Home Range and Movement Patterns of Lions (*Panthera Leo)* in Tarangire National Park, Tanzania

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Abstract

African lion (*Panthera leo*) populations in East Africa are decreasing. The biggest threat being the human-lion conflict caused by habitat loss and fragmentation, which end up making most protected areas too small to sustain the widely roaming large carnivores. In this research we investigated the population of lions in Tarangire National Park mainly focusing on ecological characteristics such as home ranges and movement patterns. We determined home range and movement patterns for six prides using data obtained from the Radio and GPS collars. These ecological data were compared between wet and dry season and between different prides. Home ranges were large ranging from 52 Km^2 to 616 Km^2 with an average of 209 Km^2 (Standard error 90.8990) and extensively overlap. Home ranges were largest in wet season and the smallest in the dry season. Movement was smallest in the dry season and large during the wet season due to migration of prey species particularly Zebra and Wildebeest.

Key words: African lion, Pride and Home range.

{**Citation:** Hudson Laizer, Thadeo M.C., Tarimo, Bernard Kisui. Home range and movement patterns of lions (Panthera Leo) in Tarangire National Park, Tanzania. American Journal of Research Communication, 2014, 2(1): 44-58} www.usa-journals.com, ISSN: 2325-4076.

Introduction

All across Africa, large carnivore populations are declining and are under pressure from increasing human population (Nowell and Jackson, 1996). The major threats to large carnivore include habitat loss, decline in natural prey abundance, commercial exploitation and retaliatory kill (Woodroffe, 2001; Bauer, Nowell and Packer, 2008;Kisui, 2008).

Tanzania is estimated to have a largest lion population in East Africa, of which 80% living in the protected areas including national parks (Mesochina *et al.*, 2010). However, due to habitat fragmentation, most protected areas are too small to support wide-ranging carnivore like lions, such species are forced to utilize adjacent dispersal areas for supplementary food and other needs (Woodroffe and Frank, 2005). This increases the chances of human-carnivore conflicts making it difficult for the two to coexist.

The home range of a carnivore is generally as large as is necessary but as small as possible to satisfy energetic needs (Gittleman and Harvey, 1982; MacDonald, 1983). The upper and lower limits are determined by energy expenditure during territorial defense and food availability respectively (MacDonald, 1983).

Large home ranges overlap extensively with those of adjacent prides, while small home ranges tend to have little or sometimes no overlap. There are various factors that may influence lions home range size. Prey availability and distribution has been shown to significantly affect the home range size of lions and other large carnivores (Macdonald, 1983; van Orsdol *et al.*, 1985; Grigione *et al.*, 2002; Bauer and De Iongh, 2005). Spong (2002) found that the home range size was not correlated to pride size. The lion' sex may also influence the size their territories. Loveridge *et al.* (2009) showed that the home range size of lionesses was influenced mainly by pride size, prey abundance and dispersion, while for male lions it is also determined by prey biomass and female pride density. Intra- and interspecific competition, physical barriers, the season, food resources and water can influence home range size (Spong, 2002; Druce *et al*., 2004).

This study investigate the movement patterns and home ranges of lion population in Tarangire National Park, it also compare home ranges size between wet and dry season, as well as home range overlap.

Materials and Methods

Study area

Tarangire National Park is located between 3º40' and 5º35' South and 35º45' and 37º East at an elevation of 1200 to 1600 m above sea level with a total area of 2,850 km^2 (TANAPA, 2001). Its climatic condition is characterized by high variability and periodic droughts. The annual rainfall pattern generally consists of short rains from October to December followed by a short dry spell in January, with long rains occurring anytime from February to June. Although the rainy season officially runs from November to May, comparatively speaking the total rainfall in the park per year is low, at about 600mm (Lyogello, 1988). The park provides habitat for large diversity of fauna and flora. During the dry season (June to October) the park serves as a refuge and harbours largest concentrations of wildlife.

