ABUNDANCE, DISTRIBUTION AND CONSERVATION THREATS OF AFRICAN WILD DOG (*Lycaon pictus*) IN THE LOLIONDO GAME CONTROLLED AREA, TANZANIA

BY

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ABSTRACT

Assessment of abundance, distribution and conservation threats to African wild dogs was conducted in Loliondo Game Controlled Area (LGCA), northern Tanzania. Specifically, the study focused on determining population size and structure, spatial distribution, attitudes of local people towards wild dogs and wild dog conservation and threats impacting the species. Semi-structured interviews, diurnal random searches, internal and external examinations of wild dogs carcasses examined and night transect surveys were employed. Eight packs with a total of 132 recognised individuals at an average pack size of 16.50 ± SD 7.50 individuals were recorded. Pack sizes 3 individuals were reported to be sighted mostly and of all respondents (n = 210), only 26% were able to recognise wild dog sexes. The density of both known and unknown wild dogs was 0.19 animals/km^2, higher compared to other carnivores. In terms of distribution most of the packs were concentrated in the northern part as compared to the central and southern parts of LGCA. The species was observed to occur most in woodland type of vegetation. Interestingly, 55.30% of respondents showed a positive attitude towards wild dogs and wild dog conservation despite that 52.90% of respondents dismissed lack of any conservation action or strategy in place towards conserving the species. However, poisoning and Canine Distemper Virus were identified as the main threats. Therefore, conserving African wild dogs in LGCA requires mult-approach conservation efforts (i.e. awareness rising to community, fitting radio telemetry to the dogs and threats management interventions) due to nature of the species.

DECLARATION

I, **Emmanuel Hosiana Masenga** do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work. It has neither been submitted nor concurrently being submitted for degree award in any other Institution.

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DEDICATION

This study is dedicated to the following:

To my father, Hosiana Masenga for giving me education and for encouraging me in all aspects of life; without him, I would not have been here. He was such inspirational. To my mother Ester Gideon; my wife Vicky Wilfred and our daughter Angel, for their support and prayers.

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LIST OF ABBREVIATIONS

CDV	Canine Distemper Virus
CPV	Canine parvovirus
ESRI	Environmental System Research Institute
IDs	Individual Identifications
NDC	Ngorongoro District Council
GCC	Government Chief Chemist
GPS	Global Positioning System
IUCN	International Union Conservation of Nature
Kms	Kilometers
Km^2	Kilometer square
LGCA	Loliondo Game Controlled Area
NCA	Ngorongoro Conservation Area
NCAA	Ngorongoro Conservation Area Authority
RNA	Ribonucleic Acid
RT – PCR	Real-Time Polymerase Chain Reaction
SSC	Species Survival Commission
SPSS	Statistical Package for Social Science
SNAL	Sokoine National Agricultural Library
SRTM	Shuttle Radar Topography Mission
TAWIRI	Tanzania Wildlife Research Institute
UNEP	United Nation Environmental Programme
VHF	Very High Frequency

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The African wild dog (*Lycaon pictus*) is one of the world's most endangered large carnivores (Woodroffe *et al.*, 2004) and yet of high value to Africa's tourism industry (Lindsey *et al.*, 2007). The reason for its current conservation category is the small population size and ongoing decline (Woodroffe *et al.*, 2004). In the wild, fewer than 8000 individuals remain, spread across a small number of fragmented populations (IUCN/SSC, 2008).

Although the highest wild dog densities have been recorded in wooded savannah (Creel and Creel, 2002), populations have been recorded in habitats as diverse as short grasslands, montane forest (Dutson and Sillero-Zubiri, 2005) and mangroves (McNutt *et al.*, 2008). Historically, the species was once distributed across the African continent, absent only from the jungles and deserts (Woodroffe, 2004; McNutt *et al.*, 2008). Today, wild dogs remain uncommon even in essentially less disturbed wilderness, apparently due to negative interactions with larger carnivores and livestock predation (Creel and Creel 1996; Mills and Gorman, 1997; Woodroffe *et al.*, 2005).

All large carnivores need large areas to survive hence wild dogs need larger areas than almost any other terrestrial carnivore species anywhere in the world (Woodroffe *et al.*, 2005). However, dramatic range reductions resulting from extensive habitat loss and persecution mean that they now occupy just 7% of their former range

(Woodroffe, 1997; IUCN/SSC, 2008). Frequently reported major causes for the decline include habitat loss, persecution, competition with other carnivores, low prey availability and contagious diseases particularly rabies and canine distemper (Alexander and Appel, 1994; Woodroffe and Ginsberg, 1998; van de Bildt *et al.*, 2002). Other causes are snares and road kill (Woodroffe *et al.*, 2004), and genetic variation within a population over time (Oliver, 2009).

1.2 Problem Statement and Justification of Research

In the Serengeti–Mara ecosystem, wild dogs have been in decline since 1960s and the species was suggested locally extinct in 1990s after successive outbreaks of rabies, and possibly canine distemper virus (Cleaveland *et al.*, 2000; Woodroffe, 2001). The known population at the end of 1990s was just 34 individuals in the Serengeti ecosystem (Burrows *et al.*, 1995), and Loliondo-Kajiado consisted of 100 individuals in 2007 (IUCN/SSC, 2008). Pressure through competition with lions and hyaenas and possibly habitat loss through human encroachment of their territories contributed to the local extinction of the wild dogs in and around Serengeti National Park in the early 1990s (Burrows, 1995). However, there were non-systematic sightings of packs in pastoralist areas in the northeast and southeast of the ecosystem including Loliondo Game Controlled Area (Fyumagwa and Wiik, 2001) suggesting that a remnant population remains. Today, Tanzania is critically important for the conservation of remaining wild dog population in the world, yet little is known on the distribution and abundance of this threatened species in the country (Woodroffe *et al.*, 2004). Despite their formerly broad geographical distribution, little is known about current population status of the species in the Serengeti–Mara ecosystem. Moreover, highest conservation priority in Tanzania for wild dog among carnivores

(TAWIRI, 2009) calls for better understanding of the ecology of the packs for their conservation. Sighting of the species in pastoral areas suggest that future wild dog conservation in the area need involvement of local communities in providing information on their sightings hence distribution, abundance and threats they face in their natural ecosystem. Therefore, information gathered in this study enhanced our knowledge about this population and the study techniques used can be transferred for use in other areas of Tanzania, which used to be home to this species both for the future benefit of tourism industry and survival of the species.

1.3 Objectives

1.3.1 Overall objective

The overall objective of the study was to assess abundance, distribution and conservation threats of wild dog in the Loliondo Game Controlled Area.

1.3.2 Specific objectives

Specifically the study aimed:

i) To determine population size and structure of African wild dogs

ii) To assess the spatial distribution of African wild dogs

iii) To determine attitudes of local people towards wild dogs and wild dog conservation

iv) To determine and assess threats impacting African wild dogs

1.3.3 Research questions

The study was guided by the following research questions:

i) What is the population size, age and sex structure of the Loliondo wild dog population?

ii) What is the spatial distribution pattern of the wild dog packs and what factors determine this pattern?

iii) What are the current local communities’ attitudes towards wild dogs and wild dog conservation?

iv) Are there any opportunities for initiatives to reduce costs or create benefits from wild dog as a way to improve attitudes?

v) What are the main threats facing different packs?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Taxonomy and Description of Wild Dogs

Fossil evidence does not resolve the query on origin of African wild dogs, and within Africa, identification of the oldest *Lycaon* is complicated by the difficulty of distinguishing *Lycaon* fossils from those of an early Pleistocene wolf, *Canis africanus* (Creel and Creel, 2002). 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). However, no geographical boundaries separated these proposed subspecies, and dogs sampled from the intermediate area showed a mixture of southern and eastern haplotypes, an indication of a cline rather than distinct subspecies (Girman and Wayne, 1997).

African wild dog is the largest wild canid weighing 22 to 25 kg on average (Creel and Creel, 2002) with long legs, large rounded ears and very variable coat pattern. Hence, their body is blotched with black, white, yellow and grey and is identified by distinctive colour distribution, and bushy tail, which is frequently white tipped (Stuart and Stuart, 1996).

2.2 Ecology and Behaviour of Wild Dogs

The African wild dog is one of the world's most endangered large carnivores and presents a particular challenge for conservation because animals live at low population densities but range vary widely. These aspects of their ecology and life history mean that populations require vast areas to remain viable in the long term. Therefore, in order to know their fate there is a need to understand well the aspect of their ecology and behaviour. Wild dogs have disappeared from 25 of the 39 countries they formerly occupied despite the persistence of apparently suitable habitat, prey, and other large carnivores' species in many areas (IUCN, 2006; IUCN/SSC, 2008). Population densities average around 2.0 adults and yearlings per 100 km^2 (Fuller *et al.,* 1992a) and home ranges average 600-800 km^2 per pack in eastern Africa (Woodroffe and Ginsberg, 1998), with some packs ranging over areas in excess of 2000 km^2 (Fuller *et al*., 1992a). However, the largest nature reserves containing wild dogs. Selous, has an area of 43 600 km^2 and an estimated 880 adult wild dogs (Creel and Creel, 2002).

African wild dogs are gregarious animals that form packs of up to 40 members (Gusset *et al.*, 2009). Before their recent population decline, packs of up to 100 animals had been recorded (Creel and Creel, 2002). Average pack size is 7 to 15 members and is composed of a group of related females and a group of related males, with the males and females being unrelated (Gusset *et al.*, 2009). Only the alpha female, the oldest female, and alpha and beta males, the fittest males, reproduce but litters of 10-11 pups on average are produced by a single pack (Woodroffe *et al.*, 1997; Nowak, 1999). Most new wild dog packs form when young animals (usually but not always in their second year) leave their natal packs in same-sex dispersal groups and seek new territories and members of the opposite sex (McNutt, 1996). Such dispersal groups may travel hundreds of kilometres (Fuller *et al*., 1992b), and have been recorded in areas very remote from resident populations (Fanshawe *et al*., 1997). This dispersal behaviour can complicate the interpretation of distribution data, as sightings of small groups of wild dogs do not necessarily indicate the presence of a resident population (IUCN/SSC, 2008).

