frequency, sampling effort and true density. Journal of Applied Ecology **35**:378-385.
Wasser, S. K., B. Davenport, E. R. Ramage, K. E. Hunt, M. Parker, C. Clarke, and G. Stenhouse. 2004. Scat detection dogs in wildlife research and management: application to grizzly and black bears in the Yellowhead Ecosystem, Alberta, Canada. Canadian Journal of Zoology-Revue Canadienne De Zoologie **82**:475-492.
Woodroffe, R., J. R. Ginsberg, D. W. Macdonald, and I. S. C. S. Group 1997. The African Wild Dog - Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland.

Burrows, R. (1995). Demographic changes and social consequences in Wild Dogs, 1964-1992. Serengeti II: Dynamics, management and conservation of an ecosystem. P. Arcese. Chicago, University of Chicago Press**:** 400-410.
Creel, S. and N. M. Creel (2002). The African Wild Dog: Behavior, Ecology, and Conservation. Princeton, Princeton University Press.
Ginsberg, J. (1996). Survivorship in African Wild Dogs. Conservation Biology. **10:** 313-314.
Karanth, K. U. and J. D. Nichols (1998). Estimation of tiger densities in India using photographic captures and recaptures. Ecology. **79:** 2852-2862.
Maddox, T. (2002). The ecology of cheetahs and other large carnivores in a pastoralist-dominated buffer zone. Anthropology. London, University of London.
Mills, M. G. L. and M. L. Gorman, Eds. (1997). Factors affecting the density and distribution of wild dogs in the Kruger National Park. Conservation Biology.
Sillero-Zubiri, C., M. Hoffmann, et al. (2004). Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan. Gland, Switzerland, IUCN.
Silver, S. C., L. E. T. Ostro, et al. (2004). The use of camera traps for estimating jaguar Panthera onca abundance and density using capture/recapture analysis. Oryx. **38:** 148-154.
Smith, D. A., K. Ralls, et al. (2003). Detection and accuracy rates of dogs trained to find scats of San Joaquin kit foxes (Vulpes macrotis mutica). Animal Conservation. **6:** 339-346.
Stander, P. E. (1998). Spoor counts as indices of large carnivore populations: the relationship between spoor frequency, sampling effort and true density. Journal of Applied Ecology. **35:** 378-385.
van de Bildt MWG, Kuiken T, Visee AM, Lema S, Fitzjohn TR, Osterhaus ADME (2002). Distemper outbreak and its effect on African wild dog conservation. Emerging Infectious Diseases,2):211-213.
Wasser, S. K., B. Davenport, et al. (2004). Scat detection dogs in wildlife research and management: application to grizzly and black bears in the Yellowhead Ecosystem, Alberta, Canada. Canadian Journal of Zoology-Revue Canadienne De Zoologie. **82:** 475-492.
Woodroffe, R., J. R. Ginsberg, et al. (1997). The African Wild Dog - Status Survey and Conservation Action Plan. Gland, Switzerland, IUCN.

Annex 1
Participants list

Name	Organization/ Institution	Contact Address	Tel:	Email
Hosiana Emmanuel	TAWIRI-SWRC	Box 661 Arusha	028261526	emasenga76@yahoo.com
Sarah Durant	TAWIRI/ZSL/WCS	Box 661 Arusha	0744 - 874860	cheetah@habari.co.tz
Peter Coppolilo	WCS-Rungwa-Ruaha	Box 1654IR	0744 - 090010	pcoppolilo@wcs.org
Novatus Magoma	NCAA-RPU (Ngorongoro)	Box 1, Ng	0748 - 841771	ncaa_faru@cybernet.co.tz
Maurus Msuha	TAWIRI	Box 661 Arusha	0748 - 225801	carnivores@habari.co.tz
Alexander Lobora	TAWIRI	Box 661 Arusha	0748 – 301924	carnivores-atlas@habari.co.tz
George Sabuni	TAWIRI	Box 661 Arusha	254 – 8240	tawiri@habari.co.tz
Christine Mertzel	Carnivore Disease Project	Box 14935 Arusha	0748 – 694014 028 - 2621502	carnivorediseaseproject@yahoo.com
Jerome Kimaro	TAWIRI	Box 661 Arusha	0741 – 275538	carnivore-education@habari.co.tz
Rehema Tibanyenda	Wildlife Division	Box 1994 DSM	0744 – 281025	rhematiba@yahoo.co.uk
Midala, B.M.C.M	Wildlife Division	Box 1994	0744 854755	director@wildlife.go.tz
Titus Mlengeya	TANAPA	Box 3134 Arusha	0748 – 302133	tanapavet@yahoo.com
Karen Laurenson	FZS/UWIK	Box 14935 Arusha	028 2621500	karenlaureson@fzs.org
Joe ole Kuwai	FZS	Box 14935	028 262106/9	joeolekuwai@fzs.org
Flora Kipuyo	TAWIRI	Box 661 Arusha	0744 844468	fkgerson@yahoo.com

graduate studies on foraging ecology and reproductive strategies.

K. Laurenson and D. Knobel (Centre for Tropical Veterinary Medicine, University of Edinburgh, UK) are testing a combination of vaccination trial and field techniques to investigate the dynamics of canid pathogens, particularly rabies, in domestic and wild carnivore species.

Anteneh Shimelis and Ermias A. Beyene (Addis Ababa University), S. Williams (Wildlife Conservation Research Unit, University of Oxford), S. Thirgood (Frankfurt Zoological Society, Tanzania) are studying predator-prey interactions in Bale, assessing whether rodent populations are regulated by competition (with domestic livestock) or by predation (by wolves and raptors).

Gaps in knowledge

Although the behavioural ecology of the species is well known, this has been focused in the optimal habitats in the Bale Mountains. Additional information on dispersal distance and survival would be useful. Investigation into the role of the species in the epidemiology of canid-related diseases is necessary. Studies on wolf-prey relationships and prey availability in the high risk populations of northern Ethiopia are also urgently needed.

Core literature

Gottelli and Sillero-Zubiri 1992; Gottelli *et al.* 1994, 2004; Haydon *et* al. 2002; Laurenson *et al.* 1998; Marino 2003, 2004; Sillero-Zubiri 1994; Sillero-Zubiri and Gottelli 1994, 1995a,b; Sillero-Zubiri *et al.* 1996a,b, 2000, 2004a; Sillero-Zubiri and Macdonald 1997.

