

Endangered African Wild Dogs: Ecological Disturbances, Habitat Fragmentations, and Ecosystem Collapse in Sub-Saharan Africa.

Makarius P. Itambu

Department of Archaeology and Heritage Studies, University of Dar es Salaam, Tanzania

Abstract:

*The African wild dog (*Lycaon pictus*) is among the species that have declined to the point where it is now listed as endangered by the International Union for the Conservation of Nature (IUCN, 2012). Formerly, the African wild dog population was estimated to span 39 African countries, but today, they have disappeared from much of their former habitats, now occupying just 7% of their former geographic range. They are presently found in only 14 countries primarily in the southern part of the continent, including South Africa, Tanzania, Kenya, Zimbabwe, Namibia, and Botswana. The largest populations are presently found in northern Botswana, the Selous Game Reserve in Tanzania, and in Kruger National Park in South Africa. In East Africa, the largest population is found in Tanzania and Kenya in the Serengeti-Maasai-Mara ecosystems and in the Selous Game Reserve. The current, global population is estimated to be between 3000-5000 which is comprised of less than 1400 mature individuals. Methodically, this study deeply underscored these data from critical library research i.e., archival sources, books and articles, and other published literatures across the globe which are pertinent to this research topic.*

Key words: Wild dogs, Ecology, Habitat loss, Endangered Species, Sub-Saharan Africa.

1. Introduction

Africa is home to a large variety of animal species that are of concern from the perspective of global conservation and management, including African wild dogs/ painted dogs, rhinos, elephants, chimpanzees, gorillas, lions, and a variety of endemic sub-Saharan African plants. Unfortunately, these large numbers of wildlife species are currently in decline, primarily as a result of conflicts with human encroachment, which is contributing to the destruction and degradation of the natural ecosystems and thus threatening the rich biodiversity of sub-Saharan Africa.¹

The endangered status of wild dogs is paradoxical, because they possess several life-history characteristics expected to promote population resiliency. They are highly fecund² very adaptable to various types of ecological ecotones, weather, seasons, topography, and climates, and able to disperse long

¹ R. Woodroffe, et. al. "Livestock Predation by Endangered African Wild Dogs (*Lycaon pictus*) in northern Kenya." *Biological Conservation* 124 (2005): 225-234.

² T. K. Fuller, et.al. "Population Dynamics of African Wild Dogs." In D. R. McCullough and R.H. Barrett eds., *Wildlife 2001: Populations* (London: Elsevier Applied Science, 1992), 1125-1139.

distances to colonize new areas³. Their high reproduction rates and the adaptive behaviours that they possess make them able to live in various habitats and ecozones has not however, guaranteed their survival and multiplication in sub-Saharan Africa and their population size is continuing to decline as a result of sensitivity to ongoing habitat fragmentation, conflict with human activities, and infectious disease.⁴

Thus, this paper surveys various literature pertinent to biodiversity and ecological fragmentation in Sub-Saharan Africa and its adverse consequences to the Wild dogs' survival. This article is solely based on thorough literature reviews; thus, it will highlight, examine, and discuss in detail their unique life history, habitat physiognomy, biogeography, and how these relate to key factors that threatens the survival of African wild dogs. It will also address ecological conservation and management issues that need to be taken into consideration to rescue this species from total extinction in Sub-Saharan Africa, and in Tanzania specifically.

³ R. Woodroffe, "Ranging Behaviour of African Wild Dog Packs in a Human-Dominated Landscape." *Journal of Zoology*, 283 (2011): 88-97.

⁴ R. Woodroffe and C. Sillero-Zubiri. "Lycaon pictus: The IUCN Red List of Threatened Species", (2012) <http://www.iucnredlist.org/details/12436/0>; C. Gortazar et.al., "Diseases shared between wildlife and livestock: a European perspective." *European Journal of Wildlife, Res* 53 (2007): 241-256.

2. Background Information

This section tries to underscore key issues pertinent to African wild dog's life history, general behavioural and physical characteristics which are quintessential to them. The African wild dogs are a member of the Canidae (dog) family, and the only representative of its genus.⁵ They are a medium-sized species with large ears and a characteristic brightly coloured mottled fur pattern. They can be distinguished from other dogs because they have fewer toes and a unique dentition specialized for their carnivorous diet. The African Wild dog lives in cohesive and cooperative packs of 10-30 individuals, with a strict social hierarchy. Highly sociable, they hunt together, share food, and assist each other with raising offspring and other activities. African Wild dogs are obligate cooperative breeders, so most of the pups are offspring of the alpha male and female. Females begin breeding at approximately 3 years of age, with an average female breeding age of approximately 5.5 years⁶. Litters of 2-20 pups are born after a gestation period of 70 days. After birth the mother stays with the pups for a few weeks and the rest of the pack care for them. In these cohesive and cooperative packs, the young are cared for by both male and female adults. Upon reaching maturity, it is the females that

⁵ K. A. Leigh, et. al., "Loss of Genetic Diversity in an Outbreeding Species: Small Population Effects." *The African Wild dog (Lycaon pictus) Conservation Genetics* 13 (2012), 767.

⁶ Woodroffe and Sillero-Zubiri, "Red List of Threatened Species".

migrate to join new packs⁷. African wild dogs are scavengers and opportunistic predators that hunt small to medium-sized ruminants, such as impalas, kudus, wildebeest, Thomson's gazelles and other various species of antelopes. Before the hunt, they will circulate among other pack members, vocalizing, sniffing and touching each other. They are cooperative and effective hunters that chiefly predate on medium-sized antelope species.⁸ While the dogs weigh 20-30 kg, they typically hunt prey weighing approximately 50 kg, and in large groups they can kill animals as large as 200 kg.⁹

3. The African Wild Dogs Population Decline: A Critical Review and Discussion

Historical data indicate that wild dogs were formerly distributed throughout sub-Saharan Africa, from desert to mountain summits of North and West Africa, and probably were absent only from lowland rain forest and the driest desert. However, over the last five decades, the African wild dog population has declined dramatically. The wild dogs have disappeared from 25 of the 39 countries in which they were previously found, and only 6 populations are believed

⁷ G. S. A Rasmussen. "Livestock Predation by the Painted Hunting Dog (*Lycan pictus*) in a Cattle Ranching Region of Zimbabwe: A Case Study." *Biological Conservation* 88 (1999): 133-139.