African wild dogs cooperate in hunting their prey (Creel and Creel, 1995), which consists mainly of medium-sized ungulates particularly impala (*Aepyceros melampus*) but may range in size from hares (*Lepus spp*.) and dik diks (*Madoqua spp.*) to kudu (*Tragelaphus strepsiceros*) and even, occasionally, eland (*Taurotragus oryx)* (Van Dyk and Slotow, 2003; Woodroffe *et al*., 2007a). Packs also cooperate to breed (Woodroffe *et al.*, 2004); with usually only one female and one male being parents of the puppies, but all pack members contributing to puppies care (Malcolm and Marten, 1982). As females have never been observed to raise puppies to adulthood without assistance from other pack members are often used as the units of measuring wild dog population size. The female plays a role in caring the puppies as it form a cooperate breeders (Gusset *et al.*, 2009). However, most packs consist of a dominant (alpha) breeding pair and their offspring, accompanied by same sex adult relatives of either or both of the alpha pair and sometimes offspring of one or more subordinate pairs. Within the pack these animals have unique social concerns and structure. They cooperate in caring for the young as well as wounded or sick pack members, and when return from a kill they feed regurgitated food to the young, wounded and sick, as well as any adult that was not able to go on the hunt (Creel *et al.,* 2004). Knowledge on social behaviour of wild dogs are important in conservation of wild dogs as pointed out that some implication such as human impact and interspecific competition has consequences in wild dogs social behaviour (Woodroffe *et al.,* 2004). In addition to sociality and the effects of interspecific competition, wild dogs have large home ranges for which to sustain a demographically effective population size of 500 individuals, an estimated area of 30 380 km^2 is required (Creel and Creel, 2002).

Coordination between members of an African wild dog pack is seen throughout a hunt, whereas effectiveness depends on the number of cooperating hunters in several stages. The rally appears to ensure that members are aware, alert and ready to hunt simultaneously, prior to trotting in search of prey (Maddock and Mills 1994; Gusset *et al.,* 2006). They are fast runners; reach a speed of more than 40 miles per hour (65 km/hr) (Creel and Creel, 2002). Individual wild dogs pursuing a prey animal do not all follow same straight course. Together, these patterns sometime result in one or more wild dogs intercepting a prey animal after a shortcut, whether intentional or not (Fanshawe *et al.,* 1997; Spiering *et al.,* 2010). Once a prey animal has been caught, pack members cooperate in pulling it down, or in occupying the animal’s attention by feinting from the front, while others attack from behind and begin disembowelling. Wild dogs cooperate in defence of their kills from other carnivores due to behaviour of maintaining close social bonds between pack members (Gusset and Macdonald, 2010).

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African wild dogs are always found at low population densities and are invariably lower than the densities of sympatric large carnivores, typically by 1–2 orders of magnitude (Creel and Creel, 1996). This basic pattern suggests that wild dogs differ from sympatric large carnivores in some fundamental aspects of ecology. Consequently, most populations of wild dogs are small, and only handfuls exceed 500 individuals (Creel *et al.*, 2004). Serengeti National Park, which is part of the Serengeti-Mara ecosystem, formerly supported several wild dog packs although densities were never high (Burrows, 1995). The packs den in widely scattered locations in the wet season when water is normally widely available in a plethora of temporary pools/water courses (Burrows, 2002). The denning period is the only time when wild dogs return to the same location each day mostly than other times, as it is extremely rare for a pack to sleep in the same place for two consecutive days (Creel and Creel, 2002). The packs spend approximately three months close to the natal den after the birth of a litter of pups. The behaviour of the dogs towards the pups varies with the age of the pups (McNutt and Silk, 2008). It seems likely that recent recovery of wild dogs to the east of the ecosystem may be followed by natural recolonisation of the protected areas. Such a natural recovery would be highly beneficial for Tanzania's and Kenya tourist industries, but given past low densities inside the parks, would probably not represent a marked increase in the numbers of wild dog packs in the ecosystem (Woodroffe *et al.*, 2004).

Indirect competition probably has no substantial effect upon wild dog numbers. However, although they are efficient hunters, wild dogs do sometimes lose their kills to scavengers. Indeed, a number of authors have suggested that one benefit of sociality for wild dogs is that group living allows for more effective defence of the kill (Woodroffe *et al.,* 1997). In Selous, competition at kills is not intense, and come primarily from spotted hyenas (Creel and Creel, 1996). In Serengeti National Park, where hyena group sizes are larger may take a wild dog kill after hunting (Hofer and East 1993). Although wild dogs occasionally lose their kills to lions, spotted hyaenas are much more important kleptoparasites (Creel and Creel, 1996). For example, in the Serengeti National Park, Tanzania, hyenas were present at 86% of wild dog kills and always fed from carcasses eventually (Fanshawe and Fitzgibbon, 1993; Gusset *et al.,* 2008). In the Selous Game Reserve, Tanzania, wild dogs avoid lions by focusing hunting activities in deciduous woodlands where prey encounter rate is only 3.75 prey/km compared to elsewhere in the reserve where prey encounter rates is much higher (9.88prey/km) (Creel and Creel, 2002). This habitat is relatively dominant in the northern Selous region along the periphery of the reserve and is separated into four large patches, separated by long grass, *Terminalia-Acacia* woodland, and short grass (Creel and Creel, 2002). The latter two are preferred lion habitat, requiring wild dogs to traverse these areas of potential confrontation in order to utilize the full range of what is already considered a marginal habitat of low prey densities. Therefore, wild dogs are able to persist in closed habitats, such as deciduous woodlands, in part because of a decrease in both competitive exclusion and kleptoparasitism by the other large-bodied African carnivore association members (Creel, 2001).

2.3 Reasons for Wild Dog Decrease in Number

African Wild dogs population decline has been related to their limited ability to inhabit human dominated landscapes. Where human densities are high and habitat consequently fragmented, wild dogs encounter hostile farmers and ranchers, snares set to catch wild ungulates, and high speed traffic and domestic dogs harbouring potentially fatal diseases (Woodroffe *et al.*, 1997; IUCN/SSC, 2008). Close contact and associated licking promotes the spread of introduced diseases (Keita and Thomas, 1996). These threats are common among large carnivores. African wild dogs low population densities and wide ranging behaviour mean that they are more susceptible to human impacts in comparison with other species (McNutt and Silk, 2008). Despite these human impacts on their populations, wild dogs can coexist successfully with people under the right circumstances (Woodroffe *et al.*, 2007a). Moreover, tools have been developed to reduce the impacts of conflicts with game and livestock ranchers, accidental snaring, and road accidents, although safe and effective tools to manage disease risks are still under development (Woodroffe *et al.*, 2005).

The group-living and complex social behaviour has a dramatic effect on the population dynamics of the species and consequently may affect their conservation and extinction risk (Green, 2004). Group size effects, and possible component Allee effects resulting from groups dropping below a minimum threshold size, were suggested to be intrinsic to species with an obligate cooperative breeding system (Courchamp and Macdonald, 2001). In wild dogs participation in cooperative behaviour becomes a constraint on successful reproduction, so that group size cannot be decreased once individual fitness depends on it, generating an Allee effect (Courchamp *et al.*, 2000). This breeding behaviour reduces the size of effective population (the breeding population) and at the same time the population becomes more vulnerable to fragmentation (Stuart and Stuart 1996; Creel and Creel, 2002). Therefore, on group size and Allee effects have conservation implications in wild dogs (Somers and Gusset, 2009), because not all adults are involved in breeding process.

Beginning in the 1970s, institutionalized culling of wild dogs by wardens and game rangers came to an end, and they are now legally protected in the seven nations that hold substantial numbers (Fanshawe *et al.,* 1991). Prior to 1986 no pack extinction in the Serengeti was known other than those shot by rangers/game wardens as vermin, a practice which fortunately ceased in 1973 (Burrows, 1992). Between 1956 and 1975 in Zimbabwe alone 3404 wild dogs were shot (Childes, 1988). Direct persecution of wild dogs within national parks increased during the 20th century as they were considered as vermin (Green, 2004). Due to the view of wild dogs being competitors in hunting areas and a threat to livestock, persecution both within and outside protected areas still occurs (Woodroffe and Ginsberg, 1997). Overall, livestock loss to wild dogs is low (Rasmussen, 1999; Woodroffe *et al.,* 2005) but it can be high locally (Woodroffe and Ginsberg, 1997). During the mid 1980s wild dogs became protected (Creel and Creel, 2002). Before then they were persecuted within and outside protected areas (Woodroffe *et al*., 1997).

Diseases have been identified as major threat to wildlife conservation (Woodroffe *et a*t., 2007a). The endangered animals are more vulnerable to diseases and may cause a rapid decline. Canine distemper virus (CDV), rabies, canine parvovirus (CPV), anthrax (*Bacillus anthracis*) (Creel *et al*., 1995) and other pathogens affect wild dogs

(Woodroffe and Ginsberg, 1997; Cleaveland 2000; Creel and Creel, 2002). The interspecific competition and low numbers combined with diseases are believed to be responsible to the Serengeti wild dog extinctions (Burrows *et al*., 1994; Ginsberg *et al*., 1995; Morell, 1995; Dye, 1996; Creel and Creel, 2002). The population also declined due to inadequate supply of food (shortage of food) in the wild (Keita and Thomas, 1996). For example, in Kruger National Park (South Africa), impala is the major prey making 80% of the kills; hence short supply of impala in the wild resulted into decline of their number (Keita and Thomas, 1996). The threat of disease is likely to be amplified by increased contact between wild dogs and domestic dogs. According to Green (2004), the threat issues to wild dog conservation were summarized in Fig. 1.