Reviewers: Neville Ash, M. Karen Laurenson, James R. Malcolm, Zelealam Tefera Ashenafi, Stuart Williams. **Editor:** Michael Hoffmann.

6.5 African wild dog *Lycaon pictus* (Temminck, 1820) Endangered – EN: C2a(i) (2004)

R. Woodroffe, J.W. McNutt and M.G.L. Mills

Other names

English: Cape hunting dog, painted hunting dog; **French:** lycaon, cynhyène, loup-peint; **Italian:** licaone; **German:** hyänenhund; **Spanish:** licaon; **Indigenous names:** Afrikaans: wildehond (Namibia, South Africa); Amharic: takula (Ethiopia); Ateso: apeete; isiNdebele: iganyana iketsi leKapa (South Africa); isiXhosa: ixhwili (South Africa); isiZulu: inkentshane (South Africa); Kalenjin: suyo (Kenya); Kibena: liduma; Kibungu: eminze; Kichagga: kite kya nigereni; Kihehe: ligwami; Kijita: omusege; Kikamba: nzui; Kikukuyu: muthige; Kikuyu: muthige (Kenya); Limeru: mbawa; Kiliangulu: eeyeyi; Kimarangoli: imbwa; Kinyaturu: mbughi; Kinyiha: inpumpi; Kinyiramba: mulula; Kisukuma: mhuge; Kiswahili: mbwa mwitu; Kitaita: Kikwau; Kizigua: mauzi; Lozi: liakanyani; Luo: sudhe, prude; Maasai: osuyiani (Kenya, Tanzania); Mandingue: juruto (Mali, Senegal); Nama and Damara:!Gaub (Namibia); Samburu: Suyian (Kenya); Sebei: kulwe, suyondet; Sepedi: lehlalerwa, letay.. (South Africa); Sesotho: lekanyane, mokoto, tlalerwa (Lesotho, South Africa); Setswana: leteane, letlhalerwa, lekanyana (Botswana, South Africa); Shona: mhumhi (Zimbabwe); siSwati: budzatja, inkentjane (Swaziland, South Africa); Tshivenda: dalerwa; Woloof and Pulaar: saafandu (Senegal); Xitsonga: hlolwa (Mozambique, South Africa); Yei: umenzi (Botswana).

Taxonomy

Hyaena picta Temminck, 1820. Ann. Gen. Sci. Phys. 3: 54. Type locality: "à la côte de Mosambique" [coastal Mozambique].

The genus *Lycaon* is monotypic and was formerly placed in its own subfamily, the Simoncyoninae. Whil.. this subfamily division is no longer recognised (Wozencraft 1989), recent molecular studies have supported the separation of this species in its own genus (Girman *et al.* 1993). Wild dogs have been grouped with dhole (*Cuon alpinus*) and bush dogs (*Speothos venaticus*), but morphological similarities among these species are no longer considered to indicate common ancestry, and they are now considered close to the base of the wolf-like canids (Girman *et al.* 1993).

Genetic and morphological studies carried out by Girman *et al.* (1993) initially suggested the existence of separate subspecies in eastern and southern Africa. However, no geographical boundaries separated these proposed subspecies, and dogs sampled from th intermediate area showed a mixture of southern and eastern haplotypes, indication of a cline rather than distinct subspecies (Girman and Wayne 1997).

Chromosome number: 2n = 78 (Chiarelli 1975).

Description

A large, but lightly built canid, with long, slim legs and large, rounded ears (Table 6.5.1). The coloration of the pelage is distinctive but highly variable, with a combination of irregular black, yellow-brown and white blotches on the back, sides, and legs. Wild dogs in north-east Africa tend to be predominantly black with small white and yellow patches, while dogs in southern Africa are more brightly coloured with a mix of brown, black and whit.. Each animal's pelage coloration is unique, and this can be used to identify individual animals. Coloration of the head and tail is more consistent: almost all dogs have a yellow-brown head with a black 'mask', black ears, and a black line following the sagittal crest, and a white tip to

Table 6.5.1. Body measurements for the African wild dog.

	Kruger National Park, South Africa (M.G.L. Mills unpubl.).	Laikipia and Samburu Districts, Kenya (R. Woodroffe unpubl.).
HB male	1,229mm (1,060–1,385) n=16	962mm (845–1,068) n=5
HB female	1,265mm (1,090–1,410) n=15	990mm (930–1,045) n=4
T male	354mm (320–420) n=15	345mm (328–380) n=5
T female	326mm (310–370) n=13	328mm (320–333) n=4
HF male	250mm (230–260) n=13	245mm (225–318) n=5
HF female	241mm (230–250) n=14	224mm (215–229) n=3
E male	135mm (125–148) n=15	128mm (110–145) n=5
E female	130mm (125–135) n=15	129mm (120–136) n=4
WT male	28.0kg (25.5–34.5) n=12	21.0kg, n=1
WT female	24.0kg (19.0–26.5) n=12	18.0kg, n=1

the tail. The length of the pelage varies regionally, but hair is generally very short on the limbs and body but longer on the neck, sometimes giving a shaggy appearance at the throat. There are four digits on each foot, all with claws; and in most individuals, the pads of the second and third toes are partially fused. Females have six to eight pairs of mammae. Males are slightly heavier than females, and are easily recognised by the conspicuous penis sheath.

The dental formula is 3/3-1/1-4/4-2/3=42. In common with *Cuon* and *Speothos*, departure from the typical form of dentition within the Canidae is found in the lower carnassial where the inner cusp of the talonid is missing so that instead of forming a basin, this part of the tooth forms a subsidiary blade. This suggests a highly predacious diet, with corresponding diminished importance of vegetable matter (Ewer 1973).