⁸ R. Woodroffe, et. al. "African wild dogs (*Lycan pictus*) can subsist on small prey: implications for conservation." *Journal of Mammals* 88 (2007): 181-193.

⁹ C. Carbone, et. al. "Feeding Success of African wild dogs (*Lycan pictus*) in the Serengeti: The Effects of Group Size and Kleptoparasitism." *Journal of Zoology* 266, No. 2 (2005), 153.

to number more than 100 animals. Presently, it is believed that between 3,000 and 5,500 dogs remain in 600-1,000 packs only and most of these are to be found in eastern and southern Africa¹⁰. The African wild dogs have become one of the most critically endangered species in Africa. Once nearly 500,000 wild dogs roamed Africa between 1950-1960s, this period was a high time in the history of wild dogs rise in population until its decline in the early 1990s. From 1990-2000s, it is when they virtually declined in some parts, mostly in sub-Saharan Africa and now there is only an estimated 3,000 to 5,000¹¹, and then re-appearances in the 2005 while greatly reduced in numbers due a few reasons such as the encroachment on farmer and rancher lands, as well as habitat fragmentation. Also, the drastic reduction in the wild dog population has been attributed to several factors, among them, human population growth and farming activities, deterioration of their habitat and contact with domestic dogs and the diseases they carry, change in reproduction behaviours, and with genetic variation and a new strand of canine distemper which threatens the species with further decline.

¹⁰ J. R. Malcolm and C. Sillero-Zubiri. "Recent records of African wild dogs (*Lycaon pictus*) from Ethiopia." *Canid News* 4, No. 2 (2001).

¹¹ *Ibid.*

In the 1960s, research on African wild dogs in the Serengeti ecosystem documented more than 100 individuals, declining rapidly to 40 individuals by the end of the 1970s¹². By 1985, only three packs were regularly seen in the area: the Salei pack, which would regularly range from central to southeastern plains; the Ndoha pack found in the western Serengeti; and the mountain pack, reaching to the most eastern Serengeti plains nearby Maasai Mara National Park on the Kenyan boarder.¹³ By 1991, the wild dogs in Serengeti National Park were almost wiped out and have not been seen since. It is believed that this extinction was due to an outbreak of viral diseases including rabies and canine distemper virus that were induced by stress caused by intervention, particularly the practices of vaccination, immobilisation, and wild dog collaring¹⁴. In early 1993, some single sex groups of African wild dogs were spotted in the wider ecosystem around the park, and then from 2000 onwards, repeated complaints from Maasai and Sonjo livestock pastoralists about flocks being attacked and depredated by the wild dogs were reported to the Ngorongoro district authorities. The establishment of

¹² Carbone, "Feeding Success of African wild dogs"; Woodroffe, et al., "Livestock predation by endangered African wild dogs"; P. B. Stearns & S. C. Stearns eds., *Watching from the Edge of Extinction* (New Haven & London: Yale University Press, 1999).

¹³ Carbone, "Feeding Success of African wild dogs"; Stearns and Stearns, *Watching from the Edge*.

¹⁴ Stearns and Stearns, *Watching from the Edge*; S. C. Gascoyne, et. al. "Rabies in African wild dogs (*Lycaon pictus*) in the Serengeti region, Tanzania." *Journal of Wildlife, Dis.* 29 (1993): 396-402.

Serengeti wild dog restoration and monitoring project with the aims of increasing their numbers and re-establishing a healthy wild dog population in the Serengeti ecosystem. This paper explores some of the reasons behind the decline in number and even disappearance of these creatures in many parts of Western Arica region, Southern and Eastern Africa and thus provides several proposed solutions to stem this. Mitigation measures are ranging from habitat management and conservation to restoration programs so as to rescue these animals from total disappearance on earth's surface.

3.1 Western Africa

In west and central Africa, Croes et al. reported that the current status of the African wild dog in West African region is largely unknown¹⁵. The vast areas of unspoiled Sudano-Guinean savannah and Guinea-Congolese forest that stretch from western northern Cameroon to central Africa hosts very few of these endangered species. Similar to other sub-Saharan countries, the wild dogs in sub-Saharan region are facing numerous threats, mainly caused by human encroachment and a lack of enforcement of laws and regulations in hunting concessions¹⁶. The Sudano-Guinean savanna and woodlands is a degrading natural habitat; a

¹⁵ B. Croes. *Distribution update Status of the African wild dog in the Bénoué Complex* (North Cameroon: IUCN/SSC Canid Specialist Group, 2012).

¹⁶ *Ibid.*

fragmented ecosystem because of anthropogenic induced factors that threaten wildlife populations. As a result, there has been a tremendous decrease in the number of wild dogs in all over sub-Saharan current ecosystems such as the case of Zambezi woodlands of the southern part of Africa.

The West African wild dog survives mainly in Senegal and potentially very few species in the western complex forests in Benin, Burkina Faso, Niger, and Cameroon. The principal threats to West African wild dogs include habitat fragmentation, conflict with human activities, road kills, and infectious disease¹⁷. The West African wild dog is a subspecies of the African wild dog native to West Africa, which is limited to these regions only. It is classified as Critically Endangered by IUCN, as it was estimated that 70 adult individuals are left in the wild. Wild dogs have disappeared from much of their former range; less than 6% of the species' historical range is still known to support resident populations. Most of the wild dogs have been virtually eradicated from West Africa, and greatly reduced in central and northeastern Africa¹⁸. As noted in the beginning, the largest populations remain in southern Africa (especially northern Botswana, western Zimbabwe, eastern Namibia, and South Africa), Kenya and Tanzania in eastern Africa as well.

¹⁷ Croes, *Distribution Update Status of the African Wild Dog*.

¹⁸ *Ibid*.