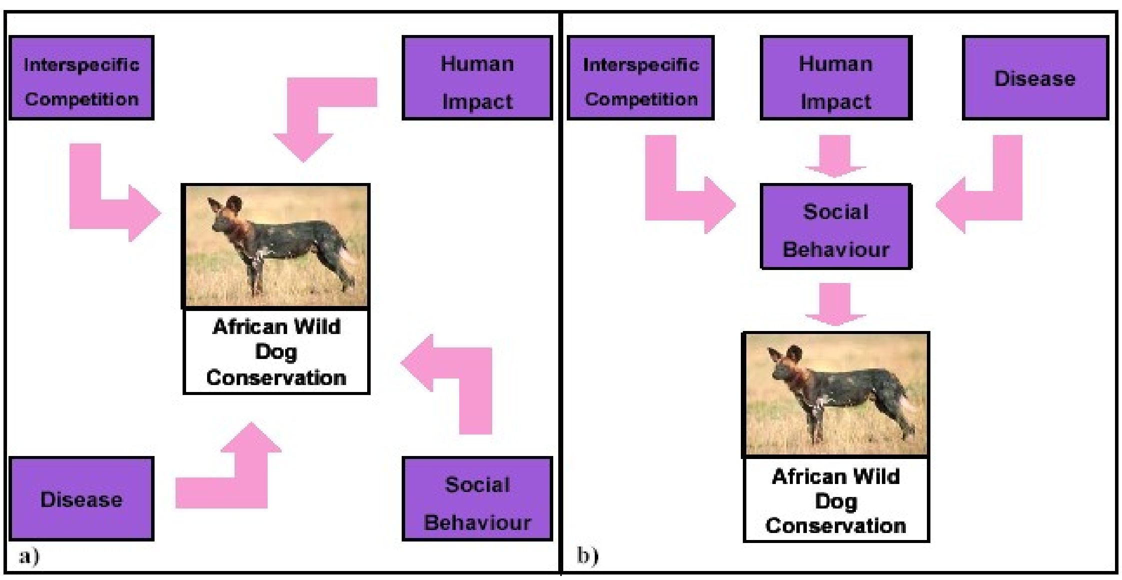


Figure 1: A summary of the threats to African wild dog conservation, a) each threat acting individually, b) African wild dog social behaviour that effect their conservation (Source: Green, 2004)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Area

3.1.1 Location

The study was conducted in Loliondo Game Controlled Area (LGCA), which falls within the Serengeti ecosystem in northern Tanzania. In addition, wild dogs in adjacent protected areas i.e. NCAA and Maasai Mara were studied. Loliondo Game Controlled Area (Fig. 2) lies within the Maasai ancestral lands between latitudes 2° 5' 00" and 2° 2' 60" S; and longitude 35º61'67" and 35° 37' 00" E. It encompasses an estimated area of 4 000 square kilometers, roughly third of the area of Serengeti National Park. There are no physical barriers separating the LGCA from the bordering protected areas.

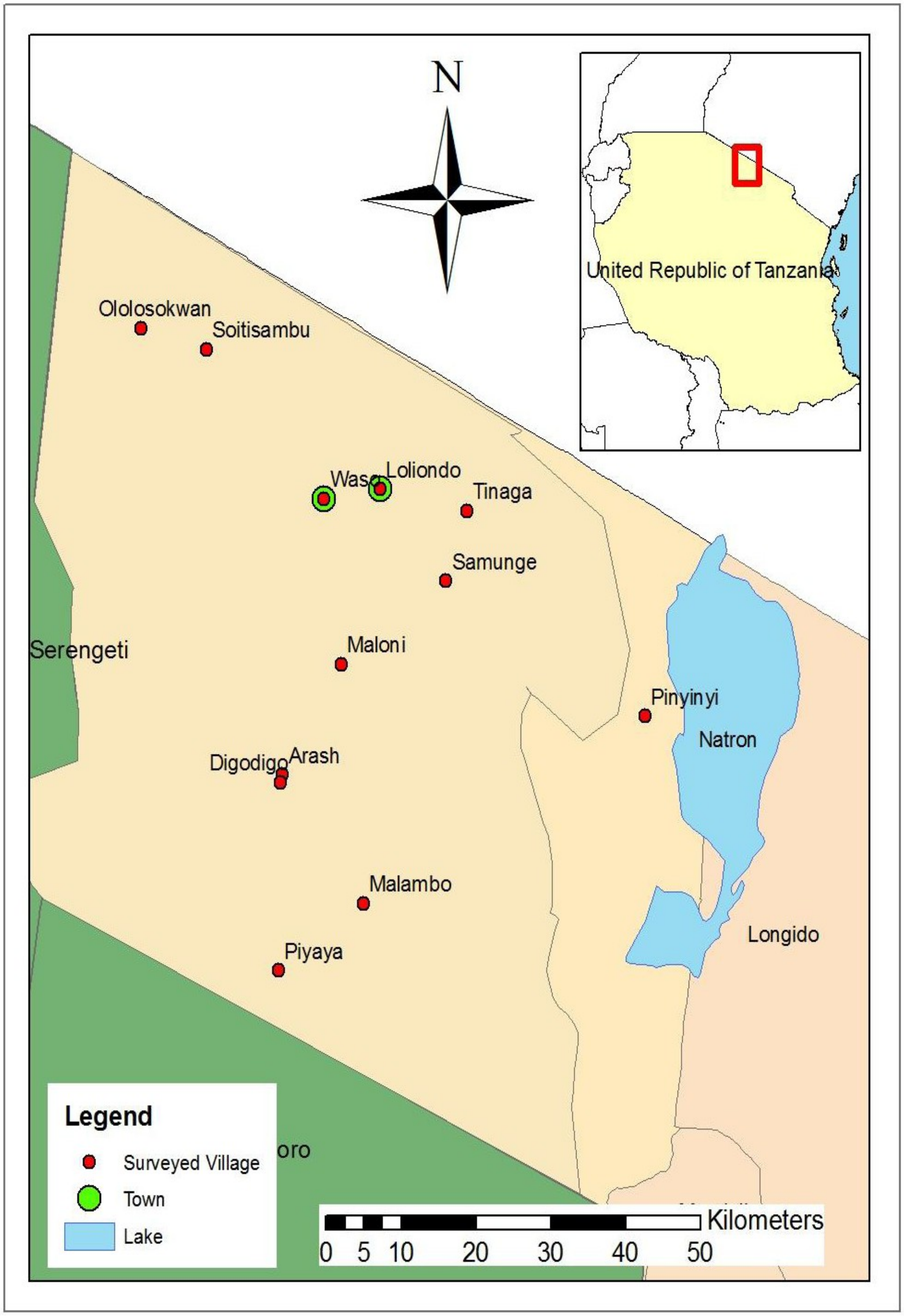


Figure 2: Map of Loliondo GCA showing surveyed villages 2009

3.1.2 Attributes of the human communities

Overall, there were 16 study villages even though the semi structured interviews were limited to only 6 villages. The age structure (in years) of respondents consisted of four categories: 31- 40 (5%), 41-50 (26%), 51-60 (38%) and > 61 (23%). However, 8% of individuals had no knowledge at all of their age. Majority of respondents i.e. 126 (60.80%) had primary school education whereas 50 (23%) had no formal education. Other education categories were standard twelve 26 (12.40%), diploma 7 (3.30%) and University education 1 (0.50). Numbers and corresponding percentages for the sex of respondents interviewed are summarized in Table 1.

Table 1: The distribution of the respondents by village in respect of sex

	Villages					
	Ololosokwan	**Soitsambu**	**Piyaya**	**Malambo**	**Digodigo**	**Samunge**
Male	30 (86%)	34 (97%)	33 (94%)	26 (74%)	17 (49%)	27 (77%)
Female	5 (14%)	1 (3%)	2 (6%)	9 (26%)	18 (51%)	8 (23%)
Total	**35 (100%)**	**35 (100%)**	**35 (100%)**	**35 (100%)**	**35 (100%)**	**35 (100%)**

The human population density in the eastern part of the ecosystem (LGCA) decreases from north to south–the highest density is found close to Kenyan border and around Wasso and Loliondo towns in the north, and the lowest density in the Gol Mountains area in the south, where there are mainly seasonal settlements of nomadic Maasai (Masenga and Mentzel, 2005). Currently, the human population of Loliondo District is estimated at 176 607, of which 85 684 are males and 90 923 are females. The estimate is computed using 4.5% annual growth rate (NDC, 2009). Human activities such as settlement, cultivation (including mechanized commercial farming), pastoralism, tourism, and licensed hunting are permitted (Homewood *et al.,* 2001) in the area. The economic activities of local communities include agro-pastoralism, with more of them engaged in livestock keeping (about 80%) and small scale agriculture (13%) production system (NDC, 2009).

3.1.3 Climate and vegetation

Generally the climate is warm and dry, coolest from June to October, with a mean annual temperature of 20.8°C, which is often less than the diurnal variation (UNEP, 2008). The average annual rainfall varies between 400mm and 600mm (Homewood *et al.,* 2001). However, LGCA exhibits a bi-modal rainfall pattern with peaks occurring in December and April and a total of 400–1 200mm per annum (Norton-Griffiths *et al.,* 1975).

The vegetation in LGCA varies from open woodland to short grass plains. The northern part is primarily of open woodlands on rolling hills, interspersed with rocky outcrops. It consists of a mosaic of *Acacia drepanolobium* in black cotton soils, high altitude forests of Pencil cedar, long grass plains dominated by *Acacia gerardii*, *Rhus natalensis*, *Euclea divinorum*, and *Acacia hockii* tree species (Homewood *et al.,* 2001). The forests are mostly situated on the hilltops or along watercourses in valleys. The mountain forests are classified as closed evergreen forests, which contain major tree species such as *Fagaropsis anglolensis (Olmoljoi), Olea welwitschii (Ololiondo), Juniperus procera (Oltarakwa)*. Acacia species are dominant in open scattered valley forests (Ojalamini, 2006). Short grass plains with a high net primary productivity during rains (Sinclair *et al.,* 2002) are present to the

South converging into *Acacia/Commiphora* woodland. The short grass plains are important breading grounds of Wildebeest (*Connochaetes taurinus*). In the central part, and in and around the Sonjo area, there are mountains with steep slopes and densely vegetated gullies. In the south, the Gol Mountains give way to the short grass plains (Sinclair *et al.,* 2002).

3.1.4 Wildlife

Loliondo is an important part of the semi-annual migratory route of millions of wildebeests and other ungulates northward into the Maasai Mara Game Reserve and Amboseli National Park in Kenya between April and June, and returning southward between December to January every year. The survival of the Ngorongoro-Serengeti-Maasai Mara ecosystem and the wildlife it supports is highly linked to the existence and health of Loliondo (Homewood *et al.,* 2001). The Gol Mountains and Sanjan Gorge are important nesting refuge for Rüpell's Griffon Vulture (*Gyps rueppellii*) and White Backed Vulture (*Gyps africanus*) both of which are near-threatened (Ojalamini, 2006). Carnivores such as wild dog (*Lycaon pictus*) (endangered) and cheetah (*Acinonyx jubatus*) (threatened) are present (Sinclair *et al.,* 2002).

3.2 Data Collections

Primary data were collected based on three methods namely, diurnal random search of wild dogs, systematic night field surveys, internal and external examination of wild dogs carcasses and semi-structured interviews. This approach was necessary due to rarity of the subject animal. Secondary data were obtained from unpublished reports and journal publications at Tanzania Wildlife Research Institute (TAWIRI) and at Sokoine National Agricultural Library (SNAL).

3.2.1 Population size, structure and distribution of wild dogs

Diurnal random searches of wild dogs were conducted in areas historically known to have wild dogs. The searches were made by a team comprising of the researcher and enumerators (persons trained to locate wild dogs and make records). Pack sizes, age and sex of sighted individuals and position were recorded for each pack encountered. Positions were recorded with the aid of a hand held Global Positioning System tool (GPS – Garmin 12) for mapping distribution. Photographs were taken using a high resolution camera (8.0 mega pixel) for subsequent individual/pack identification (IDs). A binocular was used to aid determination of pack sizes and individual/pack identification where possible. Also, habitat/vegetation types were identified, and den sites and number of pups together with any incidence of wild dog attack by other carnivores were recorded (Appendix 1).