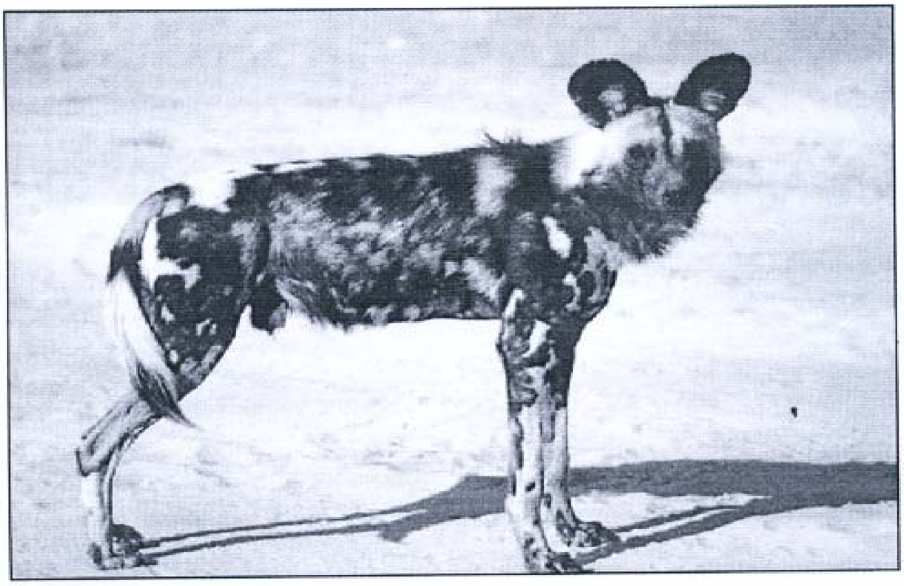
Subspecies No subspecies are currently recognised (Girman and Wayne 1997; Girman *et al.* 2001).

Similar species Wild dogs are occasionally confused with feral dogs and striped hyaenas (*Hyaena hyaena*), and even side-striped jackals (*Canis adustus*) and bat-eared foxes (*Otocyon megalotis*), but are morphologically distinct from all.

Distribution

Historical distribution Historical data indicate that wild dogs were formerly distributed throughout sub-Saharan Africa, from desert (Lhotse 1946) to mountain summits (Thesiger 1970), and probably were absent only from lowland rainforest and the driest desert (Schaller 1972).

Current distribution Wild dogs have disappeared from much of their former range – 25 of 39 former range states no longer support populations (Fanshawe *et al.* 1997). The species is virtually eradicated from West Africa, and greatly reduced in central Africa and north-east Africa.



Male African wild dog, age unknown. Moremi Wildlife Reserve, Okavango Delta, Botswana, 1990.

Chris and Tilde Stuart

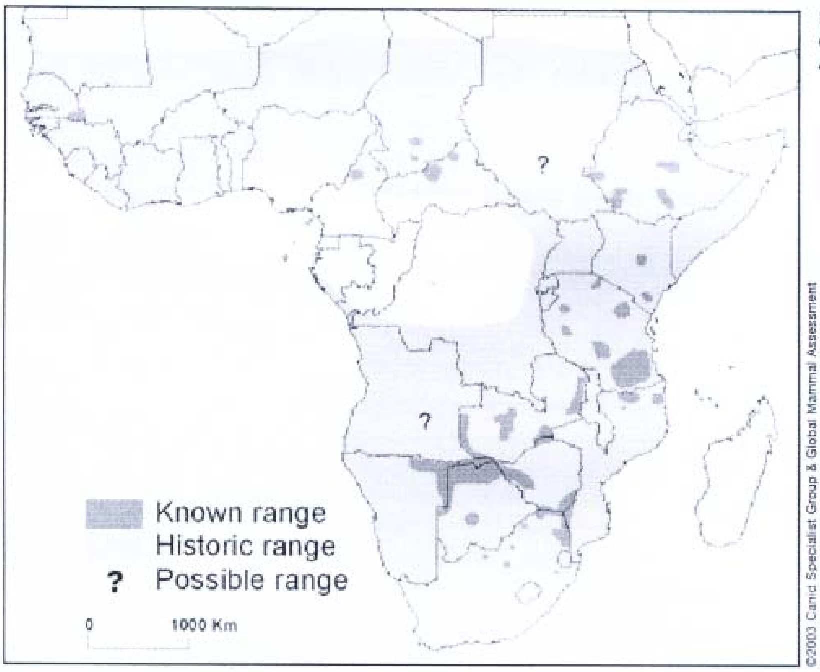


Figure 6.5.1. Current distribution of the African wild dog.

The largest populations remain in southern Africa (especially northern Botswana, western Zimbabwe, eastern Namibia, and Kruger National Park, South Africa) and the southern part of East Africa (especially Tanzania and northern Mozambique). Details of current distribution and status are in Woodroffe *et al.* (1997).

Range countries Angola (?), Botswana, Cameroon, Central African Republic, Chad, Ethiopia, Kenya, Mozambique, Namibia, Senegal, South Africa, Sudan, Swaziland (vagrant), Tanzania, Zambia, Zimbabwe. (Fanshawe *et al.* 1997). Wild dogs are known to be, or presumed to be, extinct or near-extinct in Benin, Burkina Faso, Burundi, Democratic Republic of Congo, Eritrea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Malawi, Mali, Niger, Nigeria, Rwanda, Sierra Leone, Togo and Uganda (Woodroffe *et al.* 1997). The situation in Angola is unknown, but it is possible that packs still occur there.

Relative abundance

Wild dogs are rarely seen, even where they are relatively common, and it appears that populations have always existed at very low densities. Population densities in well-studied areas are given below (Table 6.5.2), which Ginsberg and Woodroffe (1997a) used to estimate the size of remaining populations at between 3,000–5,500 free-ranging wild dogs in Africa.

Table 6.5.2. Population densities of wild dogs in various study areas across Africa (updated from Woodroffe *et al.* 1997).

Study site	Population density (adults/100km²)
Aitong, near Maasai Mara, Kenya	2.6–4.6
Okavango Delta, Botswana	3.5
North-central Botswana	0.5
Hluhluwe-Umfolozi Park, South Africa	3.3
Hwange National Park, Zimbabwe	1.5
Zambezi Valley Complex	2.0
Kruger National Park, South Africa	0.8–2.0
Selous Game Reserve, Tanzania	4
Serengeti National Park, Tanzania 1967–1979	1.5
Serengeti National Park, Tanzania 1985–1991	0.67

Estimated populations/relative abundance and population trends The following estimated sizes and trends of national wild dog populations in Africa are updated from Woodroffe *et al.* (1997) (Table 6.5.3). Figures for protected and unprotected areas are approximate, since few wild dog populations are confined entirely to protected areas. For this reason, populations given for protected areas are almost universally over-estimated, with concomitant under-estimates for numbers outside protected areas.

Table 6.5.3. The status of wild dogs in range states across Africa (I=increasing, S=stable, D=declining).