3.2 Southern Africa

Although African wild dogs were once distributed through much of sub-Saharan Africa, they are now absent from most of their range and are classified as endangered by the IUCN. The main reasons for their demise are widespread destruction of habitat, loss of prey, and direct persecution through hunting, snaring and poisoning. Botswana is one of the last wild dog strongholds, with 700-800 individuals living in northern Botswana. In contrast, wild dogs are seen only infrequently in the south-eastern part of the country, largely because of conflict with livestock farmers¹⁹. In this southern part of the continent, South Africa is one of only seven countries with a viable population of African wild dogs (*Lycaon pictus*). As per the national population in 2017, there was 372 adults and yearlings and comprised three subpopulations in Kruger National Park, an intensively managed metapopulation established through reintroductions into isolated, fenced reserves, and a free-roaming population that occurs naturally outside protected areas. The Kruger supports a substantial population which has declined over time²⁰ while the metapopulation is the only subpopulation that has increased significantly over time (both in population size and number of packs), likely due to intensive conservation efforts and the reintroduction of wild

¹⁹ Woodroffe and Sillero-Zubiri, "Red List of Threatened Species".

²⁰ *Ibid.*

dogs into 15 additional reserves since 1998²¹. The free-roaming subpopulation has remained small but stable, even though the number of packs has declined due to anthropogenic threats. The overall national population has remained stable even though the number of packs has increased. Kruger has consistently supported the highest proportion of the national population over the last two decades. Nevertheless, the contribution of the metapopulation has increased significantly over time. Despite the differences in survey effort among the three subpopulations, South Africa has a small population approximately 500 wild dogs but stable population of them, with the metapopulation contribution becoming increasingly important²². The circumstances in the country necessitate, and demonstrate the benefit of, intensive, adaptive management for the national population of wild dogs²³.

South Africa has a stable wild dog population that is evident by the national population growth rate on zero, because in this country the wild dog population is relatively well protected than any other countries in sub-Saharan Africa, and collectively can be considered a stronghold for wild dogs

²¹ S. Nicholson, et. al. "A 20-Year Review of the Status and Distribution of African Wild Dogs (*Lycaon pictus*)." *South Africa African Journal of Wildlife Research* 50, No. 1 (2020), 8.

²² Woodroffe and Sillero-Zubiri, "Red List of Threatened Species".

²³ Woodroffe and Sillero-Zubiri, "Red List of Threatened Species"; see also Nicholson et. al., "A 20-Year Review of the Status and Distribution of African Wild Dogs".

in Africa. Comparing this estimate to the other large, protected and documented populations in Africa, northern Botswana also has a stable population (0% annual growth) and Selous in Tanzania has a growing population (3.8% growth)²⁴. Examples from other non-protected populations in Africa, however, show dramatic and widespread declines in their populations²⁵. This information highlights that the relatively small but stable population in South Africa is vitally important in maintaining a viable and genetically diverse population in Africa. However, as the growth rate is on zero, any shifts in reproduction and survival within each subpopulation could drive the national population towards more systematic decline in the near future.

In Zimbabwe, Hwange National Park is also home to one of the most elusive predators on the continent, the endangered African wild dogs; and approximately 160 wild dogs live in Hwange and its environments. As more people settle around Hwange, the African wild dog population faces increasing pressure in the form of habitat fragmentation and human-wildlife conflict. The most pressing threat to the wild dogs' survival, however, is poaching²⁶, because the poachers endanger Hwange wild dogs' survival as it has recently

²⁴ S. Creel and N. Creel. *The African Wild Dog: Behavior, Ecology, and Conservation* (Princeton: Princeton University Press, 2002).

²⁵ Woodroffe and Sillero-Zubiri, "Red List of Threatened Species".

²⁶ *Ibid.*

evinced. With limited employment opportunities and sporadic rainfall that negatively impacts farming yields, bush meat hunting has gained popularity over the past several years to make a living²⁷. Poachers in Zimbabwe like any other parts of sub-Saharan Africa commonly use wire snares, which kill large animals indiscriminately, and the wild dogs are particularly vulnerable to injury or death by snares because they cover a lot of ground while hunting²⁸. The wild dogs travel more than 12 miles per day on average in searching for foods, something that make them fell to snares, poachers sometimes poison water sources with cyanide, although poachers normally targeting elephants for their ivory, but it kills a variety of other species in the process²⁹. Stemming the tide of poaching within Hwange National Park has proven challenging for the resource-strapped Zimbabwe Parks and Wildlife Management Authority not to mention the fact that protecting the park itself is not sufficient in the country³⁰. Wild dogs and other species frequently travel beyond the park's borders into its buffer zones, where the risk of encountering poachers and snares is much higher³¹.

Hinting at the effect of extrinsic factors such as prey availability on ranging behavior, home ranges are generally smaller where prey are relatively sedentary (e.g., Kruger

²⁷ Woodroffe and Sillero-Zubiri, "Red List of Threatened Species".

²⁸ *Ibid.*

²⁹ Fuller, et.al., "Population Dynamics of African Wild Dogs".

³⁰ *Ibid.*

³¹ Woodroffe and Sillero-Zubiri, "Red List of Threatened Species".

National Park³²), while dogs living in areas with seasonal abundances of migratory prey (e.g., the Serengeti short-grass plains in Tanzania) have the largest known home ranges. In the Okavango Delta in northern Botswana, seasonal variation in forage quality and quantity related to annual flooding strongly influences prey distributions and possibly contributes to comparatively complex patterns of resource availability for wild dogs, but such factors have not been considered in previous wild dog ranging studies³³. Intrinsic factors such as pack size³⁴ or pack composition may also influence ranging patterns, and while reproductive status may not affect ranging patterns in social groups to the extent that it does solitary animals, range contraction during denning is well documented in African wild dogs³⁵. In recent years, the wildlife conservation programs on wild dogs were introduced and the dogs were released into the Northern Tuli Game Reserve (NOTUGRE)³⁶. This reintroduction was launched in order to facilitate the establishment of a viable

³² Fuller, et.al., “Population Dynamics of African Wild Dogs”.

³³ Wilfred, “Conservation of Endangered African Wild Dogs (*Lycaon pictus*) in Western Tanzania: A Call for Research and Action.” *Huria Journal* 24 (2020).

³⁴ M G. L. Mills and M. L. Gorman. “Factors affecting the density and distribution of wild dogs in the Kruger National Park.” *Conservation Biology* 11 (1997): 1397–1406; Creel and Creel, *African Wild Dog*.