Field data collection

The study was conducted over a six months period, from March to September 2013. Data collected during this study was supplemented with the long-term data from the Tarangire Lion Project from year 2010 to 2012. Lion locations were obtained on daily basis with the help of radio and GPS collar. All telemetry work was done from the ground using a four-wheel drive vehicle. The location of the collared lion was confirmed using a hand held GPS its coordinates were marked and recorded in a notebook.

Data analysis

Calculation and mapping of the fixes and the home ranges was done with ArcView 3.2 GIS with the extensions spatial analyst and animal movement. Home ranges were calculated using Minimum Convex Polygon (MCP) method (Mohr, 1947; Stander, 1991; Funston *et al*., 2003; Bauer and De Iongh, 2005; Jhala *et al*., 2009); a line joining the outer most points forms a convex polygon that represents the minimum perimeter of the home range. Home ranges for dry and wet season were delineated using 95% kernel home ranges for point distributions, and 75% kernels to delineate core areas. For purposes of this study areas that were defined by the 95% Kernel that fell outside the reserve boundary were clipped as these could not contribute to the home range.

Results

Home range size

Tarangire lion population had an average home range size of 209.27 Km^2 with the Standard error of 90.8990 (n=6) (Table 1). The home ranges were based on sightings of six prides from January 2010 to August 2013. The Silale-minyonyo pride occupied the largest home range of 616.82 km^2 compared to other prides. On the other hand New Silale had the smallest home range of 52.32km^2.

Table 1: Home range size of six prides in the Tarangire NP

Pride	Period	Area (Km^2)
New Tarangire Hill	2010-2013	109.55
Silale Mnyonyo	2010-2013	616.82
Old Silale	2010-2013	80.93
New Silale	2010-2013	52.32
Kuro	2010-2013	74.56
Tarangire Hill	2010-2013	321.46
Total		1255.6
Mean		209.3
SE		90.8990
Range		52-616

Home range overlap

Pride ranges and territories may overlap but each pride maintains a core area where most activities are undertaken with little interaction with other lion groups. The home ranges for some of the Tarangire lions overlapped extensively. The Silale Minyonyo pride, which has the biggest home range, overlapped with those of Kuro, New Silale, Old silale, New Tarangire hill and Tarangire hill prides (Figure 1).