Country	In and around protected areas Population	Trend	Outside protected areas Population	Trend	Total
Botswana	500	S	300		800
Cameroon	50	D?			50
Central African Republic	150	?			150
Chad	70	?			70
Ethiopia	200	?	200	?	400
Kenya	100	S?	250	I	350
Mozambique	200	?			200
Namibia	100	S	300	S?	400
Senegal	20	?			20
Somalia	0	?	20	?	20
South Africa	300	S	110	I?	410
Sudan			50	?	50
Tanzania	1,300	S?	500	S?	1,800
Zambia	430	?	?	–	430
Zimbabwe	400	SD?	200	I	600
Grand total					**5,750**

Habitat

Wild dogs are generalist predators, occupying a range of habitats including short-grass plains, semi-desert, bushy savannahs and upland forest. While early studies in the Serengeti National Park, Tanzania, led to a belief that wild dogs were primarily an open plains species, more recent data indicate that they reach their highest densities in thicker bush (e.g., Selous Game Reserve, Tanzania; Mana Pools National Park, Zimbabwe; and northern Botswana). Several relict populations occupy dense upland forest (e.g., Harenna Forest, Ethiopia: Malcolm and Sillero-Zubiri 2001; Ngare Ndare Forest, Kenya). Wild dogs have been recorded in desert (Lhotse 1946), although they appear unable to establish themselves in the southern Kalahari (M.G.L. Mills unpubl.), and montane habitats (Thesiger 1970; Malcolm and Sillero-Zubiri 2001), although not in lowland forest. It appears that their current distribution is limited primarily by human activities and the availability of prey, rather than by the loss of a specific habitat type.

Food and foraging behaviour

Food Wild dogs mostly hunt medium-sized antelope. Whereas they weigh 20–30kg, their prey average around 50kg, and may be as large as 200kg. In most areas their principal prey are impala (*Aepyceros melampus*), kudu (*Tragelaphus strepsiceros*), Thomson's gazelle (*Gazella thomsonii*) and wildebeest (*Connochaetes taurinus*) (Table 6.5.4). They will give chase of larger species, such as eland (*Tragelaphus oryx*) and buffalo (*Syncerus caffer*), but rarely kill such prey. Small antelope, such as dik-dik (*Madoqua* spp.), steenbok (*Raphicerus campestris*) and duiker (tribe *Cephalophini*) are important in some areas, and warthogs (*Phacochoerus* spp.) are also taken in some populations. Wild dogs also take very small prey such as hares, lizards and even eggs, but these make a very small contribution to their diet.

Foraging behaviour Wild dogs hunt in packs. Hunts are almost always preceded by a "social rally" which is believed to coordinate the pack in preparation for hunting. Once prey sight the dogs, they may flee, or stand and defend themselves alone or as a herd. During chases, wild dogs can run at speeds of up to 60km/h, and are specially adapted to deal with the heat stress that this involves (Taylor *et al.* 1971). After one dog has made the first grab, other pack members may help to drag the quarry to the ground. Once the quarry has been captured, the animal is killed by disembowelling. In some hunts, one pack member may restrain the head of the prey by biting its nose and holding on while others make the kill. Hunts can appear to be highly coordinated events, but in many areas packs tend to split during hunts with individual dogs often chasing and bringing down the prey alone, then leaving it to find and bring the rest of the pack to the kill.

Hunting success is high in comparison with other large carnivore species (e.g., in Serengeti, 70% of 133 wild dog hunts ended in a kill, compared with 23% of 523 lion hunts; Schaller 1972). As a result of social hunting, each pack member has a higher foraging success (measured as kg killed per km chased) than it would if it hunted alone (Creel and Creel 1995). Members of larger packs are also able to specialise on more profitable prey species (e.g., wildebeest; Creel and Creel 2002), and are better able to defend their kills against scavenging hyaenas (Fanshawe and FitzGibbon 1993). Wild dogs themselves very rarely scavenge (Mills and Biggs 1993).

Damage to livestock or game Wild dogs do take livestock in some areas, but this is a fairly rare occurrence. In and around the Maasai Mara National Reserve, Kenya, wild dogs ignored livestock, and Samburu and Maasai herders

Table 6.5.4. Diet of wild dogs in three selected study areas. 'n' indicates the number of kills recorded in each area.

Study area	n	impala	kudu	reedbuck	Thomson's gazelle	wildebeest	warthog	Reference
Kruger NP South Africa	78	69%	15%	15%	–	–	–	Mills and Biggs (1993)
Aitong, Kenya	60	17%	–	–	67%	8%	2%	Fuller and Kat (1990)
Selous GR, Tanzania	347	54%	–	–		29%	9%	Creel and Creel (2002)

interviewed in northern Kenya indicated that wild dogs rarely caused problems (R. Woodroffe unpubl.). A study of wild dog depredation on commercially raised livestock in Zimbabwe found that the dogs took fewer cattle than the farmers believed (26 cattle from a herd of >3,000, over a two year period, cf. 52 losses attributed to wild dogs; Rasmussen 1999). Wild dogs hunting in livestock areas outside Selous Game Reserve, Tanzania, were never observed to kill livestock in six years of observation (Creel and Creel 2002). Nevertheless wild dogs can become a severe problem for sheep and goats, with multiple animals being killed in a single attack (R Woodroffe unpubl.).

The impact of wild dogs on wild ungulates is likely to be small in intact ecosystems, where dogs are uncommon in comparison with other predators (e.g., lions *Panthera leo*, spotted hyaenas *Crocuta crocuta*) taking essentially the same prey (Mills and Biggs 1993; Creel and Creel 1996). However, historically, wild dogs have been perceived to have a serious impact on game species (e.g., Bere 1955) and are still reviled by game farmers who consider them a major competitor, taking prey that could have been sold to commercial hunters or purchasers of live game (P. Lindsey unpubl.).

Social behaviour

Wild dogs are intensely social animals, spending almost all of their time in close association with each other (e.g., McCreery 2000). Packs are dynamic and may fluctuate rapidly in numbers. They may be as small as a pair, or number as many as 30 adults and yearlings – average pack compositions for various study sites are summarised in Table 6.5.5. Packs are usually formed when small same-sex subgroups (usually litter-mates) leave their natal groups and join sub-groups of the opposite sex (McNutt 1996a; McCreery and Robbins 2001). Occasionally, new packs form by fission from larger groups, with males and females emigrating together. In newly formed packs, the females are typically closely related to one another, but not to the males, and the males are closely related to one another, but not to the females. Young born into such packs may remain there, or disperse as yearlings or young adults to form new packs. Because wild dogs are obligate social breeders, the pack, rather than the individual, should be considered the basic unit within the population.