³⁵ Creel and Creel, *African Wild Dog*.

³⁶ Woodroffe and Sillero-Zubiri, “Red List of Threatened Species”; see also Nicholson et. al., “A 20-Year Review of the Status and Distribution of African Wild Dogs”.

population of wild dogs in the Limpopo Valley region of eastern Botswana³⁷. The wild dogs originate from the Marakele National Park in South Africa and were donated to NOTUGRE by South African National Parks (SANParks)³⁸.

In 2006, the governments of Botswana, South Africa and Zimbabwe signed a trilateral memorandum of understanding to establish the Limpopo-Shashe Transfrontier Conservation Area (L-STFCA). This area incorporates the Northern Tuli Game Reserve in Botswana, Tuli Circle in Zimbabwe, and Mapungubwe National Park and World Heritage Site in South Africa. In the Okavango Delta of northern Botswana, wild dogs are said to range over 3000 km² including the area beyond the core conservation area³⁹.

3.3 East Africa

African wild dogs are generalist predators, occupying a range of habitats including short-grass plains, semi-desert, bushy savannahs, and upland forests. While early studies in the Serengeti National Park, Tanzania, led to a belief that wild dogs were primarily an open plains species (Figure 1), more recent data indicate that they reach their highest densities in thicker bush and woodland (e.g., Selous Game Reserve, Tanzania; northern Botswana). Several relict populations occupy dense upland forest e.g., Haremma Forest in

³⁷ *Ibid.*

³⁸ Creel and Creel, *African Wild Dog*; Woodroffe and Sillero-Zubiri, "Red List of Threatened Species", op. cit.; Nicholson et. al., "A 20-Year Review of the Status and Distribution of African Wild Dogs".

³⁹ *Ibid.*

Ethiopia⁴⁰. Wild dogs have been recorded in desert⁴¹, although they appear unable to establish themselves in the southern Kalahari, and in montane habitats⁴², 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 type⁴³.

The increasing isolation of wild dog populations in East Africa presents a serious conservation problem, precisely because the species ranges widely and usually finds itself in a human dominated hostile environment outside protected areas⁴⁴. For instance, in Maasai Mara Kenya, a pack can cover over 650 km² outside Maasai Mara Game Reserve including the area beyond the core conservation area. While the survival and ecological requirements of wild dogs can be met in an area of about 10,000 km²,⁴⁵ human activities affect wild dogs even in larger areas. On the other hand, it has been

⁴⁰ Malcolm and Sillero-Zubiri, "Recent records of African wild dogs from Ethiopia".

⁴¹ *Ibid.*

⁴² *Ibid.*

⁴³ K. A. Alexander and M. J. G. Appel. "African Wild Dogs (*Lycaon pictus*) Endangered by a Canine Distemper Epidemic among Domestic Dogs near the Masai Mara National Reserve, Kenya." *Journal of Wildlife, Dis.* 30 (1994): 481-485.

⁴⁴ Woodroffe et. al., "Livestock Predation"; Woodroffe et. al., "Implications for Conservation"; Woodroffe, "Ranging Behaviour".

⁴⁵ R. Woodroffe and J. R. Ginsberg. "Conserving the African wild dog (*Lycaon pictus*): Diagnosing and treating causes of decline." *Oryx* 33, No. 2 (1999): 132-142.

suggested that a typical conservation area should be at least 3500 km² to ensure the survival of wild dogs⁴⁶. For example, fragmented habitat leads to isolation of subpopulations, thus intensified kleptoparasitism due to reduced source-sink dynamics in prey populations. Vegetation cover and density influence both kleptoparasitism and hunting efficiency. Dense vegetation reduces prey detectability by wild dogs. Contrariwise, open habitat intensifies competition from kleptoparasites⁴⁷; because wild dogs live at low densities and in most cases, packs can hardly defend their kills depending on the number of kleptoparasites at carcasses and their ability to locate wild dog kills⁴⁸.

In both Kenya and Tanzania (Masai Mara-Serengeti ecosystem), the prey density is a trade-off between kleptoparasitism and food intake. As prey density increases, competitor's density also increases thereby intensifying kleptoparasitism. For instance, prey densities in Selous Game Reserve are lower compared to Serengeti and Ngorongoro, but the density of wild dogs in the reserve exceeds the other protected areas.⁴⁹ Wild dogs are also present in the Ugalla ecosystem of western Tanzania whereby the Ugalla Game

⁴⁶ Woodroffe et. al., "Livestock Predation"; see also Wilfred, "Conservation of Endangered African Wild Dogs in Western Tanzania".

⁴⁷ M. L. Gorman. "High hunting costs make African wild dogs vulnerable to kleptoparasitism by hyaenas." *Nature* 391 (1998): 479-481.

⁴⁸ S. R. Creel and N. M. Creel. "Six ecological factors that may limit African wild dogs (*Lycaon pictus*)." *Animal Conservation* 1 (1998): 1-9.

⁴⁹ Creel and Creel, "Six ecological factors that may limit African wild dogs".

Reserve hosts a small, isolated, and poorly studied population of African wild dogs which are critically endangered species. Like many other parks and game reserves in East Africa, the loss of wildlife and wildlife habitats because of logging, bushmeat hunting and other unsustainable livelihood activities in the area cannot be overstated⁵⁰. Indeed, this has started signaling the uncertainty of future Ugalla wild dog survival because the habitat is so fragmented and no clear deliberate efforts to make the species decline impossible. There is a call by the ecologists and the general public for the mutual and collaborative campaigns towards the abolishment of wildlife poaching in the hunted areas, improving connectivity between hunting and non-hunting areas to provide refuge for severely exploited species and regular monitoring to assess impacts of hunting⁵¹.

Unfortunately, these are yet to be achieved in western Tanzania although they would undoubtedly ensure the availability and sustainable use of wildlife resources for both conservation purposes, research, education, and local livelihoods. Recent research, for example, indicates that most of the animals in Ugalla ecosystem apart from the wild

⁵⁰ Wilfred, "Conservation of Endangered African Wild Dogs in Western Tanzania.

