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, letaya (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. While 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 the 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 white. 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.

Chris and Tilde Stuart

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

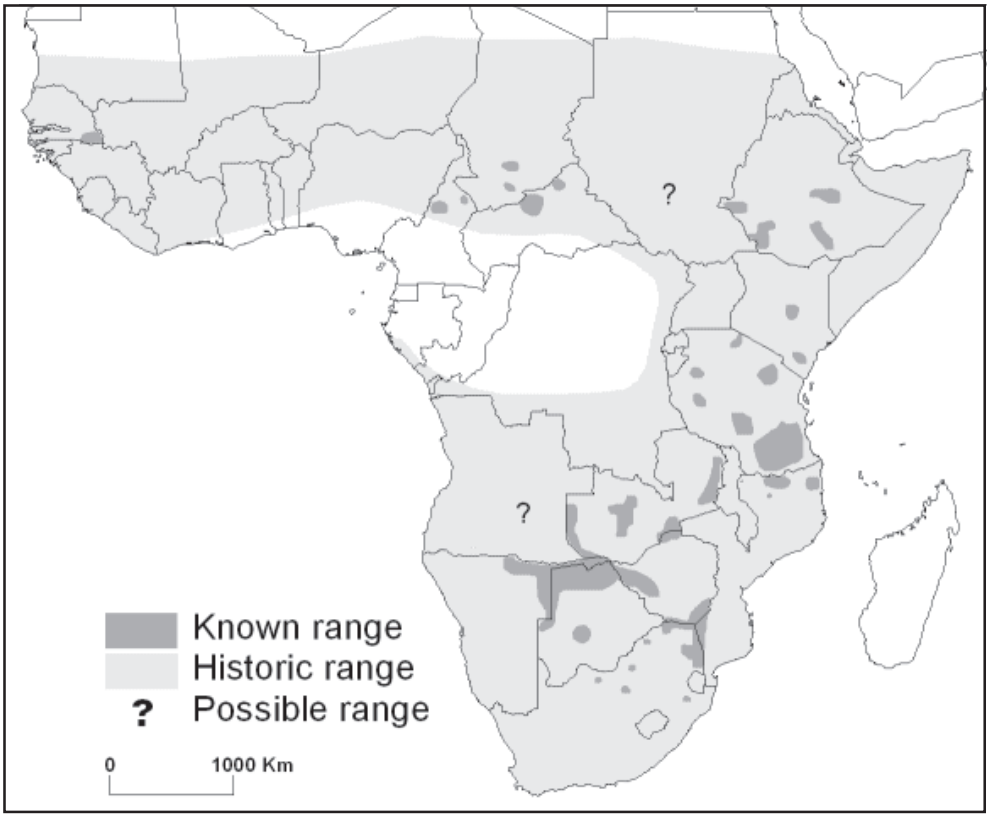

Figure 6.5.1. Current distribution of the African wild dog.

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/100km^2)
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 (50–200km^2) 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
Hwange National Park, Zimbabwe 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 km^2 (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 5,000km^2 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 43,000km^2 (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 25,000km^2, 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. Burrrows), 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-ká-ha; Nama: bergdamara; Hei||kum San (Bushmen): ||ab;