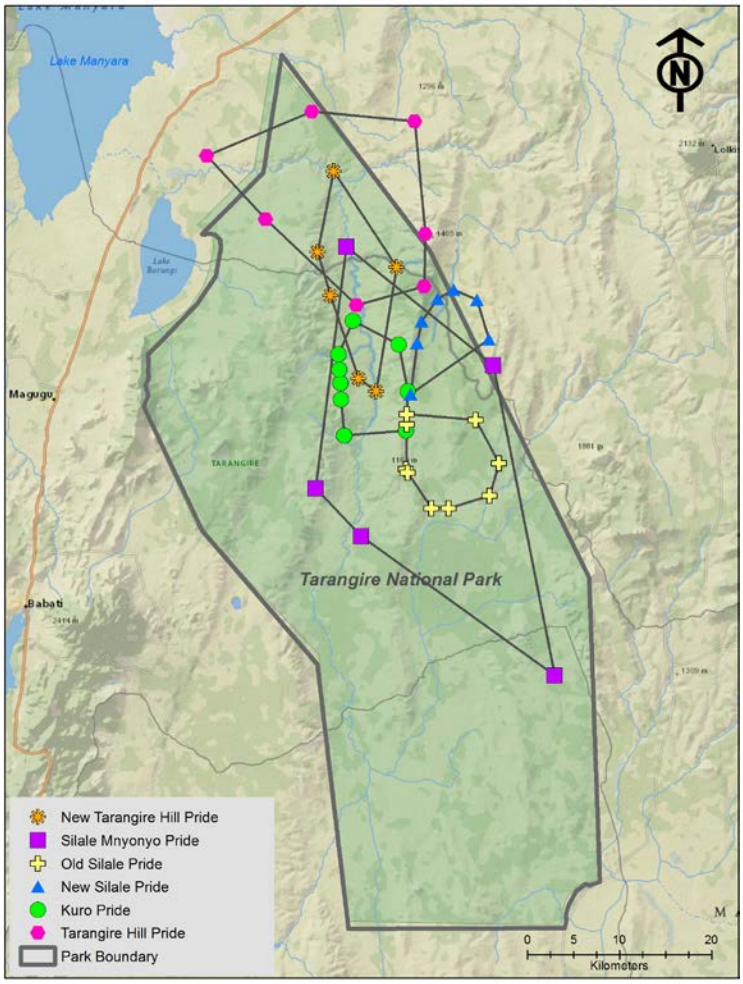

Figure 1:A map of Tarangire NP showing home range size and overlap for six prides year 2010-2013.

Movement patterns in relation to seasonal variation

The home ranges and movement for Tarangire lions are larger during the wet season (November to May), which extends even outside the park boundaries and shrink during the dry season (June to October) in which most of the prides spend their time inside the park boundaries. (Figure 2 and 3).

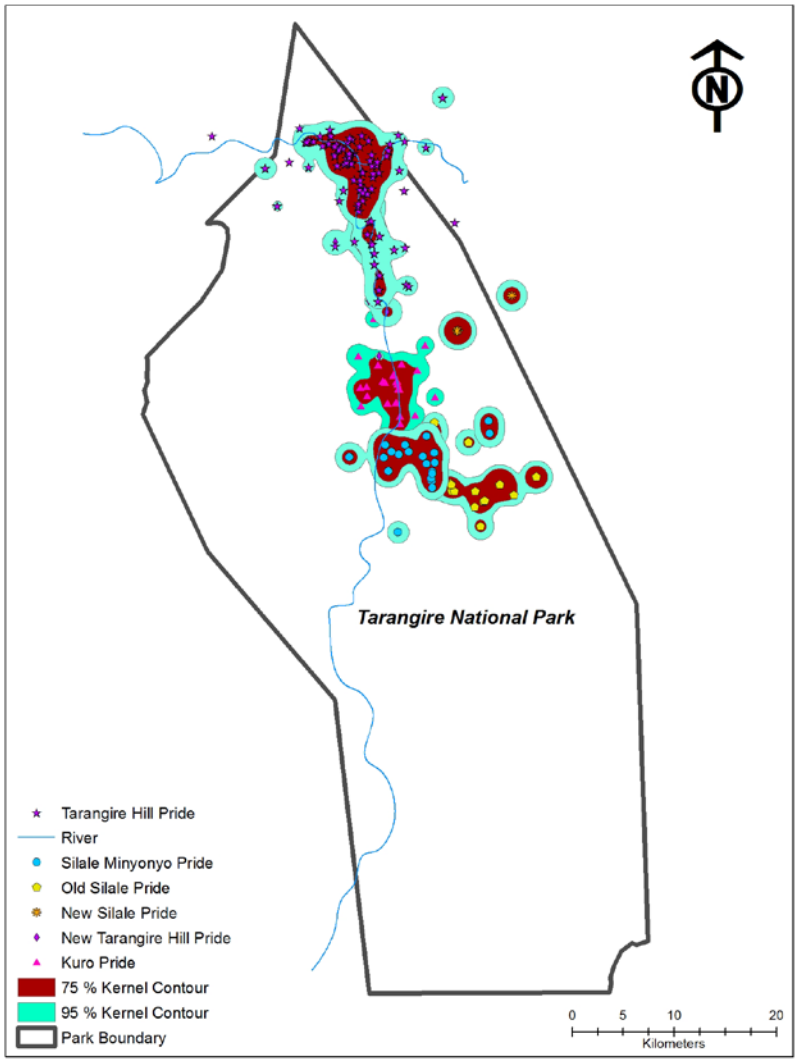

Figure 2:A map of Tarangire NP showing Home ranges and location of some lions during the dry season.