⁵¹ Wilfred, "Conservation of Endangered African Wild Dogs in Western Tanzania.

dogs are removed through poaching⁵². Moreover, trends in trophy hunting and legal subsistence hunting have reached the point where individuals targeted are not old enough and hunting quotas are hardly realised⁵³, and there is no clear policy to supervise this or any other standardized mechanism and frameworks to protect the endangered organisms from disappearance due to activities of whether legal or illegal hunting in most of the protected areas across the East Africa⁵⁴.

4. Wild Dogs' Habitat Fragmentation in Sub-Saharan Africa

The habitat destruction and the degradation of natural ecosystems typically leads to fragmentation, the division of habitat into smaller and more isolated fragments (patches) separated by a matrix of human-transformed land cover. This is caused by roads in proximity to natural habitats, along with related infrastructures, and other land use activities and developmental projects near wildlife habits areas. The reduction in the amount of suitable habitat, dissection of what remains into isolated patches, creation of barriers to movement and dispersal between adjacent habitat patches, and greater exposure to human land uses along fragment edges, all initiate long-term changes to the

⁵² *Ibid.*

⁵³ *Ibid.*

⁵⁴ Alexander and Appel, "African Wild Dogs Endangered by a Canine Distemper Epidemic".

structure and function of the remaining fragments⁵⁵. These factors affect species directly, as well as their interactions with other animals in the ecosystem; all which contribute to ecological disruption of the habitat as a whole.

Habitat fragmentation can have varying physical and psychological effects depending upon the scale at which the disruption is perceived⁵⁶. A large mammalian predator, for example, may be able to travel from one forested patch to another through agricultural areas with little effect. A small mammal may not be able to make the same trip because of increased vulnerability to predators or hostile environmental conditions. In a study conducted in Banff National Park in Alberta, Canada, habitat patches between roads became unique home ranges of smaller ranging species, such as the marten, rats, and squirrels⁵⁷. Even within wildlife

⁵⁵ R. T. Forman and L. E. Alexander. "Roads and their major ecological effects." *Annual Review of Ecological Systems* 29 (1998): 207-231; S. M. Alexander and N. M. Waters. "The effects of highway transportation corridors on wildlife: a case study of Banff National Park." *Transportation Research Part C* 8 (2000): 307-320.

⁵⁶ J. A. Wiens. "Wildlife in patchy environments: metapopulations, mosaics, and management." In D. McCullough ed., *Metapopulations and Wildlife Conservation* (Cambridge: Cambridge University Press, 1996).

⁵⁷ Alexander and Waters, "Effects of Highway Transportation Corridors on Wildlife"; Forman and Alexander "Roads and their major ecological effects"; see also B. A. Wilcox and D. D. Murphy. "Conservation strategy: the effects of fragmentation on extinction." *American Naturalist* 125 (1985): 879-887.

conservation habitats meant to protect species, roads can cause fragmentation of the natural habitats resulting in very isolated smaller patches surrounded by uninhabitable or hostile human environments.⁵⁸ Fragmentation of wildlife habitats has been documented in varying habitats, resulting in disturbance in wild animals' population equilibrium by disrupting patterns of their movements and behavior that contribute to high mortality rates, injuries, declining reproduction, resource depletion, and an overall decrease in biodiversity. Research in Banff National Park in Alberta, Canada on road fragmentation showed that modern infrastructure prevents animals from crossing, and creates barriers that disrupt movement patterns both directly, by blocking access, and indirectly, as animals fear and avoid crossing, even though they could do so.⁵⁹

These results in Banff are concordant and correlative to other similar studies conducted on sub-Saharan African wildlife management in which they revealed that road construction adjacent to or intersecting protected areas has negatively impacted the demographic distribution movement pattern of wild animals, altered animal communities, reduced biological diversity, and increased the threat of extinction⁶⁰. Despite documentation of these negative outcomes in other locations, the barrier effect

⁵⁸ D. R. McCullough ed., *Metapopulations and Wildlife Conservation*. (Washington, DC: Island Press, 1996).

⁵⁹ Forman and Alexander, "Roads and their major ecological effects."

⁶⁰ *Ibid.*

remains little studied with regard to road fragmentation in sub-Saharan Africa.⁶¹

Regardless of the paucity of research on barriers, sub-Saharan African wildlife ecology is highly fragmented and characterized by several isolated patchy islands of biodiversity that serves as a “refugia” for the very few remaining endangered animal species. For example, forest, landscape, and road fragmentation near wildlife reserves that preserve rare and endangered species becomes increasingly evident nearer wildlife’s habitats. Development projects, agricultural activities and human population growth continues at an alarming rate; more land is cleared or altered for human use, roads are constructed crossing through wildlife protected areas, profoundly altering the landscape and biodiversity of distinct ecological regions.⁶²

MacArthur and Wilson developed the Island Biogeography Theory to explain the impact of this disruption, and the formation of isolated islands of habitat on biodiversity⁶³. According to this theory, islands of habitat that form from fragmentation disrupt the continuity of a former and similar

⁶¹ *Ibid.*

⁶² G. B. Cox. *Conservation Biology* (Dubuque, Iowa: William C. Brown Publishers, 1997).

⁶³ R. H. MacArthur and E. O. Wilson. “The Theory of Island Biogeography.” In *Monographs in Population Biology* (Princeton: Princeton University Press, 1967).

landscape that was endemic to a particular species. Since an island can be understood as “a self-contained region whose species originate entirely by immigration from outside the region”⁶⁴, these remnant patches of habitat, national parks, and nature reserves can be considered islands. Because of isolation, evolutionary processes are impacted, as animals are unable to migrate or interact, decreasing the gene flow that usually supplies the effects of mutation through natural selection. Ecosystem fragmentation is essentially a disruption of the continuity of a former and similar landscape that was endemic to the particular species.

According to MacArthur and Wilson, larger islands will have a greater number of species than smaller islands, and the species diversity found on a particular undisturbed island is determined solely by the relationship between the number of species found immigrating to the island and the rate that populations on the island become extinct.⁶⁵ Rates of immigration will decrease over time as more species become established; rates of extinction will increase over time: when more species are present, more have the chance of going extinct in that particular island environment.⁶⁶ This is a species-habitat/ecology relationship that tries to explain how only one variable shift in an ecosystem may trigger or distract the larger and wider part of the ecosystem. ‘Area’

⁶⁴ M. L. Rosenzweig. *Species Diversity in Space and Time* (Cambridge: Cambridge University Press, 1995).