Wild dogs have large home ranges (Table 6.5.6), which they defend infrequently but aggressively against neighbouring packs. Ranges are much larger than would be expected on the basis of their body size. Packs are confined to relatively small areas (50–200km²) when they are feeding young pups at a den, but outside the denning period they range widely. As a result, wild dogs' large home ranges translate into very low population densities (Table 6.5.2). The home ranges of neighbouring wild dog packs overlap considerably, but wild dogs can, nevertheless, be considered territorial: packs rarely enter other packs' core areas and these areas are defended aggressively as well as by scent-marking. Even wild dog packs that inhabit protected areas may travel extensively outside the reserve borders where they encounter human activity and threats such as roads, snares and livestock and game farmers likely to persecute them. Wild dogs dispersing away from their natal packs may range even more widely. Dispersing wild dogs have been tracked over hundreds of kilometres (Fuller *et al.* 1992a), a characteristic that could account for the occasional reports of single wild dogs, or single-sex groups from countries such as Uganda, Democratic Republic of Congo and Swaziland, where there have been no resident wild dog populations for several decades.

Wild dogs have a complex communication system, including a number of unique vocalisations (Robbins

Table 6.5.5. Pack compositions of wild dogs in various study sites across Africa. Data updated from Woodroffe *et al.* (1997), with unpublished data from Botswana and Kruger.

Study site		Sample (pack-years)	Adults	Yearlings	Pups
Hwange National Park, Zimbabwe	1989–1990	5	7.8	3.2	5.4
	1992–2000	13	3.9	2.0	6.7
Kruger National Park, South Africa		76	4.0	2.2	4.5
Masai Mara National Reserve, Kenya		6	4.2	4.0	8.8
Northern Botswana		75	6.6	4.4	9.9
Selous Game Reserve, Tanzania		39	8.9	4.3	7.9
Serengeti National Park, Tanzania		7	6.6	6.0	11.2

Table 6.5.6. Home ranges of wild dogs in various study sites across Africa (updated from Woodroffe *et al.* 1997).

Study site	No. packs	Home-range size in km² (range)
Aitong, near Masai Mara, Kenya	1	659
Hwange National Park, Zimbabwe	4	423 (260–633)
Kruger National Park, South Africa	20	553 (150–1,110)
Moremi Game Reserve, Botswana	9	617 (375–1,050)
Selous Game Reserve, Tanzania	11	433 (SE±66)
Serengeti National Park, Tanzania	5	1318 (620–2,460)

2000), as well as olfactory communication both within and between packs (van Heerden 1981; M. Parker unpubl.).

Reproduction and denning behaviour

A pack consists of any group of wild dogs with a potentially reproductive pair. In a pack larger than two adults, the reproductive pair consists of the dominant male and the dominant female (Frame *et al.* 1979; Malcolm and Marten 1982). In most wild dog packs, the dominant female is the mother of all the pups, although two or even three females may breed on some occasions. Similarly, the dominant male fathers most (but not necessarily all) of the pups (Girman *et al.* 1997). Dominant males are usually no more assiduous in caring for pups than are other males in the pack (Malcolm and Marten 1982). In fact, all pack members are involved in caring for the pups. Such additional care is vital if pups are to survive; because very small packs (<4 members) rarely manage to raise any pups (J.W. McNutt unpubl.). Cooperative care may even extend to caring for adopted pups (McNutt 1996b).

Births are seasonal, and gestation lasts 71–73 days (J.W. McNutt unpubl.). Wild dogs have very large litters for their body size, averaging 10–11 and occasionally as many as 21 (Fuller *et al.* 1992b). Pup sex ratios are male-biased in some populations (Fuller *et al.* 1992b; J.W. McNutt unpubl.). The pups, each weighing approximately 300–350g, are born in an underground den which they use for the first three months of life. Such dens are often those of aardvark (*Orycteropus afer*), sometimes modified by warthog or spotted hyaenas. The mother is confined to the den during early lactation, and is reliant on other pack members to provision her during this time. Wild dogs feed the mother and pups (from four weeks of age) by regurgitating solid pieces of meat. Some pack members also "baby-sit" the pups and chase predators off while the remainder of the pack is away hunting. Pups are generally fully weaned by eight weeks but continue to use a den for refuge until 12–16 weeks of age. Wild dogs reach sexual maturity in their second year of life, but social suppression of reproduction in subordinates of both sexes means that few animals breed at this age (Creel *et al.* 1997). Few animals breed at any age due to reproductive suppression. However, it is common for two-year old females and less frequent for two-year old males to reproduce.

Competition

Competition with larger predators has a major impact on wild dogs' behaviour and population biology (Creel and Creel 1996; Mills and Gorman 1997). Lions, in particular, are a major cause of natural mortality (Table 6.5.7, 6.5.8), and wild dogs tend to move away if they detect the presence of lions (Creel and Creel 1996). Spotted hyaenas also occasionally kill dogs of all ages (J.W. McNutt pers. obs.). They also steal kills from wild dogs, particularly in open areas where such kills are easily located (Fanshawe and FitzGibbon 1993). While the loss of kills to hyaenas is much less common in more closed bush, wild dogs' high metabolic rate means that prey loss to competitors has the potential to seriously impact their energy balance (Gorman *et al.* 1998). Leopards (*Panthera pardus*) have also been recorded to kill pups (M.G.L. Mills unpubl.).

Competition with larger carnivores might help to explain wild dogs' wide-ranging behaviour. While larger predators tend to occur at higher densities where prey are more abundant, wild dogs (like cheetahs, *Acinonyx jubatus*) tend to avoid these areas. Because they range in areas of comparatively low prey densities requiring greater travel times during hunting, they are effectively forced to occupy larger home ranges. This wide-ranging behaviour, coupled perhaps with their preference for areas of reduced predator density, explains why wild dogs inhabiting isolated reserves are so exposed to human activity on and around reserve borders.

Mortality and pathogens

Wild dogs experience high mortality in comparison with other large carnivore species. Annual adult mortality varies between populations, with averages ranging from 20–57% (summarised in Creel and Creel 2002). Similarly, pup mortality during the first year of life is relatively high, and averages around 50% in most populations. There is some evidence to suggest that pup survival is higher in large packs where there are more helpers to assist with their care.

Natural sources of mortality The principal cause of natural mortality is predation by lions (Tables 6.5.7, 6.5.8), although hyaenas, crocodiles and leopards also kill wild dogs in some areas.

Persecution While pups die almost exclusively from "natural" causes (Table 6.5.8), more than half of the mortality recorded among adults is caused directly by human activity, even in some of the largest and best-protected areas (Table 6.5.7). Wild dogs using protected areas often range outside the borders and into areas used by people. Here they encounter high-speed vehicles, guns, snares and poisons, as well as domestic dogs, which represent reservoirs of potentially lethal diseases.