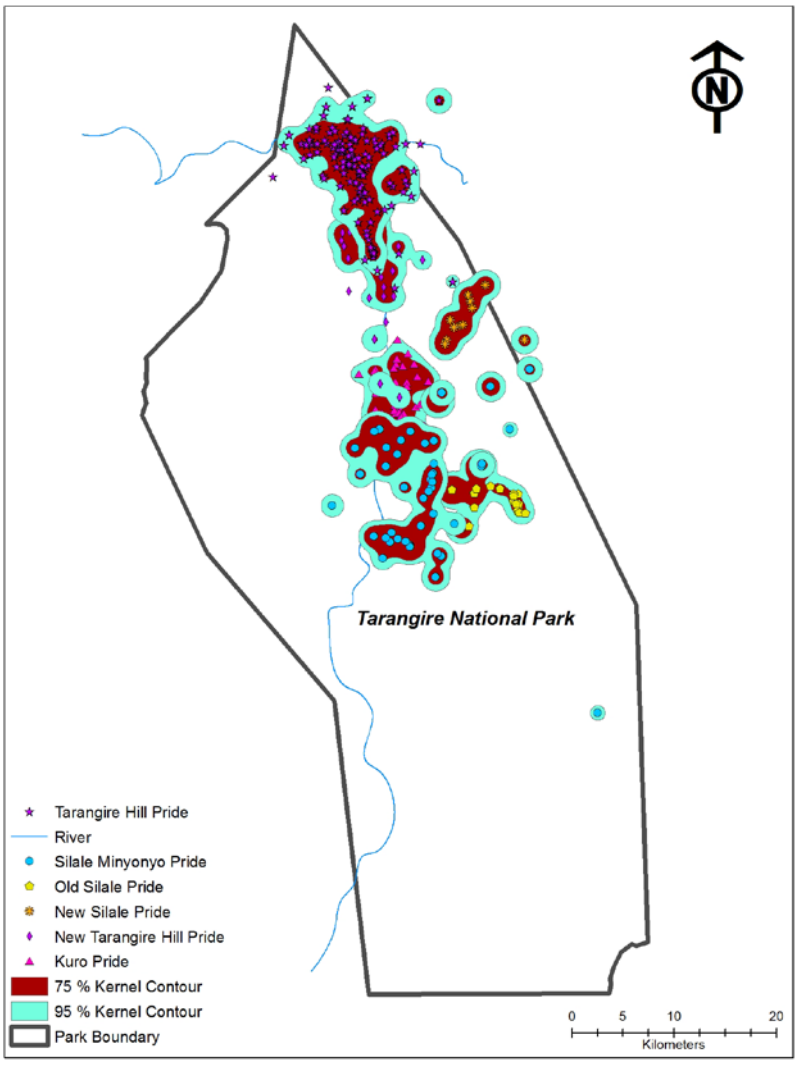

Figure 3: A map of Tarangire showing Home ranges and locations of some lions during Wet season.

Discussion

Home range size

The home range of six prides in Tarangire National Parks ranges from 52 Km^2 to 616 Km^2 (Table 1) with an average of 209 Km^2 (SE = 90.8990). The lions home ranges vary considerably across study areas as in Etosha National Park reported by Stander (1991) the

home ranges for Etosha lions range from 150 Km^2 to 2075 Km^2. Even the studies on the neighboring protected areas showed variability with home ranges varying from 20 Km^2 to 45 Km^2 for Lake Manyara National Park and Ngorongoro Conservation Area (Schaller 1972; Hanby and Bygott 1987). On the other hand the home range for Serengeti lion as reported by Schaller (1972) ranges from 30 Km^2 to 400 $Km^{2.}$ Thus in Tarangire National Parks lions seemed to occupy substantially medium sized home ranges compared to other National Park.