⁶⁵ MacArthur and Wilson, “The Theory of Island Biogeography”.

⁶⁶ *Ibid.*

and 'isolation' are identified as two key island features that impact this balance as larger areas can support more species, and isolation decreases movement patterns. In other words, the number of species increases with island area, but decreases with reduced area. For instance, humans migrating into an established ecosystem are causing other animals to go extinct like the nomadic pastoralists Maasai of East Africa or the Palaeo-Indian Native people migrations to North America and Australia for example, contributed to the extinction of the certain animal species; hence, humans were a good example of variable shift in those ecosystems.

These human disturbances have created artificial habitats for wildlife characterized by physical and functional ecological fragmentations. For instance, in the Serengeti ecosystem, the traditional construction of Bomas by Maasai pastoralists and houses by Sonjo farmers adjacent to protected areas have caused severe ecological fragmentation as animals attempt to avoid human contact. This has resulted in the creation of several fragmented or disconnected habitats that accommodate a minimum viable population, which increases population vulnerability. In turn, these patchy and isolated habitats dictate the larger movement of animals, their reproduction patterns, and limits hybridization, resulting in a weaker genetic pool. Furthermore, animals are more susceptible to climate and environmental stress because they inhabit areas reduced in size and resources,

causing slight changes in the environment to have greater impacts overall. Thus, in these small habitable areas, the animal's competition for the resources will increase, and there will be less ecological interactions between biotic and abiotic components on the landscape, contributing to increases in communicable contagious diseases that further increase the risk of extinction.

The alarming population decline of African wild dogs from much of their historical range is directly correlated with human population expansion and related anthropogenic pressures. Specific characteristics of African wild dogs, particularly their wide-ranging behaviors, life-history characteristics and inbreeding avoidance, and natural predating behaviors, increases their risk of encountering human activities, conflict with farmers, and exposure to infectious disease, which all accelerate and escalate their vulnerability⁶⁷. They typically have large home ranges and travel long distances. However, because of human population expansion and the associated contraction of their habitats, they are now confined to agro-pastoral and pastoral communal lands.⁶⁸ With significantly decreased home ranges, dogs still wander long distances, often away from the boundaries of protected areas and reserves, where they are at much higher risk of conflict with human populations.⁶⁹ In

⁶⁷ R. Woodroffe and J. R. Ginsberg. "Edge effects and the extinction of populations inside protected areas." *Science* 280 (1998): 2126-2128.

⁶⁸ Rasmussen, "Livestock Predation by the Painted Hunting Dog".

⁶⁹ Woodroffe et. al., "Livestock Predation".

fact, most of the kills by wild dogs occur outside protected areas in communal lands.⁷⁰

Once outside protected areas, as part of their natural predator behavior, they frequently attack and kill domestic livestock. Historically wild dogs were actively destroyed through institutional culling, but laws enacted in the early 1970s legally protect them in most regions where they are common⁷¹. Unfortunately, this has not stopped the practice, and reports of them being hunted, snared and killed by farmers have been documented in Loliondo district Tanzania. In Benoue Complex Game Reserve in Northern Cameroon and in Zimbabwe⁷². Although there is evidence that most agro-pastoralists and pastoralists exaggerate their complaints related to livestock depredation by wild dogs, they are still a common target.⁷³

Ecological instability, fluctuation and disturbances causes populations to become segregated, which can contribute to inbreeding depression (reduced biological fitness and population bottleneck), decrease genetic variability, and in

⁷⁰ Rasmussen, "Livestock Predation by the Painted Hunting Dog". Woodroffe, et al. (2005), op. cit.

⁷¹ J. H. Fanshawe, et.al. "The wild dog: Africa's vanishing carnivore." *Oryx* 25, No. 3 (1991): 137-146.

⁷² Rasmussen, "Livestock Predation by the Painted Hunting Dog".

⁷³ Woodroffe et al., "Livestock Predation"; Rasmussen, "Painted Hunting Dog".

turn, impact the long-term fitness of species. The usual migration of animals that help maintain population dynamics are also limited. In the case of African wild dogs, wildlife ecological disturbances have had a profound impact on population numbers because of their natural inbreeding avoidance behaviors. Since pack members are often all offspring of the alpha pair, there are few breeding opportunities within the pack. Instead, animals may leave in search of mates in other packs. As a result, the death of an alpha often causes pack disintegration. Although these dispersal behaviors have the advantages of increasing gene flow and ensuring more robust genetic variability, the fragmented habitats and threats outside of reserve borders have negative effects on dispersal success while compromising the survival of these out-breeding populations. Decreasing populations of African wild dogs may also affect reproductive success as chances of raising a pup to maturity is correlated with the age of the mother and the size of the pack. Pack size influences reproduction rates because there are more adults to care for and guard the pups, hunting tends to be more successful and uses less energy (Figure 1), they are better at defending kills, and they are more likely to win clashes with other packs. With smaller populations and lower life expectancy, fewer animals are likely to reach maturity.

The ecology and habitat utilization are closely related to both prey availability and predator avoidance behaviors, influencing patterns of movement and interaction. Although

it has been widely reported that predation by larger carnivores threatens wild dog populations in sub-Saharan Africa⁷⁴, the research is conflicting. Research in Kenya, Tanzania, Zimbabwe, Namibia, Botswana, and South Africa has reported that predation by lions or lions and spotted hyenas is the primary cause of natural mortality in wild dogs⁷⁵. Simulation experiments using audio recording playbacks of lion roars and hyena whoops to intimidate wild dogs revealed that dogs were more likely to run away, stand their ground or partially approach in response to lion roars when in open environments than when in dense habitats, where the risk of ambush is greater. Interestingly, the experimental observations revealed that the wild dogs were not afraid of hyena whoops. From these simulations, the researchers deduced that hyenas do not pose serious dangers to the lives of wild dogs and their pups. Experimental research on wild dog habitats suggest that lions currently represent an immediate high-level threat to wild dogs that is invariably best avoided, whilst the threat from hyenas may not be so great or perhaps is simply unavoidable.