Hunting and trapping for fur There is no known trade in the fur of wild dogs and virtually no commercial hunting or trapping. Quotas for commercial hunting have been issued in the past in Cameroon, but the full quota has not been taken (Breuer 2003).

Road kills Road kills are an important cause of mortality for both adults and pups (Tables 6.5.7, 6.5.8), partly because wild dogs use roads to travel and may also rest on them.

Table 6.5.7. Causes of adult mortality in free-ranging populations of African wild dogs. Figures show the percentages of deaths attributed to each cause. Numbers in brackets give the total number of known deaths recorded in that study site. Updated from Woodroffe *et al.* (1997), using unpublished data provided by G. Rasmussen, S. Creel and K. McCreery and R. Robbins.

	Kruger NP, South Africa	Northern Botswana	South-western Zimbabwe	Selous GR, Tanzania	Zambia	Total
Natural causes						
Predators						
Lions	26% (19)	47% (15)	4% (85)	20% (10)	0% (36)	**10% (165)**
Spotted hyaenas	0% (19)	7% (15)	2% (85)	0% (10)	0% (36)	**2% (165)**
Unknown/others	11% (19)	7% (15)	1% (85)	0% (10)	3% (36)	**3% (165)**
Other wild dogs	16% (19)	0% (15)	0% (85)	40% (10)	0% (36)	**4% (165)**
Disease	0% (19)	0% (15)	0% (85)	0% (10)	22% (36)	**5% (165)**
Accident	0% (19)	33% (15)	2% (85)	0% (10)	0% (36)	**4% (165)**
Subtotal natural	**53% (19)**	**94% (15)**	**12% (116)**	**60% (10)**	**25% (36)**	**27% (196)**
Human causes						
Road kill	5% (19)	0% (15)	19% (116)	0% (10)	22% (36)	**16% (196)**
Snared	21% (19)	0% (15)	42% (116)	40% (10)	6% (36)	**30% (196)**
Shot	21% (19)	0% (15)	27% (116)	0% (10)	14% (36)	**20% (196)**
Poisoned	0% (19)	0% (15)	0% (116)	0% (10)	33% (36)	**6% (196)**
Unknown	0% (19)	7% (15)	0% (116)	0% (10)	0% (36)	**0.5% (196)**
Subtotal human	**47% (19)**	**7% (15)**	**88% (116)**	**40% (10)**	**75% (36)**	**73% (196)**

Table 6.5.8. Causes of pup mortality in free-ranging populations of African wild dogs. Figures show the percentages of deaths attributed to each cause. Numbers in brackets give the total number of known deaths recorded in that study site. Updated from Woodroffe *et al.* (1997), with unpublished data from S. Creel and G. Rasmussen.

	Kruger NP, South Africa	Selous GR, Tanzania	South-western Zimbabwe	Total
Natural causes				
Predators				
Lions	37% (38)	6% (36)	14% (22)	**20% (96)**
Spotted hyaenas	0% (38)	6% (36)	18% (22)	**6% (96)**
Monitor lizard	0% (38)	6%(36)	0% (22)	**2% (96)**
Other wild dogs	50% (38)	77% (36)	5% (22)	**50% (96)**
Disease	8% (38)	6% (36)	0%(22)	**5% (96)**
Subtotal natural	**95% (38)**	**100% (36)**	**37% (22)**	**83% (96)**
Human causes				
Road kill	0% (38)	0% (36)	27% (22)	**6% (96)**
Snared	5% (38)	0% 36)	9% (22)	**3% (96)**
Shot	0% (38)	0% (36)	27% (22)	**6% (96)**
Unknown	0% (38)	0% (36)	0% (22)	**0% (96)**
Subtotal human	**5% (38)**	**0% (36)**	**63% (22)**	**16% (96)**

Pathogens and parasites The impact of disease is almost certainly under-estimated in Tables 6.5.6 and 6.5.7 (disease outbreaks tend to be episodic, while these data come from stable populations unaffected by epizootics at the time of study), and is likely to be particularly severe in small populations. Rabies is known to have contributed to the extinction of the wild dog population in the Serengeti ecosystem on the Kenya-Tanzania border in 1990 to 1991, and is suspected to have caused the deaths of several packs in northern Botswana in 1995 and 1996. Canine distemper has also caused at least one whole-pack death in Botswana, although the impact of distemper appears smaller than that of rabies, with several populations showing evidence of non-fatal exposure. An unidentified *Toxoplasma* sp. was implicated in the deaths of 23 out of 24 pups from two litters at a den in the Kruger National Park (M.G.L. Mills pers. obs).

Longevity: In Hwange National Park, Zimbabwe, a male dog lived up to 11 years (G. Rasmussen pers. comm.). In Kruger National Park and northern Botswana, no wild dog has survived more than 10 years, and most dogs studied in Selous Game Reserve, Tanzania, lived six years or less (Creel and Creel 2002).

Historical perspective

Wild dogs play only a small role in traditional cultures, in comparison with other predators such as lions and hyaenas. They are valued in some areas as their kills are a source of meat; various body parts may also be considered to have medicinal and magical powers. In colonial times, wild dogs were almost universally reviled, with a reputation as ugly, cruel and bloodthirsty killers. Game managers' attitudes to them are exemplified by Bere's (1955) observation that they "*...hunt in packs, killing wantonly far more than they need for food, and by methods of the utmost cruelty... When the Uganda national parks were established it was considered necessary, as it had often been elsewhere, to shoot wild dogs in order to give the antelope opportunity to develop their optimum numbers...*". Such persecution in the name of "game" management and conservation continued as national parks' policy in some areas well into the 1970s, and unofficially this attitude still persists in a few areas.

Conservation status

Threats As described above, the principal threats to wild dogs are conflict with human activities and infectious disease. Both of these are mediated by habitat fragmentation, which increases contact between wild dogs, people and domestic dogs. The important role played by human-induced mortality has two long-term implications. First, it makes it likely that, outside protected areas, wild dogs may well be unable to co-exist with the increasing human population unless better protection and local education programmes are implemented. This will be a serious problem for wild dog populations outside protected areas. Second, wild dog ranging behaviour leads to a very substantial "edge effect", even in large reserves. Simple geometry dictates that a reserve of 5,000km² contains no point more than 40km from its borders – a distance well within the range of distances travelled by a pack of wild dogs in their usual ranging behaviour. Thus, from a wild dog's perspective, a reserve of this size (fairly large by most standards) would be all edge. As human populations rise around reserve borders, the risks to wild dogs venturing outside are also likely to increase. Under these conditions, only the very largest unfenced reserves will be able to provide any level of protection for wild dogs. In South Africa, proper fencing around quite small reserves has proved effective in keeping dogs confined to the reserve (although fencing has costs, as well as benefits, in conservation terms).