It has been variously suggested that home range size and configuration of large carnivores is influenced by patterns of resource distribution (MacDonald, 1983), and by social effects (Spong, 2002). African lion ranging behavior differ between the sexes as it has been suggested that male ranges are more likely to depend on both food resources and the need to defend and access female prides, while female ranges are configured around access to resources (Schaller, 1972). This difference in home range size is caused by both behavioral and physical characteristics of males and females. Males are much bigger than females which result in higher energetic needs (Schaller, 1972). Due to these factors males have larger home ranges than females (Scholte *et al.*, 2007; Van Rijssel, 2008). In this study different prides seemed to use the resources of their territory and sometimes overlap and use the resources from other prides territory i.e. Home range overlap (Figure 1).

Movement patterns in relation to seasonal variation

Seasonal variation affects the home range size as well as movement of lions in many protected areas. Visser *et al.* (2009) reported that lions of Waza National Park in Cameroon spent much of the dry period outside the park boundaries and their movement increases during this dry period. This observation contrast with what was observed in Tarangire lions during this study, which much of the time during the dry period were spent inside the national park and during the wet season they spent much of their time outside the park boundaries.

Usually the home range changes according to seasons in relation to prey availability and abundance (Schaller, 1972; Macdonald, 1983). On the contrary, in some areas, home ranges do not change significantly with seasons (Druce *et al*., 2004; Loveridge *et al.*, 2009). In Tarangire NP, most swamps and waterholes dry up during the dry season, as noticed elsewhere (Thrash *et al*., 1995; Loveridge *et al.*, 2009) except for Tarangire River and some parts of Silale swamp. Due to this fact, Tarangire serves as a refuge for most wildlife species especially the large herbivores such as Zebra and Wildebeest during the dry season where they are concentrated alongside the Tarangire River. During the rainy season, grass and water are available everywhere. Preys particularly Zebra and Wildebeest are randomly distributed and most of them migrate to adjacent communal lands outside the park boundaries (Figures 4 and 5). Lions are then obliged to disperse, increasing their home range, as found by Bauer and De Iongh (2005). Whether the displacement of the home range led to a significant increase of the home range needs to be confirmed by further studies in Tarangire NP.

Conclusion

The findings from this study shows that Tarangire lions had the home range ranging from 52 Km^2 to 616 Km^2 with the average of 209 Km^2 (Standard error= 90.8990). These home ranges are larger compared to those found in several studies in other parts of Africa with the size ranging from 20 Km^2 to 400 Km^2 (Schaller, 1972; van Orsdol *et al*., 1985; Loveridge *et al*., 2009). Home ranges and movement were large during the wet seasons whereby lions spend up to six months outside the park boundaries to adjacent communal lands. These findings suggest that the conservation of the lion population and other resources within a protected area should not be limited inside the boundaries of this area but should be extended to all neighboring areas. In order to cope with these edge effects, the conservation efforts should be intensified both in and outside the park boundaries.