Systematic night field surveys of carnivores along four major roads (Piyaya plain–Piyaya Suyan campsite, Maloni village centre–Samunge Hahara sub-village, Malambo Lake Natron junction–Malambo village centre and Gol road junction-Nasera rock) were employed. A total of 20 km along each road were surveyed. In this case each road was treated as transect. Transects were driven at a fixed speed of 20 km/hr (Buckland *et al.,* 2001), with two observers and one recorder seated at the back of a Land Rover station wagon. Each observer scanned one side of the road using a hand held spotlight. Name of carnivore species, group size, side of the road (right/left), the perpendicular sighting distance, position, time of sighting and kilometer driven were recorded every time a carnivore species was seen (Appendix 2).

3.2.2 Peoples attitudes towards wild dogs and threats of wild dog conservation

3.2.2.1 Attitudes

The purposive sampling technique was used to select six villages from the government register book in which to conduct interviews. The villages selected were Ololosokwan, Soitsambu, Piyaya, Malambo, Samunge and Digodigo. The sampling unit in this case was a household. According to der Gier (2004) sample size should be at least 30 to 50 to ensure adequate representation of the population. Therefore in this study, the sample size was 35 households per village. Simple random sampling design was used to obtain the households sampled. The design is preferred to over other designs because it gives each unit in the population an equal probability of being selected, and all choices are independent of one another. Under this method, the whole population is taken as a single composite unit (Sancheti and Kapoor, 2007). Subsequently, semi structured interviews with household representatives from villages surrounding the study area were employed. Respondents included 3 *Ilgwanak* (Head of Maasai traditional norms of different age group) and 5 key informants per village (i.e. village executive officer, village chairman, village environment committee officer, village game scout officer and teacher). The information regarding merits and demerits of wild dogs, conservation threats of wild dogs, activities/sources of threats and mitigation of threats on wild dog conservation were focused (Appendix 3). The survey had four main sections: (i) Respondents characteristics, (ii) African wild dog general information, (iii) Main threats facing wild dog populations and (iv) Attitudes of local communities towards conservation of wild dogs.

3.2.2.2 Threats

Internal and external examinations of wild dog carcasses encountered during the survey were conducted and recorded. Some fresh carcasses were found near water source suggesting mortality occurred few days ago before they were discovered. These carcasses looked very dehydrated, brownish and swelling under the tails in most cases with open recta (evidence of severe bloody diarrhea). Eleven out 23 fresh carcasses collected were examined for the cause of death.

The lungs appeared reddish-brown to black with extensive hemorrhages with consolidation in parts of the lobes with or without emphysema. The diaphragmatic muscles were congested with reddish to brown discoloration. The livers were slightly enlarged with thick margins and dark in color with portions of cooked like appearance. The spleen were enlarged with thick margins, and evenly distributed dark and brown patches on both sides. In some cases, kidneys were only congested; however, in others they appeared enlarged with evidence of hemorrhages on cut surfaces. The stomach was empty in most of the carcasses while only few had scanty brownish watery contents. The thoracic cavity was filled with reddish to brown coloured fluid (sanguineous fluid or fibrin) and there was congestion in the inner surfaces of the chest cavity (pleura).

Visceral organs including lungs, heart, intestines, liver, spleen, kidneys, lymph nodes, salivary glands and brain were collected and examined. These samples were used for screening of Canine Distemper Virus. Tissue samples in duplicates were preserved in glycerol saline, 10% buffered formalin, ethanol, methanol and RNA later, and thereafter the samples were frozen. Only tissues preserved in glycerol saline were used for bacterial culture. In addition, 10% buffered formalin, ethanol and methanol were used to fix tissues for histopathological examination whereas tissues in RNA were used for virus isolation and sequencing.

3.4 Data Analysis

3.4.1 Population size, structure and distribution

The data from the systematic night field surveys of carnivores including wild dog were prepared and summarized in Microsoft Office Excel 2003. The summaries were average pack size, minimum and maximum pack size and age ratios. Similarly, the population size of carnivores other than the wild dogs was estimated in the excel sheet following Davis and Winstead (1980):

$P = AZ/2YX$, where;

P = population size

A = Total study area

Y = Mean perpendicular sighting distance

X = total length of all transects and

Z = Total number of animals counted

The density (D) of wild dog was computed by dividing the population size (N) by the size of the survey area (A) (Wilson *et al.*, 1996). The density of other carnivores were computed using the strip width transect for density estimate using line transect (Buckland *et al.*, 2001). On the other hand, data from random searches were collated in ArcGIS 9.2 (ESRI, 2006) to map spatial distribution of the packs and habitat types for the wild dogs.

3.4.2 Attitudes and threats of local people towards wild dogs

The data generated through semi-structured interviews were translated from *Kiswahili* into English and categorized into themes and sub-themes, each of which was assigned an identification code for easy analysis. Descriptive analyses were employed in the Statistical Package for Social Sciences for Windows (SPSS 16). Relative importance of each threat was obtained by scoring and ranking technique (Kajembe and Kessy, 2000). Other results were summarised in tables and graphs.

Later on tissue samples were submitted to the Government Chief Chemist (GCC) in Dar es Salaam for toxicological analysis. Samples which were fixed in 10% buffered formalin were submitted for histopathological examination. The tissues were first processed routinely, embedded in paraffin, sectioned at 4µm and stained with haematoxylin-eosin (H and E). Few samples preserved in RNA later were used for the molecular analyses.

The messenger Ribonucleic Acid (mRNA) was isolated from two wild dog samples and Reverse transcriptase polymerase chain reaction (RT-PCR) was performed. *Morbillivirus* specific primers that amplify a region of the Pgene (P1: 5’-ATGTTTATGATCACAGCGGT-3’ and P2: 5’-ATTGGGTTGCACCACTTGTC-3’) (Barret *et al.,* 1993) as well as primers homologous to sequences of the Fgene (FC1: 5’-GGACTGATAATGTCCATTA-3’ and FC2: 5’-

ATAGCTTTGTTAGACTGTT-3’) were used (Liermann *et al.*, 1998). The phylogenetic sequence on a 388bp fragment of a P gene was analyzed and the joining trees were generated using Tamura Nei parameter with 1000 bootstrap pseudo-replications (Kumar and Tamura, 2004).

CHAPTER FOUR

4.0 RESULTS

4.1 Population size and structures of wild dogs

Over 75% (n = 160) of respondents from household interviews admitted to have had seen wild dogs. Whereas, 24% (n = 50) respondents had not reported seen wild dogs. The "yes" or "no" answer depended on how long a respondent had lived in the area by the time of survey, meaning that respondents who had shifted to the area in recent years had less chance of having sighted the animal compared to those who had lived in area for over five years.

Respondents reported to have had sighted African wild dogs in groups of varying sizes (Table 2, Fig. 3). However, villagers in Piyaya and Malambo villages had an opportunity to see 4 of the 5 pack size categories whereas those in Soitsambu and Samunge saw the least number of pack size categories (Fig. 3). Overall, larger pack sizes, i.e. 21 – 30, 31 - 40 and those with individuals >40 were rarely seen compared to those with individuals between 1 - 10 and 11 - 20 with most pack sighted with 3 individuals (Table 2). Apparently, majority of respondents were unable to recognizes sex of a wild dog as only 55 respondents (26%) of all respondents were able to recognize only 2 adult males with other 8 respondents (4%) recognizing only 3 sub adult female.

Table 2: African wild dog pack sizes reported by respondents in six studied villages LGCA 2009

Pack sizes	1 - 10	11 - 20	21 - 30	31 - 40	>40	**Total**
Respondents (N)	122	25	5	5	3	160
Percentage (%)	76%	16%	3%	3%	2%	100%

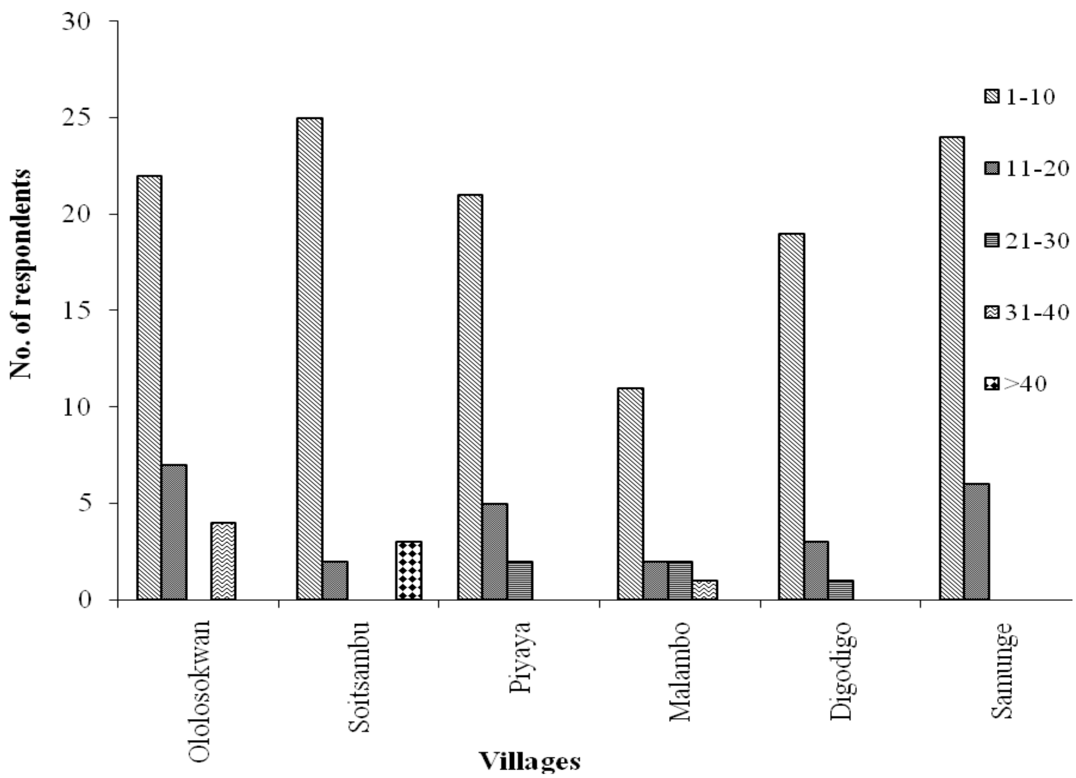


Figure 3: African wild dog pack sizes reported in six study villages in the LGCA 2009

During the diurnal random searches for African wild dogs, a total of 8 packs were recorded in the area and given names depending on the pack's place of residence. The Tinaga pack was found to consist of 19 adult dogs whereas the Losoito pack in the central part of Loliondo had 15 sub adult dogs. Also, 6 den sites were found with the number of pups ranged between 2 to 4 (Table 3) making a total of 132 individuals. The size of known packs ranged from 4 to 25 individuals with an average pack size of 16.50 ± SD 7.50 (CI, 0.50) animals. The pack sizes of known and unknown packs pooled together varied from 1 – 30 with average packs sizes of 9 ± SD 5.70 (CI, 0.20).