Even in large, well-protected reserves, or in stable populations remaining largely independent of protected areas (as in northern Botswana), wild dogs live at low population densities. Predation by lions, and perhaps competition with hyaenas, contribute to keeping wild dog numbers below the level that their prey base could support. Such low population density brings its own problems. The largest areas contain only relatively small wild dog populations; for example, the Selous Game Reserve, with an area of 43,000km² (about the size of Switzerland), contains about 800 wild dogs. Most reserves, and probably most wild dog populations, are smaller. For example, the wild dog population in Niokolo-Koba National Park and buffer zones (about 25,000km², larger than the state of Israel) is likely to be not more than 50–100 dogs. Such small populations are vulnerable to extinction. "Catastrophic" events such as outbreaks of epidemic disease may drive them to extinction when larger populations have a greater probability of recovery – such an event seems to have led to the extinction of the small wild dog population in the Serengeti ecosystem on the Kenya-Tanzania border. Problems of small population size will be exacerbated if, as seems likely, small populations occur in small reserves or habitat patches. As discussed above, animals inhabiting such areas suffer a strong "edge effect". Thus, small populations might be expected to suffer disproportionately high mortality as a result of their contact with humans and human activity.

Commercial use There are no commercial uses for wild dogs, other than non-consumptive ecotourism.

Occurrence in protected areas The occurrence of wild dogs in protected areas is described in detail in Fanshawe *et al.* (1997). The largest populations inside protected areas occur in:

- *Tanzania*: Selous Game Reserve and Ruaha National Park;
- *South Africa*: Kruger National Park;
- *Botswana*: Chobe National Park and Moremi Wildlife Reserve;
- *Zimbabwe*: Hwange National Park.

Protection status CITES – not listed.

Current legal protection Wild dogs are legally protected across much of their range. However, this protection is rarely enforced and wild dogs are extinct in several countries despite stringent legal protection (Table 6.5.9). Outside reserves, legal protection may have questionable value when it concerns a species that comes into conflict with people, often in remote areas with poor infrastructure. Under such circumstances, legal protection may serve only to alienate people from conservation activities.

Conservation measures taken The establishment of very large protected areas (e.g., Selous Game Reserve, Kruger National Park), as well as conservancies on private and communal land, has ensured wild dogs' persistence in parts of eastern and southern Africa, and maintenance of such areas remains the highest priority for wild dog conservation. Attempts are underway to re-establish wild

Table 6.5.9. The status of wild dog populations and their degree of protection across range states. The columns marked "Date" give, respectively, the date of the most recent information on which the population estimate is based, and the date of the protective legislation. Most of the information about the protected status of wild dogs was provided by the Environmental Law Centre, Bonn, Germany.

Country	Status of wild dogs	Date	Degree of protection	Date
Algeria	rare?	1989	?	–
Angola	rare?	1987	total?	1957
Benin	extinct?	1987	?	–
Botswana	present	1996	partial	1979
Burkina Faso	extinct?	1987	partial	1989
Cameroon	present	1992	partial?	?
Central African Republic	present	1987	total	1984
Chad	rare	1987	?	–
Congo	extinct	1992	total	1984
Côte d'Ivoire	rare?	1987	noxious	1965
Dem. Rep. Congo	extinct?	1987	partial	1982
Eritrea	extinct?	1992	?	–
Ethiopia	present	1995	total	1972
Gabon	extinct	1987	?	–
Ghana	extinct?	1987	partial	1971
Guinea	rare	1996	total	1990
Kenya	present	1996	partial	1976
Malawi	rare	1991	partial	?
Mali	extinct?	1989	?	–
Mozambique	rare	1996	total	1978
Namibia	present	1996	total	?
Niger	extinct?	1987	total?	?
Nigeria	extinct?	1991	total	1985
Rwanda	extinct	1987	total	1974
Senegal	present	1996	partial	1986
Sierra Leone	rare?	1996	?	–
Somalia	rare?	1994	total	1969
South Africa	present	1996	specially protected	?
Sudan	rare	1995	total?	?
Swaziland	extinct?	1992	?	–
Tanzania	present	1996	total	1974
Togo	rare?	1987	partial	1968
Uganda	rare?	1996	?	–
Zambia	present	1994	total	1970
Zimbabwe	present	1992	partial	1990

dogs in a network of very small reserves in South Africa, but this approach will demand intensive management in perpetuity and need not, at present, be used as a model for wild dog conservation elsewhere.

Conservation priorities include: (i) to maintain and expand connectivity of habitat available to wild dogs, particularly in northern Botswana/eastern Namibia/ western Zimbabwe, South Africa/western Mozambique/ south-east Zimbabwe, northern South Africa/south-east Botswana/south-west Zimbabwe and southern Tanzania/ northern Mozambique; (ii) to work with local people to reduce deliberate killing of wild dogs in and around these areas, and also in smaller populations in Senegal, Cameroon and Kenya; (iii) to establish effective techniques for protecting small wild dog populations from serious infections such as rabies and distemper; (iv) to carry out surveys to establish the status of other potentially important populations, particularly in Algeria, Angola, Central African Republic, Ethiopia, Mozambique and Sudan, and (v) to continue long-term monitoring of 'sentinel' populations to identify emerging threats. Re-establishment of extinct populations through reintroduction currently has a low priority in most areas, although natural recolonisations should be encouraged.

Occurrence in captivity

There are more than 300 wild dogs in captivity in 55 zoos as listed on ISIS and as many as 200 additional animals occur in zoos and private collections, particularly in South Africa. With the exception of a small number of animals held in the Mkomazi Game Reserve, Tanzania, all of the dogs held in captivity are of southern African origin. Successful breeding is patchy; some institutions have been extremely successful at breeding wild dogs in captivity, while others have failed. Juvenile mortality is high in most collections.

Early attempts to reintroduce captive-bred animals to the wild were hampered by the dogs' poor hunting skills and naive attitudes to larger predators. However, recent reintroductions have overcome this problem by mixing captive-bred dogs with wild-caught animals and releasing them together. This approach has been very valuable in re-establishing packs in several fenced reserves in South Africa, but is not considered a priority in other parts of Africa at present. Nevertheless, captive populations have important roles to play in developing conservation strategies for wild populations, through research (e.g., testing of vaccination protocols), outreach and education.