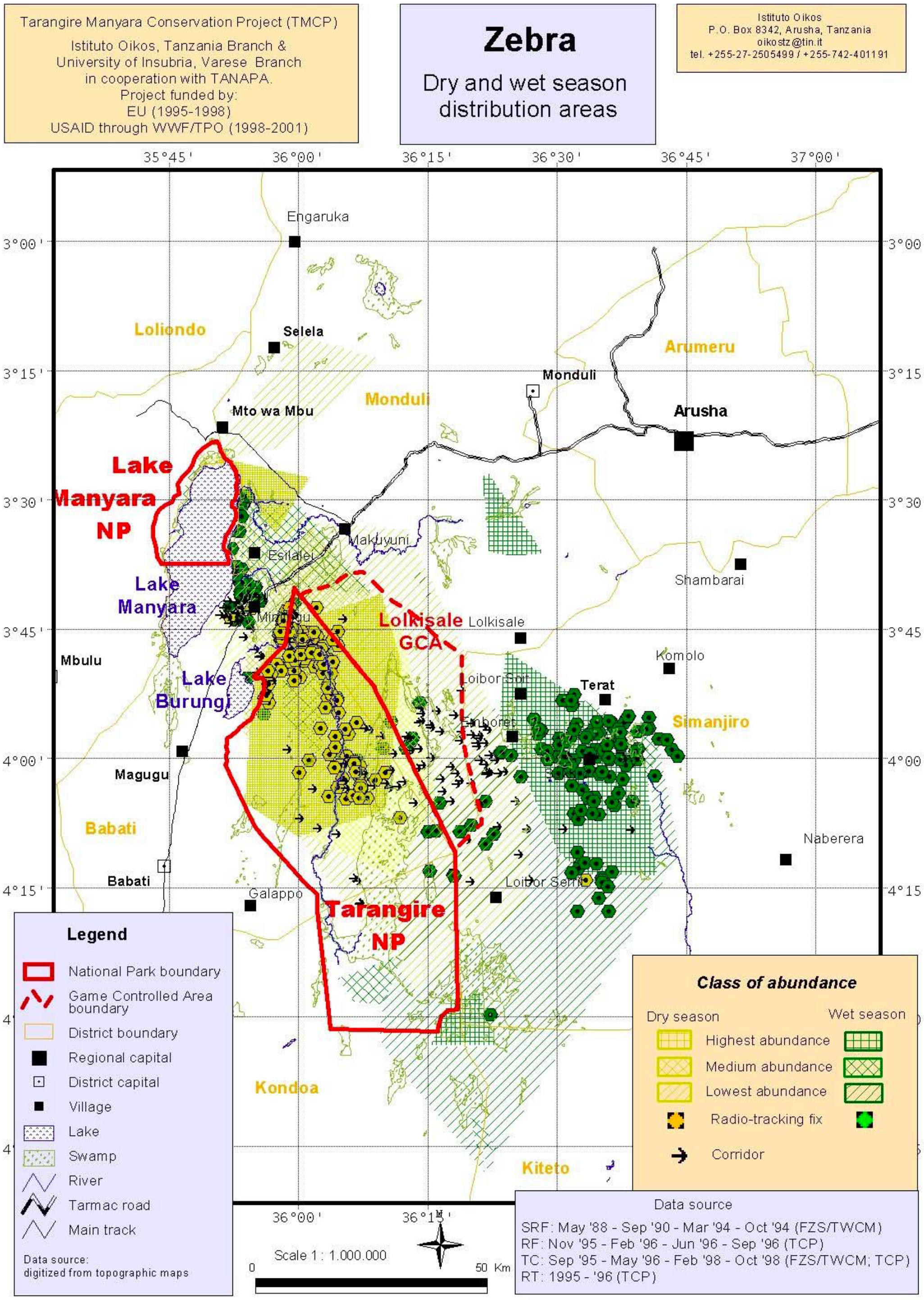

Figure 4: A map of Tarangire National Park showing Zebra population distribution in dry and wet seasons. (Source: TLP, 2000)