Table 3: The sizes and age structures of known packs of wild dogs in the study area as identified during diurnal random searches in Loliondo Game Controlled Area 2009

	Age structures			**Pack size**
Pack name	Adult	Sub adult	Pups	Total
Losoito	8	15	2	25
Malambo	10	4	4	18
Masosu	8	0	4	12
Ololosokwan	7	7	4	18
Parimangati	17	6	0	23
Samunge	3	1	0	4
Tinaga	19	0	4	23
Yasimdito	6	0	3	9
Average	**9.75**	**4.13**	**2.63**	**16.50**
Total	**78**	**33**	**21**	**132**

4.2 Spatial distribution of African wild dog, population estimates and densities of other carnivores sighted during random searches

Wild dogs were sighted within and outside LGCA (Fig. 4) and their pack sizes were recorded in various habitats/vegetation types varied (Fig. 5). Sightings outside

LGCA consisted of one sighting in the Maasai Mara, Kenya and five sightings in Ngorongoro Conservation Area (NCA).

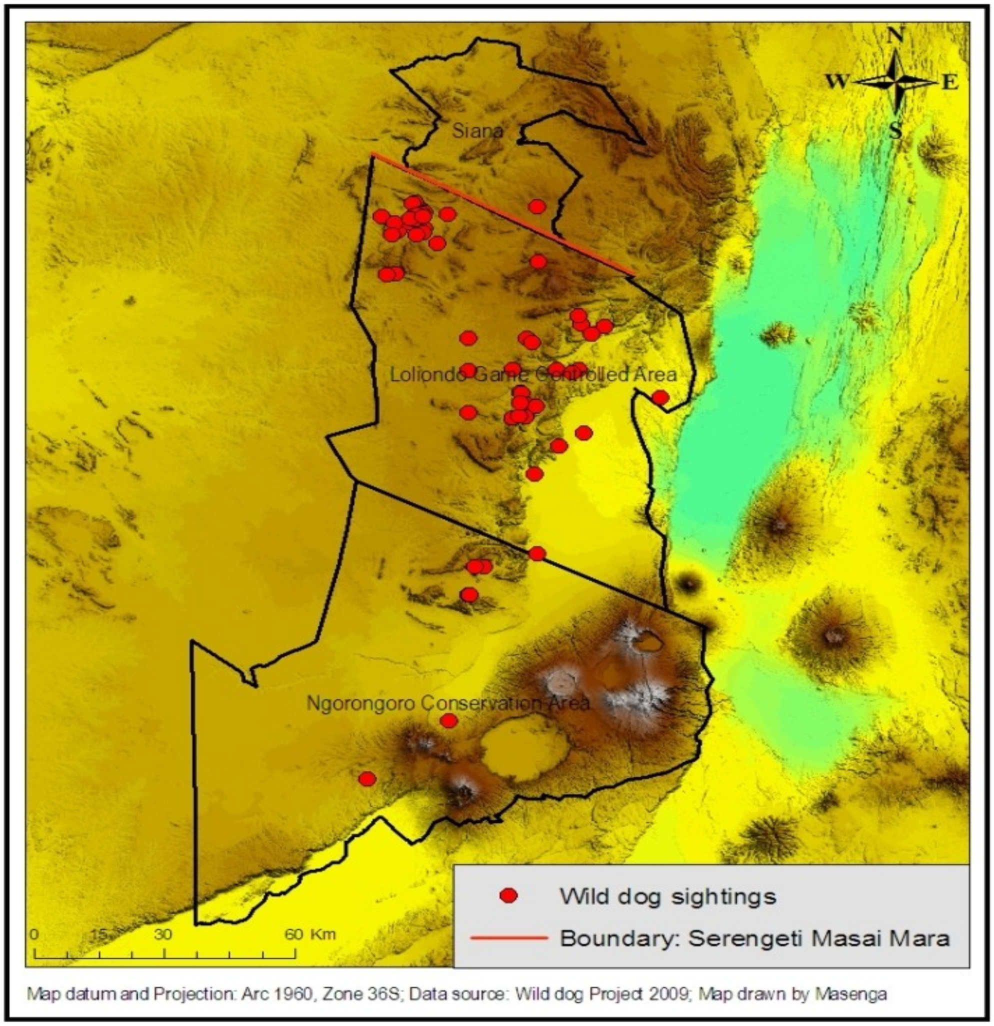


Figure 4: Spatial distribution of wild dogs in LGCA and the adjacent environs based on sightings during the diurnal random searches (Map background SRTM)

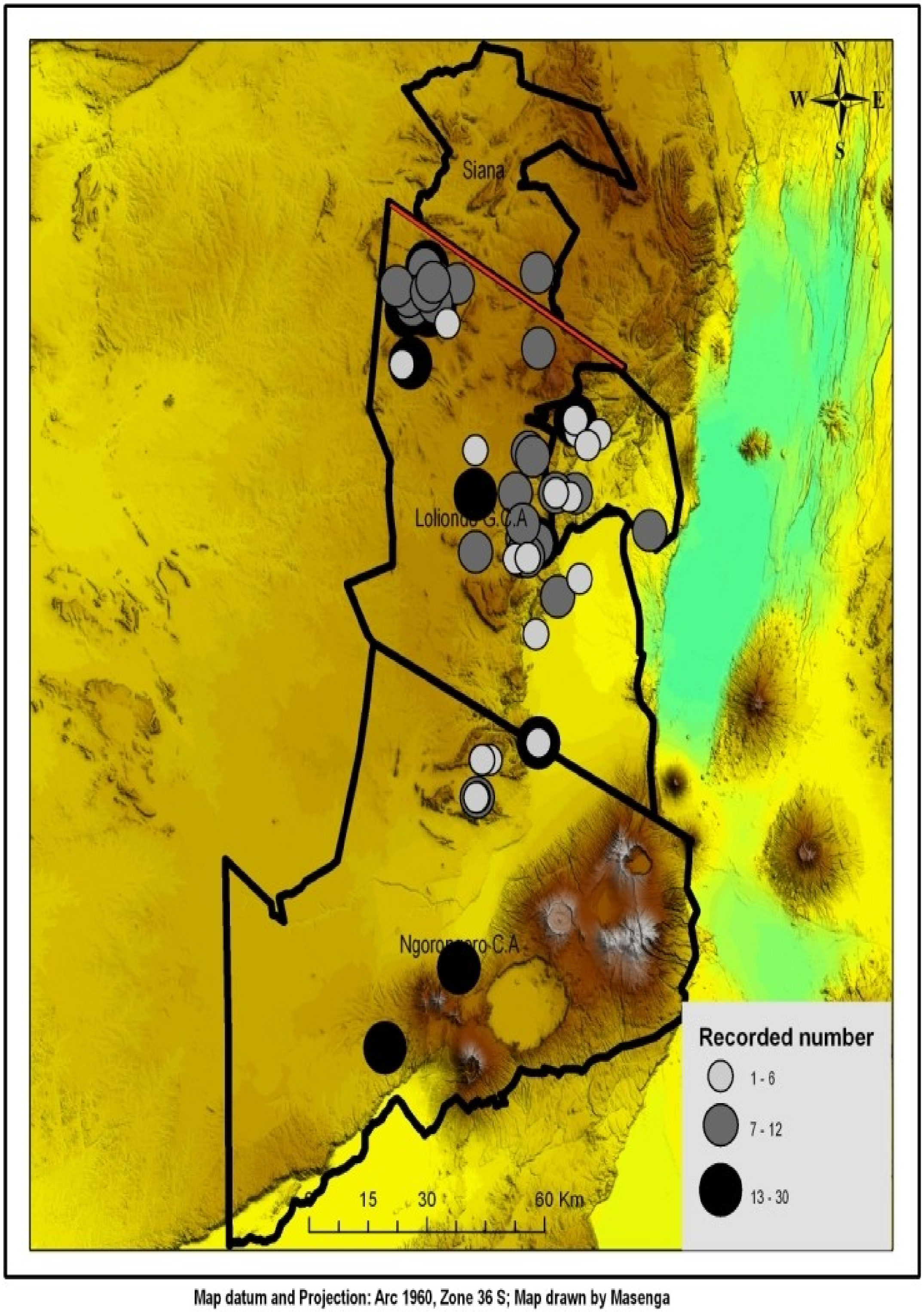


Figure 5: **Different pack sizes as sighted in various localities within and outside LGCA during the diurnal random searches in 2009 (Map background SRTM)**

During the wild dog diurnal random searches, five categories of habitat were recorded (Fig. 6). The sightings were overlaid on the vegetation types to show the wild dogs sighted in different habitat types such as shrubland (n = 2), woodland (n = 46), grassland (n = 17), bushland (n = 12) and anthropic landscape (n = 5) (Fig. 7).