Relevant research on an African wild dog population in Zimbabwe, however, reported the spotted hyenas (*Crocuta crocuta*) that direct predation of adult wild dogs by larger carnivores was rare, although spotted hyenas (are believed to

⁷⁴ Mills and Gorman (1997).

⁷⁵ Woodroffe et al., "Implications for Conservation".

impact pup and juvenile survival⁷⁶. This report also demonstrated only occasional avoidance of lion (*Panthera leo*) in high-density areas during breeding periods, although the researchers did report that predator avoidance was related to long-distance movements of den sites in some pack years⁷⁷.

Regardless of their direct impact on wild dog populations, lions and hyenas also present an interspecies competition threat that appears strong enough to hinder population size of wild dogs and promote higher extinction risk. As human encroachment forces higher concentrations of prey into smaller areas, apex predators such as lions and hyenas are attracted to the region where they outcompete wild dogs for kills. As such, wild dogs may be driven away to peripheral areas free from competition for kills and the danger of predators. Lower access to prey can cause starvation or force them outside of protected areas to predate on livestock, increasing their risk further.

Higher densities and competition with other predators also result in kleptoparasitism, whereby sometimes the wild dog's kills are grabbed away from them by lions and hyenas and therefore decreasing food supplies in relation to energy expenditure⁷⁸ Using isotope elimination methods to quantify the free-living energy demands, Gorman et. al. calculated

⁷⁶ Leigh, "Loss of Genetic Diversity".

⁷⁷ *Ibid.*

⁷⁸ Gorman, "High Hunting Costs"

and quantified the energy budgets of wild dogs used in hunting and killing⁷⁹. Their results showed some small losses of food to lion and hyena kleptoparasites, which contributed to an exponential increase in required hunting time, range, and daily energy demands. They note that a 25% increase in kleptoparasitism would require more than 12 hours of hunting per day and would therefore be unsustainable⁸⁰. This demonstrates why wild dogs are particularly vulnerable to local extinction in areas where their main kleptoparasites are abundant and the competitions for the dietary resources is extremely stiff.

Moreover, landscape degradation and fragmentation are the main anthropogenic factors that have been commonly associated with the emergence of diseases in wildlife. With increased interaction with human settlement, African wild dogs interact more frequently with domestic dogs and livestock, contracting infectious diseases from the domestic animals that further reduce their numbers. Contagious disease in livestock has been reported in northern Tanzania and has been listed as the most significant factor responsible for livestock losses in the western Serengeti. The highest frequencies of deaths due to diseases are believed to be a result of wildlife-livestock interaction epidemics, experienced in villages located closest to the protected areas.

⁷⁹ *Ibid.*

⁸⁰ *Ibid.*

This may be because local communities living close to the protected areas illegally graze their livestock inside the parks, especially during dry seasons. Furthermore, interactions between wild and domestic animals increase the risk of disease transmission⁸¹. This encroachment of protected areas by grazing also contributes to further wildlife habitat degradation.

Although African wild dogs are not as impacted by poaching as some other species, uncontrolled poaching is a threat to wildlife in general and affects both predator and prey numbers, affecting wild dogs as members of the wider ecosystem. Because African wild dogs occur at low densities in regard to their large home ranges, they are limited by competition with some larger sympatric carnivores, namely lions (*Panthera leo*) and spotted hyenas *Crocuta crocuta*⁸². With the decreasing number of wild animals due to poaching, it has also greatly affected home ranges of African wild dogs and their manipulation of environmental resources⁸³.

The number of animals killed as the result of road accidents has been increasing. Research has revealed that road mortality can be a particularly serious threat to rare, endangered or vulnerable species that already have low

⁸¹ C. Gortazar, et.al., "Diseases shared between wildlife and livestock".

⁸² Mike M. Webster and Ashley J.W. Ward, "Personality and Social Context", *Biological Reviews* 86, No. 4 (2011), 759-773.

⁸³ C. Carbone, et.al. "Energetic constraints on the diet of terrestrial carnivores." *Nature* 402 (1999): 286-288.

population levels, or those with poor life history traits that increases vulnerability to population decline and potential extinction⁸⁴. For instance, in a study by Alexander and Waters in the Bow Valley of Banff National Park, high rates of road and rail mortality of wolves have resulted in a localized extinction of their population⁸⁵. Species such as wolves, bears and elk, like the African wild dogs, have sizeable home ranges that require them to crossroads frequently. Moreover, road right-of-way, bridges, or feeder roads, and paths often attract vertebrate species because they provide good habitat for hunting, grazing, and movement, increasing the chance of vehicular-caused mortality⁸⁶.

5.0 Current Conservation and Management Efforts: Examples from the Serengeti Ecosystem

A number of wild dog population restoration and recovery projects have been established in some countries to address their decline. In Tanzania and Kenya (The Serengeti for instance, conservation agencies introduced dog recovery

⁸⁴ Forman and Alexander, "Roads and their major ecological effects."

⁸⁵ Alexander and Waters, *Effects of Highway Transportation Corridors on Wildlife*"; C. Callaghan, et.al. "Highway effects on gray wolves within the golden canyon, British Columbia." G. L. Evink, P. Garrett and D. Zeigler (eds.). *Proceedings of the Third International Conference on Wildlife Ecology and Transportation* (Florida: Department of Transportation, Tallahassee, 1999), 39-51.

⁸⁶ Forman and Alexander "Roads and their major ecological effects"; Alexander and Waters (2000).

ranches and public awareness campaigns to the local people on the endangered status of wild dogs and the need for conservation efforts. Wild dog restoration schemes in the Serengeti-Maasai Mara ecosystem and Kruger National Park nurtures African wild dogs until they have reproduced and multiplied, and then reintroduce them into their natural habitats. These efforts have produced positive results⁸⁷. In South Africa, wild dog reintroduction attempts have tried to avoid areas inhabited by dense populations of lions. It is believed now that frequent kleptoparasitism by hyenas locating wild dog kills has declined due to the fact that these restorations are avoiding high trophic-level predators⁸⁸.