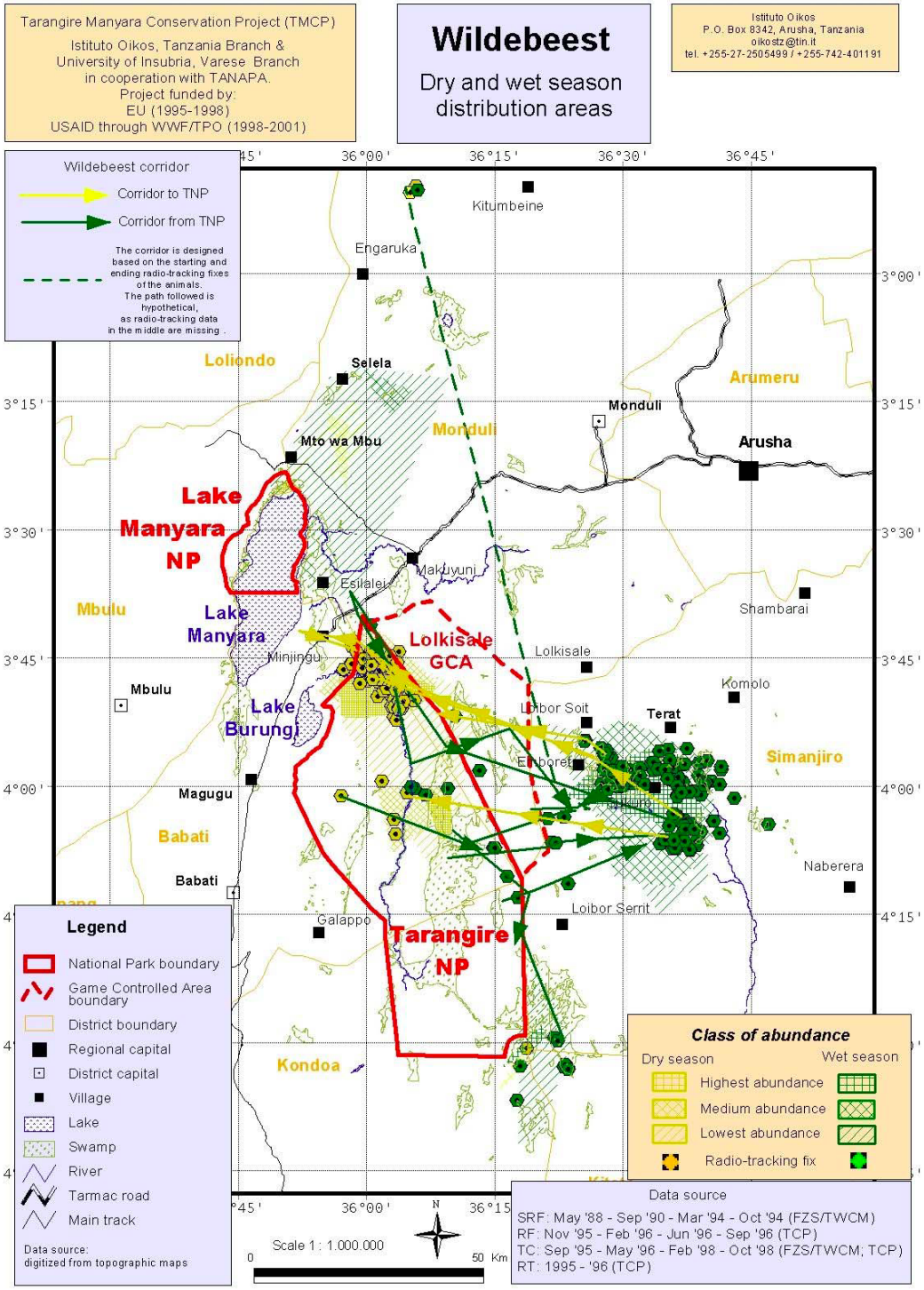

Figure 5: A map of Tarangire National Park showing Wildebeest population distribution in dry and wet season. (Source:TLP, 2000).

Acknowledgement

This study was financially supported by Tanzania Commission for Sciences and Technology (COSTECH) and The Nelson Mandela African Institution of Science and Technology (NM-AIST). Special thanks to Tanzania Wildlife Research Institute (TAWIRI) and Tanzania National Parks Authority (TANAPA) for permitting me to conduct this study in Tarangire National Parks. Sincere thanks to Tarangire Lion Project for their assistance during field data collection, and Andrew Ferdinand for his help in GIS analysis.

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