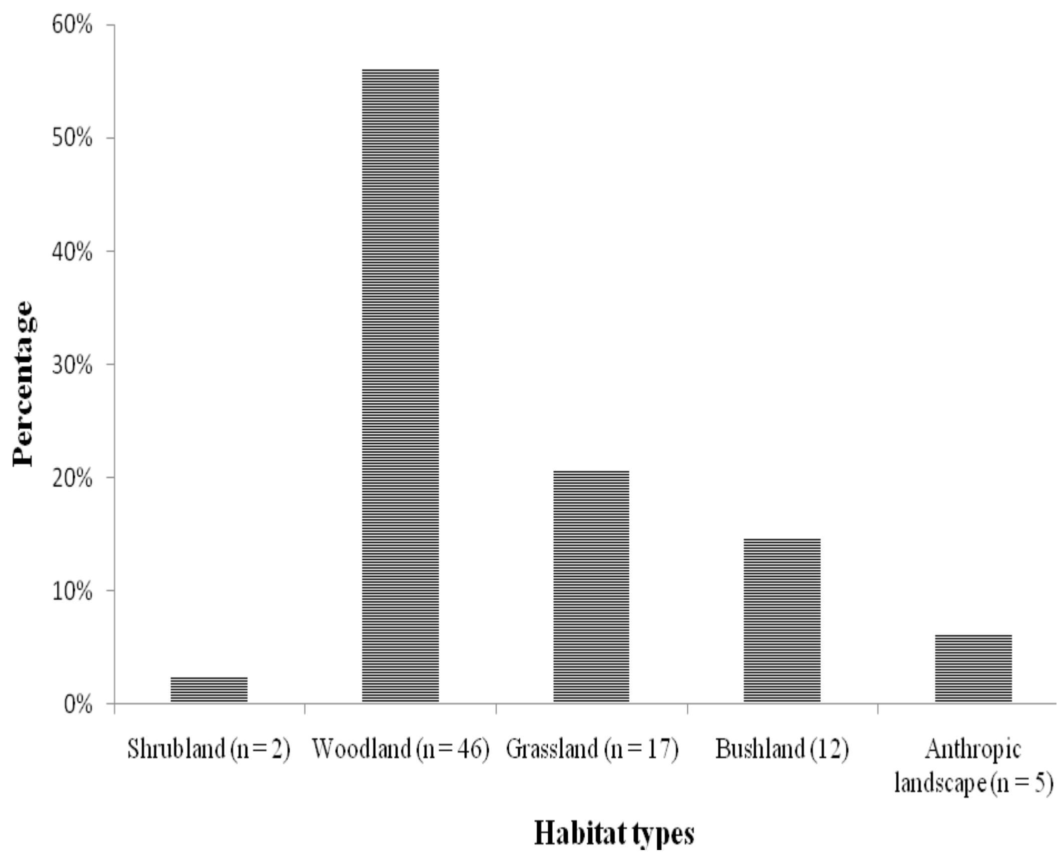
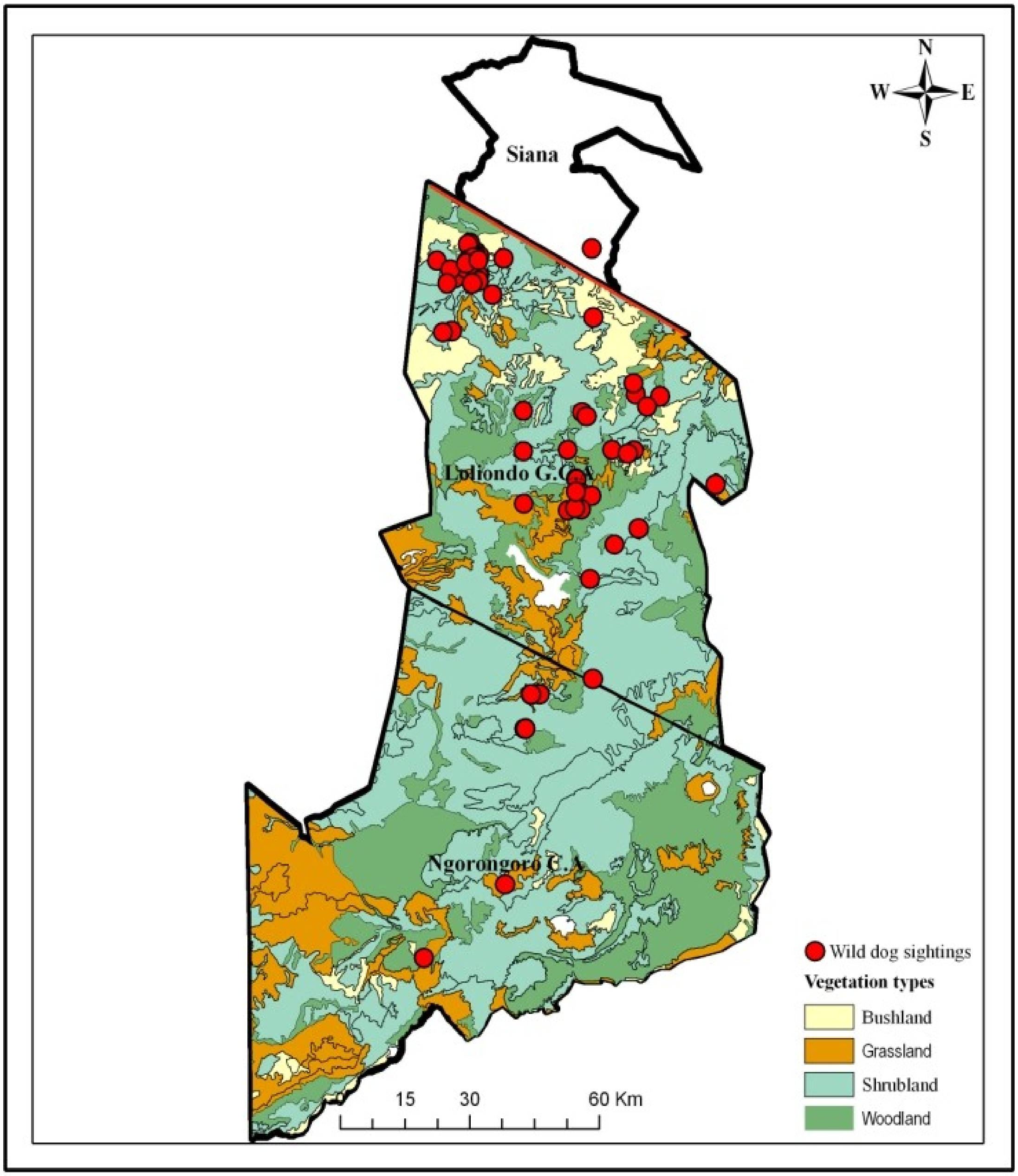


Figure 6: Relative occurrences of the African wild dogs in various habitats in LGCA 2009



Map datum and Projection: Arc 1960, Zone 36 S; Source: Serengeti Wild Dog Project: Map drawn by Masenga

Figure 7: **Wild dogs sighting in various vegetation types in LGCA and its adjacent areas (Map background SRTM)**

During the systematic night transect survey neither lion nor wild dogs were recorded. Other small and large carnivores were counted and their population estimates are presented in Table 4. The densities of all carnivores recorded were calculated (Table

5) without carnivores with observation less than 5. However the density for wild dogs itself was 0.19 animals/km^2 for the whole surveyed area.

Table 4: Small and large carnivores other than wild dog and lion that were counted in LGCA during the night surveys and the corresponding estimate of each species

Month	Species	Counts	Estimates
January 2009	Black backed jackal	1	4800
	White Tailed Mongoose	7	5600
	Domestic cat	1	4800
February 2009	Black backed jackal	4	6400
	Golden Jackal	3	4000
	Spotted hyaena	2	9600
	Bat Eared Fox	2	1600
March 2009	Golden Jackal	3	27600
	Spotted hyaena	2	9600
	White Tailed Mongoose	7	13070
	Bat Eared Fox	27	35100
	Black backed jackal	1	1600
April 2009	Bat Eared Fox	10	18000
	Serval cat	2	800
May 2009	Bat Eared Fox	7	44800
	Aardvark	1	3200
	Striped hyaena	1	3200
	Wild cat	1	800
August 2009	Golden Jackal	3	20800
	Bat Eared Fox	6	28800
	African civet	1	4800
September 2009	Golden Jackal	3	21600
	Bat Eared Fox	2	11200
October 2009	Wild cat	1	6400
	Golden Jackal	1	6400
	Bat Eared Fox	3	19200
November 2009	White Tailed Mongoose	2	12800
	Domestic dog	1	1600
	Wild cat	1	4800
	Golden Jackal	1	3200
	Bat Eared Fox	1	3400

Table 5: Summary of frequency of carnivore sightings and densities from January – November 2009

Species	Counts	Density (animals/km^2)
Bat eared fox	58	0.07
Black backed jackal	6	0.01
Golden jackal	14	0.02
White tailed mongoose	16	0.02

4.3 Attitudes of local people towards wild dogs and wild dog conservation

Respondents had varied opinions regarding presence of wild dogs within their area. Over one third (40%) showed a negative attitude towards the wild dog for reasons such as fear for livestock depredation and human attack. The positive attitude towards the animal (55.3%) such as I am very happy about wild dogs and the animal is good for tourist attraction but difficult to see (Table 6). Such positive statements were based on the understanding that the animal was rare and therefore important for income generation and employment in tourism industry.

Table 6: Local communities' attitude towards wild dogs occurring on their land in the LGCA 2009

Respondents feeling	Number of respondents	Percentage
Dangerous to livestock	77	36.70

Very happy	68	32.40
A good for tourist attraction	39	18.60
Good but they are difficult to see	9	4.30
Fear them	7	3.30
Feel normal (Not afraid of the dogs)	10	4.80
Total	**210**	**100.00**

Nevertheless, majority of community members (52.9%) were disappointed by the fact that no conservation initiatives were in place to conserve this rare and endangered animal. In contrast, less than 10% (6.2%+4.8%) of respondents reported presence of a minimum level in place of initiatives for the conservation of this rare animal as implied by statements such as “advocate wild dog watching and formulation of by laws” (Table 7).

Table 7: Local communities initiatives towards wild dog conservation in the LGCA 2009

Initiatives	Number of respondents	Percentage
Rising conservation education	76	36.10
Encourage villagers to do wild dog watching	13	6.20
Village should formulate by laws to safeguard the animal	10	4.80
No effort made to conserve wild dogs	111	52.90
Total	**210**	**100.00**

4.4 Threats to wild dog conservation

4.4.1 Ultimate and proximate threats

During the interview, a total of 210 respondents responded to the question regarding threats to survival of the African wild dog. The responses were rendered into 9 groups of threats. But, majority of respondents appeared to have no idea about the probable cause for wild dog decline (Table 8).

Table 8: Summary of responses to the question regarding threats to wild dogs in LGCA 2009

Type of threat	Number of respondents	Percentage
Don't know	74	35.20
Moved away from the area	35	16.70
Climate change	33	15.70
Livestock and human population increase	22	10.50
Persecution	17	8.10
Decline of preferred prey	16	7.60
Diseases e.g. Rabies	9	4.30
Less pups borne	4	1.90
Total	**210**	**100**

4.4.2 Poisoning

The results from the local laboratory (GCC) detected presence of organ phosphorus pesticides in liver, kidneys and spleen in 4 of 23 wild dog carcasses that were suspected for poisoning. However, lungs, intestines and stomach had no trace of organophosphorus pesticides.