Importantly, recent initiatives by the member states from the Southern Africa Development Community (SADC), who founded the so called “Trans-Frontier Conservation Areas” (TFCAs) /Transboundary Protected Areas (TBPAs) to help in conservation of regions’ natural resources, jointly stride towards sustainable natural heritage conservation. TFCAs are founded on the realization that natural resources that stand on international boundaries are shared heritage assets with the potential to contribute to conservation of biodiversity. SADC has not only embarked in economic

⁸⁷ See, for instance, R. Woodroffe, et.al. *The African wild dog: status survey and conservation action plan* (Switzerland: IUCN, 1997).

⁸⁸ Alexander and Appel, “African wild dogs endangered by a canine distemper epidemic”.

development in the region but has become a functional and integrated network of trans-frontier conservation areas where shared natural resources are sustainably co-managed and conserved to foster economic and social development, tourism, and regional integration for the benefit of both those living within and around TFCAs, as well as for mankind at large. TFCAs is community-centred, regionally integrated, and sustainably managed network of world-class trans-frontier conservation areas with a mission to foster cooperation in regional biodiversity conservation and sustainable use of their biological resources.

6. Concluding Remarks

Despite being admired for their resilience, the population of African wild dogs is in deep decline and in danger of extinction in sub-Saharan Africa. Human habitat disturbance is the prime cause in the current worldwide trend of reduced biodiversity and the central reason for the decline in African wild dog populations. Their sensitivity to habitat fragmentation as a result of their natural behavior patterns put them in conflict with humans in a variety of ways. Because human encroachment is not likely to cease or be reversible, efforts to improve chances of African wild dog survival have to take human interaction into account. Conservation requires that responsible authorities and agencies demonstrate the political will to address

management challenges and improve benefits for the local communities through wildlife management revenues.

7.0 Way Forward and Future Directions

The drastic decline in African wild dog populations in recent years makes them one of the most threatened species in the world. The causes of African wild dogs' decline include their vulnerability to habitat fragmentation and resulting conflict with humans that include purposeful and accidental killings, road accidents and infectious disease. All these causes are associated with habitat encroachment by humans and are unlikely to be reversible, though efforts are being made to salvage their lives, new ways need to be developed that would take human interaction into account.

For conservation efforts to be successful then, further research on African wild dog patterns of activity and interactions with their present environment need to be completed. Since three of the largest remaining wild dog populations are found in Kruger National Park (South Africa), the Selous Game Reserve (Tanzania), and Northern Botswana, protecting about one-third of all the African wild dogs alive today, understanding the impact on the dog populations is particularly relevant to conservation efforts. Because human encroachment is a reality, some of the environmental impacts can be ameliorated with small changes to policy and practice in regions in or near African dog habitats. Snare related deaths, either accidental, as the

result of unselective hunting techniques, or purposeful, for the sake of poaching, are one of the most documented causes of African dog population decline⁸⁹. Efforts to address these issues included reducing the number of hunters in these regions by training them in farming and fishing activities. Reducing casualties by road accidents requires increasing awareness and improving conditions with reduced driving speeds and signage on specific points on the roadway that may be of high risk of collisions. Vaccinating domestic dogs against rabies and improving sanitation in the human communities near the range of the wild dog populations may also decrease death rates caused by disease.⁹⁰

Rescue and mitigation measures used with other wild dog populations may also be applicable to help African wild dog populations and African conservators could learn by drawing examples from these other locations⁹¹. For example, in North America, Forman and Alexander suggested methods to improve road avoidance in wildlife conservation areas. We would recommend that this be adopted for Africa too⁹². For

⁸⁹ Leigh, "Loss of Genetic Diversity".

⁹⁰ J. M. André, "African wild dogs in Mozambique. In Tools for the conservation of African wild dogs. Do we know enough? What more do we need to know?" Report of a workshop on research for conservation of the African wild dog, Kruger National Park, South Africa, 25th-29th October 2004.

⁹¹ Forman and Alexander, "Roads and their major ecological effects."

⁹² *Ibid.*

successful restoration and salvaging of African wild dogs, African conservators and policy makers should avoid human-wild dog ecological interference and introduce the restored dogs into other wild dog packs in habitats with low densities of higher trophic level predators. Roads should not cut across or through conservation areas because they will indirectly effect animal movement patterns and behaviours in areas adjacent to roads.

All these efforts may mitigate the decrease in African wild dog populations, but any conservation efforts in most of Africa face one major challenge: lack of political will that both results from and causes poverty, corruption, and ignorance. African leaders lack the readiness to conserve nature and wildlife ecology because these resources do not provide immediate benefits. Rather than conserving nature for its own sake, most government conservation authorities in sub-Saharan Africa are concerned with the wildlife conservation management of large animals such as lions, giraffes, elephants, cheetahs, rhinos, and buffalos that have revenue-generating value within the tourism industry. The purpose of conservation is seen as a way of improving economic gains rather than for reasons of nature conservation or world heritage. Since African wild dogs have a negligible economic impact, they are not included in most conservation management plans hindering their chances for survival.

Local communities in Africa generally view wildlife conservation as a non-profitable, less valuable, and insignificant endeavour that has nothing to do with their daily livelihoods. The wildlife management sector is perceived as a profitable project for upper class-citizens, business tycoons, and politicians rather than a way to preserve national treasures or world heritage. There is little to no involvement of local community leaders in conservation efforts, and the public participates very little because they are not regarded as the custodians or owners of these natural resources by the government organizations. Rather, conservation efforts are viewed by most people as a way for African politicians to enrich themselves and their families from the revenue emanating from tourism, illicit trade, and corruption from poaching activities. Probably, we researchers in paleoanthropology should step in and focus, direct, and conduct our studies to address these African problems

As a result, protection and conservation of endangered species is a very difficult task in Sub-Saharan Africa, since it requires a mutual commitment, collaboration and effort by all parties: researchers, policy makers, foreign donor agencies, stakeholders, and the public. Collaborative programs for wildlife and ecological protection are desperately needed to minimize adverse effects of environmental and ecological disturbance, fragmentation,

and instability. For example, community outreach campaigns combined with military assistance for patrols of conservation areas could be very effective to combat against illicit trading and poaching. These efforts would not only benefit wild dog populations, but also assist to maintain populations of other endangered, vulnerable, and threatened animals such as rhinos, elephants, and lions, that are likely to face extinction if more deliberate efforts to protect them are not instituted.