Current or planned research projects

J.W. McNutt (University of Montana, USA) runs the Botswana Wild Dog Research Project, a long-term monitoring study of wild dog ecology and behaviour in the Okavango Delta.

R. Woodroffe (University of California, Davis, USA), principal investigator of the Samburu-Laikipia Wild Dog Project, is studying the conflicts between people and wild dogs outside protected areas in northern Kenya.

M. Rainey (African Wildlife Foundation, Nairobi, Kenya) is currently monitoring wild dogs in the Kajiado District, Kenya.

M.G.L. Mills (South Africa National Parks and Endangered Wildlife Trust, South Africa) is continuing with long-term ecological monitoring of wild dogs in the Kruger National Park.

P. Lindsey (Mammal Research Institute, University of Pretoria, South Africa) has recently concluded a bio-economic analysis of wild dog conservation in South Africa.

D. Knobel (Mammal Research Institute, University of Pretoria, South Africa and Centre for Tropical Veterinary Medicine, University of Edinburgh, UK) is investigating the development of a bait and baiting system for the delivery of oral rabies vaccine to free-ranging wild dogs.

H. Davies (Wildlife Conservation Research Unit, University of Oxford, UK and Endangered Wildlife Trust, South Africa) is the principal investigator of the De Beers Venetia Reserve Wild Dog Project, which involves the study of the biology of a reintroduced wild dog pack and the value of the species to ecotourism in a small reserve.

A. Visee (George Adamson Wildlife Preservation Trust, Tanzania) is studying infectious disease and safety/effectiveness of vaccination, as well as husbandry, of captive wild dogs in Mkomazi, Tanzania.

K. Leigh (University of Sydney, Australia) is the principal investigator of the Lower Zambezi African Wild Dog Conservation Project, a study of the threats to wild dogs in Lower Zambezi National Park aimed at generating conservation recommendations for the Zambia Wildlife Authority.

G. Rasmussen (Wildlife Conservation Research Unit, University of Oxford, UK) runs Painted Dog Conservation, a long-running project aimed at monitoring and protecting wild dogs outside protected areas in Hwange and elsewhere in Zimbabwe.

J. Chambers (Lowveld Wild Dog Project, Save Valley, Zimbabwe) is involved in the ecological monitoring of wild dogs in south-eastern Zimbabwe.

K. McCreery and R. Robbins (African Wild Dog Conservancy, Olympia, Washington, USA) have recently surveyed wild dog populations in East Kenya.

R. Lines (Namibia Nature Foundation, Windhoek, Namibia) is studying wild dog livestock conflict in Namibia.

C. Sillero-Zubiri and J.-M. Andre (Wildlife Conservation Research Unit, University of Oxford, UK) are surveying wild dogs in and around protected areas of central and northern Mozambique.

The Wild Dog Advisory Group of South Africa is overseeing the strategic reintroduction of wild dogs in a network of fenced reserves across South Africa and conducting detailed monitoring of dogs in Hluhluwe-Umfolozi Park, Pilansberg National Park, Marekele National Park and Madikwe Game Reserve.

Other long- and short-term projects have been carried out in Tanzania (Selous Game Reserve, S. and N. Creel; Serengeti National Park, L. and H. Frame, J. Malcolm, H. van Lawick, J. Fanshawe, R. Burrows), Kenya (P. Kat, T. Fuller), Zimbabwe (Hwange National Park, J. Ginsberg) and Senegal (Niokola-Koba National Park, C. Sillero-Zubiri). Restricted surveys have recently been carried out in Cameroon (T. Breuer), Mozambique (C. Sillero-Zubiri), Tanzania (Ruaha Game Reserve, Mikumi National Park, S. and N. Creel) and Nigeria (S. Baggett).

Gaps in knowledge

Several pieces of information are needed to enable more effective conservation of African wild dogs. These include: (1) establishing which techniques will be most effective and sustainable for protecting wild dogs from disease, including whether vaccinating wild dogs against rabies and distemper can ever be safe and effective, and whether other methods (including control or vaccination of domestic dogs) can reduce the risks to wild dogs; (2) determining the true impact of wild dogs on livestock under different conditions of husbandry, and the effectiveness of techniques to reduce this; (3) establishing the true impact of wild dogs on managed wild game and the effectiveness of techniques to resolve conflicts with game ranchers; (4) surveys of wild dog distribution and status are also required, particularly in Algeria, Angola, Cameroon, Central African Republic, Ethiopia, Mozambique and Sudan; (5) genetic research would be valuable to establish the distinctiveness of wild dog populations remaining in west, central and north-east Africa; and (6) the reasons for and degree of fluctuation in packs and populations need to be better understood. In addition, several aspects of wild dogs' basic biology require further study, particularly: (1) mechanisms of ranging and dispersal; (2) causes of increased mortality among dispersers; (3) reasons for large home range; (4) mechanisms of sex-ratio biasing; (5) paternity; and (6) communication.

Core literature

Creel and Creel 1995, 1996, 2002; Frame *et al.* 1979; Fuller and Kat 1990; Fuller *et al.* 1992a,b; Girman *et al.* 1997, 2001; Malcolm and Marten 1982; McNutt 1996a,b; Mills and Gorman 1997; Woodroffe and Ginsberg 1999a; Woodroffe *et al.* 1997.

Reviewers: Scott Creel, Joshua Ginsberg, Kim McCreery, Gregory Rasmussen, Robert Robbins. **Editors:** Claudio Sillero-Zubiri, Michael Hoffmann.

6.6 Bat-eared fox
Otocyon megalotis (Desmarest, 1822)
Least Concern (2004)

J.A.J. Nel and B. Maas

Other names

Afrikaans: bakoorvos, bakoorjakkals, draaijakkals; **French:** l'otocyon; **German:** löffelhund; **Indigenous names:** ||K'au||en and !Kung San (Bushmen): !u (Botswana and Namibia); Amharic: joro-kib kebero (Ethiopia); Swahili: bwega masigio; Karamojong: ameguru; Kichagga: kipara; Kigogo: nchenjeji; Kikomo: mchutu; Kinyaturu: bii; Kiramba: bili (Kenya, Tanzania); Herero: okata-kå-ha; Nama: bergdamara; Hei||kum San (Bushmen): ||ab;