4.4.3 Diseases

The histopathological examination of liver, spleen, lung, heart, kidney and brain revealed moderate to severe multi-lobular suppurative to necrotizing bronchopneumonia. In addition, there was extensive intra-alveolar and interstitial infiltration with mononuclear inflammatory cells. Epithelial lining cells of bronchi and bronchioli contained clearly visible eosinophilic intracytoplasmic inclusion bodies. There was also multi-focal moderate to severe interstitial pneumonia in some animals with formation of multiple syncytial cells. Occasionally, marked interstitial edema with some intra-alveolar hemorrhages and fibrin deposits were observed.

Some neutrophilic granulocytes were observed indicating secondary bacterial infection. These findings are consistent with canine distemper virus (CDV) infection.

The RT-PCR amplification and Sequencing together with phylogenetic analysis of amplified P-gene fragment of size 388bp obtained from the liver, spleen, lung, heart, kidney and brain demonstrated a CDV strain closely related to CDV strains previously described for lions, spotted hyenas and bat-eared foxes in Serengeti National Park, and those described for domestic dogs outside the park and wild dogs held in captive breeding programme in Mkomazi Game Reserve. Some neutrophilic granulocytes were also observed indicating secondary bacterial infection.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Population size and structures of wild dogs

African wild dog is among large carnivores now endangered second to Ethiopian Wolf (Woodroffe *et al.,* 2005). Therefore, their occurrence in any area draws attention to their conservation. LGCA which has a remnant population is among the remaining core areas in the Serengeti ecosystem. The sightings have been known to the local communities living in the area as resident individuals. The wild dog packs sizes of 1 to 10 individuals were reported in all studied villages whereas packs with >40 individuals were reported in only one village. However, respondents have no idea about the number of packs seen in the area due to inability to recognize individuals of various packs. Pack sizes were defined as the number of adults of ≥1 year of age (McNutt and Silk, 2008). Results of this study therefore correspond to previous report in the same ecosystem (Burrows, 1995) that wild dogs are still seen in small pack sizes.

Formerly, the SNP supported several wild dog packs though the densities had never been high (Creel and Creel 2002; Woodroffe *et al.,* 2004; IUCN/SSC, 2008). This study reports 8 packs, comprised of 132 individuals. This population size is lower compared to previous estimates for known packs in Tanzania, except for the wild dog pack in the Maasai Steppe, which was reported to have only 8 packs (n = 70 individuals) (TAWIRI, 2009). According to Creel and Creel (2002) and IUCN/SSC (2008), Katavi had 17 packs making 200 individuals; Kigosi-Moyowosi 33 packs making 400 individuals; Rungwa-Ruaha 35 packs making 500 individuals and

Selous 50 packs constituting 880 individuals. The present study on both known and unknown packs in LGCA range from 1 to 30 with average pack size of 9.10 ± SD 5.70 (n = 82) which does not concur with the other findings. In Luangwa protected area complex (48 180 km^2) in Zambia probably holds the second largest wild dog population in Africa with mean pack size of 8.80 ± SD 5.10 (n=24) with a pack size ranging from 1 to 27 (Somers *et al.*, 2008). Similarly, wild dog packs sizes in Northern Botswana varied from 2 to 30 adults, with an average pack size of 10.40 ± SD 5.40 (n = 84) (McNutt and Silk, 2008). The lower mean pack size in this study contributed by communities disturbing the dogs so the dogs dispersed widely.

The current recorded population size of wild dog is larger compared to what has been reported previously by Masenga and Mentzel (2005). The observed increase is linked to relatively lower carnivore populations as reported in this study. However, during the study period there were no wild dog recolanization inside the Serengeti Park. This is probably due to increased hyena and lion numbers in the Serengeti National Park causing high interspecific competition (Woodrofe *et al.*, 2004).

5.2 Spatial distribution of African wild dog, population estimates and density of carnivores other than African wild dog

Wild dogs in LGCA were found concentrated to the northern part. But they were sparsely distributed in the central part and scattered in the southern part. The order and magnitude of sightings of wild dog packs in different vegetation types of LGCA with most sightings in the woodlands (Fig. 6) are comparable to findings in Selous Game Reserve whereby wild dogs were also found to prefer woodland and bushland due to good cover (Creel and Creel, 2004). However, sightings of the same wild dog packs in LGCA and NCAA, Tanzania and Maasai Mara, Kenya suggest that wild dogs in Loliondo can also use other areas of the Serengeti Ecosystem.

Habitat variation in LGCA (i.e. woodland, shrubland, bushland, and anthropic landscapes) in combination with hills and rock outcrops possibly contribute to the tendency of wild dogs to concentrate more in the area. In other studies showed that, in Ethiopian Montane forest and East African mangrove in Ijara – Lamu in Kenya are one of ecological habitat uniqueness of wild dogs confirmed to occur (Dutson and Sillero-Zubiri, 2005; IUCN/SSC, 2008). Other factor could be the influence of wildebeest migration that occurs between December and May every year on the Southern part of Serengeti ecosystem (Holdo *et al.*, 2010). The migrating animals could be a good source of food supply to the wild dogs in the area. Contrary, studies in Hwange National Park, north-western Zimbabwe reported wild dogs to occur most in deciduous tree savanna, which constituted about 45% of the entire range (Rasmussen *et al.*, 2008).

The results from the systematic night transect survey revealed few counts for all carnivores with a special case of no wild dogs and lion sightings. The probable cause for not sighting wild dogs could be the activity pattern of the species, being more active during the day than night. However, absence of lions during the counts may be associated with Maasai culture to kill lions as part of *"Moran"* prestige or moved to other area. In Simanjiro lion has been killed by human and lion it moved away from adjacent boundary to Tarangire national park (Kissui, 2008).

The low numbers for other carnivores despite being lower than that of wild dogs could be due to high densities of livestock and human increased demand for cultivation (Ojalamini, 2006) as well as drought during the survey period. In this study the presence of low numbers of both large and small carnivores during the night surveys suggested that competition during wild dogs hunting would be low thus reduced inter-specific competition. Results of the study in Laikipia – Kenya showed that low densities of small carnivores allow for increase in wild dog population as they avoid inter-specific competition with lions (Woodroofe *et al.*, 2005) by avoiding lion and hyenas home ranges. These finding are in line with the present study. Nevertheless, other findings reported that wild dog can coexist with people only under right circumstances such as high density of prey ungulates (Treves *et al.*, 2004), low densities of domestic dogs and human (Woodroofe *et al.*, 2004; Creel and Creel, 2004).

The overall wild dog density (known and unknown packs) in this study area was 0.19 animals/sq km. By comparison, the density of adult wild dogs was 0.0195 adults/sq km which is relatively lower than what has been recorded in Selous Game Reserve, 0.04 animals/sq km (Creel and Creel, 2002) and 1.6 adults/sq km in Hluhluwe-iMfolozi Park (Somers *et al.*, 2008). However, the adult population density on the Serengeti plains over 13 years averaged 0.01 animals/sq km (Burrows, 1995) which is lower than what has been recorded in this study.

5.3 Attitudes of local people towards wild dogs and wild dog conservations

The results from respondents revealed that majority had negative attitude on wild dog presence on their land. This was due to wild dog attacks on their livestock. However, livestock depredations by wild dog were said to peak during dry season. During this time of the year when migratory herbivore species particularly wildebeests are away, livestock concentrated in habitat patches with few grasses remaining. Consequently, livestock serve as cheap and easily available prey. Presence of wildebeest migration in the area during wet season implies high abundance of prey thus wild dogs switch their feeding preference from livestock to wildebeest and other wild preys, which reduces the wild dog-human conflict. However, the retaliatory actions by local communities versus wild dogs persist following the negative attitude already developed (Marker *et al.,* 2003). The negative attitude by livestock keepers and ranchers towards wild dogs is due to economic loss they cause (Woodroffe *et al.,* 2005; Lindsey *et al.,* 2005).

The local communities realize that wild dogs are rare and important for the tourism industry. The family members who were engaged directly in taking tourist to watch wild dogs gained incentives for wild dog viewing from tourists. In addition, tour operators offer employment to members of local communities with experience of areas where wild dogs use mostly. The benefit sharing through wild dog as an asset between local communities and tourists/tour operators, have been observed in the Ololosokwan, Soitsambu and Piyaya villages. Based on this kind of values, local communities who are beneficiaries may develop a positive attitude on wild dogs and wild dog conservation. Therefore, understanding local community attitudes towards carnivores including wild dog may contribute to better management and identification of carnivores ecology, behaviour and conservation status through integrating local communities in management (Dickman, 2005).

Increased education and outreach activities regarding wild dog conservation would also be beneficial to conservation. The observed positive contact between local communities and tour operators was indicative of improved attitudes towards the wild dog, demonstrating that such contact can have clear benefits. Although some conservation education programmes have been established for schoolchildren to visit the Serengeti National Parks, this has little relevance to nomadic pastoralist. Still, it would be valuable to develop similar schemes with pastoralists, and to use these programmes to highlight the presence of wild dog in their area, with the aim of improving attitudes not only towards the wild dog, but also towards other wildlife species.

Although wild dog is an endangered species, this study showed that majority of respondents felt that there were not yet any conservation initiatives in place to serve the species. This was due to lack of the Government conservation guidelines for the species in Tanzania. The community opinion on the inspire community to kill the dogs, awareness rising and provision of community conservation education are of importance to serve the specie. The action plan for wild dog conservation has identified priority areas for the species conservation but rather has not emphasized on formulation of by-laws to safeguard the species conservation (TAWIRI, 2009). In Kruger National Park, tourist volume is high and almost 75% of guests are willing to pay to see wild dogs. These revenues are potentially sufficient for conservation initiative in the country (Lindsey *et al.,* 2005). However, in LGCA wild dog watching campaign and formulation of by laws were not in place as suggested by respondents. Therefore, in order to ensure sustainable conservation initiatives for the species in LGCA, raising conservation awareness need to be emphasized.

5.4 Threats to African wild dog populations

It is however, important to understand immediate and ultimate threats to wild dogs. Results suggest that immediate wild dog threats were not known to a greater proportion of local community, therefore aspect such as dog emigration and weather change were viewed by respondents as the ultimate threats. Their notions about the threats were based on their knowledge on the ecology of the species, which include their wide ranging behaviour. It is documented that wild dogs require large home ranges to support viable populations (Creel and Creel, 2002; Woodroffe *et al.*, 2004).

The respondents mentioned human and livestock population increase, persecution, decline of preferred prey, diseases and fewer pups borne as threats to wild dogs. However, habitat fragmentation has caused decline of wild dog home range to extend beyond reserve borders, leading to increased mortality risk due to persecution by humans, and poaching activity such as snares which can cause considerable death to dogs (IUCN/SSC, 2008). Woodroffe *et al.* (2005) also pointed out that indiscriminate killing of wild dogs by game rangers may led to its population decline. With high proportion of dogs killed by people, human induced mortality has been identified as threat to wild dog as it appears to increase due to decline in monitoring intensity (Woodroffe *et al.*, 2004).

One pack in the study area continues to decline as a result of ongoing conflict with humans. The conflict between wild dogs and human has led to intentional poisoning of the dogs due to wild dog attacks on their livestock. This has resulted to death of 65% of Parimangati pack due to poisoning in Ololosokwan village. The poison used contained organophosphate compounds which are found in cattle dip for killing ticks on livestock. The magnitude of mortality identified in this study was similar to that reported by Woodroffe *et al.* (2004) for other wild dog populations elsewhere in Africa, for which poisoning itself contributed about 8% of the population. Poisoning of wild dogs in LGCA is done in secrecy because for the Maasai it is an abomination to kill wild dogs. Therefore, most of poisoning incidences were not reported (IUCN/SSC, 2008).

The wild dog appears to be susceptible to many diseases; particularly canine distemper virus that has been confirmed to kill considerable population of the Parimangati pack. In Mkomazi Game Reserve, Tanzania, Canine Distemper outbreak caused death to a captive bred population, 49 out of 52 individual dogs died between December 2000 – February 2001 (Marco *et al.*, 2002).

The histopathological lesions described in the result section were consistent with the gross pathological examination suggesting that the pathological changes were due to viral and secondary bacterial infection. Detection of genetic material for CDV by RT-PCR can be a result of circulating antigens from previous exposure to CDV (Goller *et al.*, 2010). However, it is unlikely for the non-infectious antigens to cause pathological lesions with intra-cytoplasmic inclusion bodies which are pathognomonic for clinical CDV infection. The secondary bacterial infection probably exacerbated the severity of CDV infection. The detected CDV strain in the recent infection is similar to previously described strain in wild carnivores suggesting that the virus is still circulating in an unknown reservoir within the Serengeti ecosystem.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

From this study it is not easy to draw up conclusion of the small pack sizes recorded during the diurnal random searches and reported by the respondents. However, some more in-depth information (pack recruitment and, birth and death rate within and among pack members) are required to explain the presence of the low population sizes. The information provided show that, the wild dogs in the LGCA are magnificent carnivores among others as they had not been sighted in the Serengeti National Park which has potential for tourist during the study period.

The findings indicate that, the spatial distribution of wild dogs formed an access for wild dog game viewing in the area by tourists. Although, the nature of the wild dogs to prefer more woodland habitat type may obscure the visibility of the animal when searched by the people. Also the nature of protected area (game reserves) allowing the co-existence of mankind and wildlife in the natural settings poses a challenge wild dogs sighting. Thus most of these sighting were not close to human settlement (i.e. in areas close to human settlement such Sonjo area less sighting reported compared to Maasai area with a vast land unoccupied by human). In addition, the night transect surveys showed the presence of more sightings of small carnivores compared to large carnivores, suggesting that large carnivores were persecuted and as the result they avoid human areas.

In terms of attitudes of communities towards wild dog conservation much need to be done to improve coexistence between human and wild dogs. Mostly likely the tendency of local communities dislike the presence of this endangered species on their land is not promising for the species future survival. Since, there is no effort in place to conserve the species by the communities there is no hope for the sustainable utilization of the species in order to improve the community livelihood.

Most of the threats faced wild dogs in this study are hazardous to the future survival of the species. The combination of poisoning and diseases are the great challenges to conserve the species in the area. This is contributed by the nature of the species behaviour as they range widely and make it easily to continue contact with human activities which may lead into conflict with the wild dogs as the result persecution may increase. In terms of diseases, wild dogs range widely and they are exposed more to diseases transmission such as CDV and rabies when affect the pack.

6.2 Recommendations

From the results and discussions of this study the following recommendations are given:

- In order to conserve and monitor wild dogs in the area, further efforts should be directed towards development of database of individually recognized members of each pack. This will allow for correct records of the species in the area. When individual identification of members of all packs is complete, comprehensive monitoring of each pack should follow in order to determine birth and death rates, recruitment rate and ranging patterns of each pack.

- There is a need to gather more information on the wild dogs, particularly wild dog activity pattern and contact with livestock. The daily longitudinal study using game wardens, enumerators and systematic transect surveys, coupled with a network of information flow on every wild dog sighted is needed. This can be archived by fitting both VHF and GPS collars to alpha individuals in each pack in order to assess movement pattern and other information that can be obtained using the tools.

- Increase wild dog conservation awareness to local communities through special programs that among other things focus on importance of wild dogs in the ecosystem. This may help to change community attitudes on wild dogs.

- The wild dog ecotourism in LGCA can be improved through establishment of cooperation among local community and tour operators. Also training of the Village Game Scouts is important for the villages of more wild dog sightings and high tourist potential such as Ololosokwan, Arash, Soitsambu and Piyaya. The trained manpower can help to ensures benefit sharing through equitable distribution of income accrued from tourists and sharing of the knowledge on the wild dog sightings.

- There is a great need to embark on threats management interventions, as well as ways to control/ monitor diseases and windows for disease transmission. This should be coupled with active participation of wildlife Orgainzations/Institutions in wildlife diseases surveillance, community conservation initiatives and enable communities report any disease symptoms observed in an area.

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APPENDICES

Appendix 1: Wild dog sighting data sheet

Enumerator name................................. Questionnaire no.......................... Date......

Time	Total	Adult dogs	Sub-adult dogs	Pups	GPS location (UTM)		Habitat type (see categories)
					Northings (Y)	Eastings (X)	

Habitat type categories:

1. **Woodland –** open stand of trees at least 8m tall; Canopy cover >40%
2. **Bushland –** open stand of bushes between 3-7m tall; canopy cover > 40%
3. **Grassland –** mainly grasses and other herbs; woody plants < 10%
4. **Anthropic landscape –** vegetation has been profoundly altered by humans (e.g. villages, farms, plantations, etc.)

Comments (dogs behavior, activity pattern, diseases, abnormality etc)

1…………………………………………………………………………………………
2…………………………………………………………………………………………
3…………………………………………………………………………………………
4…………………………………………………………………………………………
5…………………………………………………………………………………………
6…………………………………………………………………………………………
7…………………………………………………………………………………………
8…………………………………………………………………………………………
9…………………………………………………………………………………………
10…………………………………………………………………………………………

Appendix 2: Night transects survey in Loliondo Game Controlled Area

Transect length 20 kms: Date:………...…..Route:……...........… Start time:………… End Time:…..........GPS Start:………/…….GPS End:…/ Weather:…Clouds:…..Last rained:…Observers names.................................

Animal	**Number**	**Side (RHS/LHS)**	**Distance from car (m)**	**GPS Mark**	**Time of sightings**	**Km driven**

Comments:……………………………….....................……………….

………………………………………………………………………………………

………………………………………………………………………………………

………………

Appendix 3: Semi structured interview for assessing abundance, distribution, threats and attitudes towards conservation of African wild dog *(Lycaon pictus)* in the Loliondo Game Controlled Area, Tanzania

A: Respondent General Information

(i) Date…………(ii) Village ………… (iii) Name of household ………… (iv) Household GPS location …............................... (v)Age …..(vi)Sex………….. (vii) Tribe……………….....… (viii) Adult…………...Children………………(xi)Job status …………………………….……… (x) Education level………………….....……...

B: African wild dog general information

1. Have you ever seen any wild carnivores? Y/N
2. If yes, mention the species you have seen, number and place where you saw them and when?

Species	Y/N	No.	Where	How often	Validation (D/M/Y)
Cheetah					
Leopard					
Hyena					
Wild dog					
Black backed jackal					
Side stripped jackal					
Silver backed jackal					
Genet					
Civet					
Mongoose					
Lion					
Aardwolf					
Serval					

3. (i) From the question above if you have seen wild dog can you describe the animal?
……
(ii) How big was the pack size you saw? Based on age and sex structure?
Adult.........................
Male...................................Female...
Sub adult.........................Male.............................Female..............................Pups...........................
4. Do you know the denning sites of any wild dog packs? Y/N
   Explain the characteristics of that area?
…………………………………………………..……………………………..……

5. (a) Have you ever seen wild dog hunting? Y/N or feeding on a kill? Y/N
(b)How do you know that the wild dogs are the responsible predators?
Seen them………... Heard them ………...….. Spoor…………..…….
Scat…………..……..

C. Main threats facing wild dogs populations

6. (a) How many wild dogs packs sizes were you used to see 5, 10 and 20 years ago?
(i) 5 years (2003 – 2008)
…………………………………………………………………………………………
(ii) 10 years (1993- 2003)
…………………………………..…………………………………………………
(iii) 20 years (1973 – 1993)
…………………………………………………………………………………………
(b) How many do you usually see these days (during the time of data collection)?
………………………...……………………………………………………………
7. Give reason to the above question (Why you think are differences in the number of wild dogs you used to see and what you seeing now)?
……………………………...……………………………………………………
8. (i) What species do wild dogs interact with when they pass in your area?
…………………………………………………………………………………………
(ii) Have you heard/seen the interaction of wild dog with other species?
Heard Y/N, Seen Y/N
(iii) What reaction do they show when they see?
People (Adult or Children)
Livestock……………………………………………………………………………
Domestic dogs………………………………………………………………………
People actively chasing/scaring them away (throwing stones, etc.)
…………………………………………………………………………………………
(iv) What reaction does people show when they see wild dogs?
…………………………………………………………………………………………
(v) What reaction does livestock show when they see wild dogs?
…………………………………………………………………………………………
(vi) What reaction does domestic dog show when they see wild dogs?
…………………………………………………………………………………………
9. (a) In your area, have you seen dead carnivores in the last five years? Y/N
If yes, how many?

Date/Month/Year	Species	Number	Place

(b) If yes, do you know why the wild animals died?

Species	Reasons for death

D: The local community attitudes towards conservation of wild dogs

11. Do you know that some wildlife species are threatened with extinction? Y/N
If yes which ones?
…………………………………………………………………………………………

12. Do you know why these species are threatened?

……………………………………………………………………………………………

13. How do you feel about having wild dogs occurring in your area from time to time?

……………………………………………………………………………………………

14. In your area can you explain benefit acquired from wild dog viewing?

....

....

15. Mention any communities' initiative on conservation of wild dogs in the area?

....

16. What is the relationship between your village and tourist wild dog watching?

....

....

17. Give out your own opinions/suggestions on what you think for future conservation of wild dogs?

……………………………………………………………………………………………

……………………………………………………………………………………………

"Thank you for your cooperation and good answer