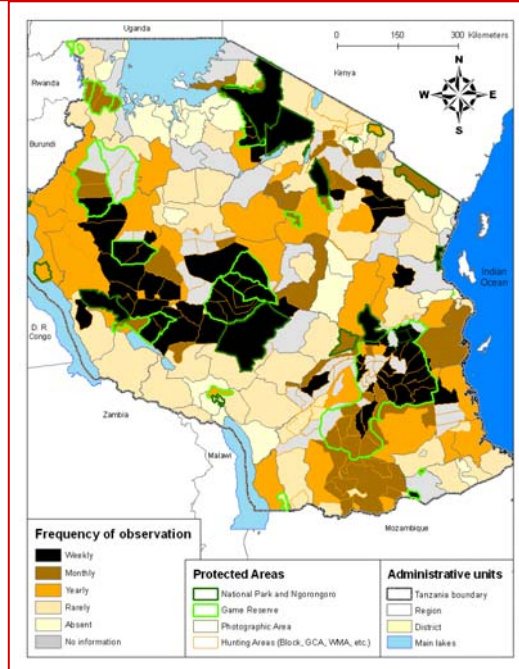
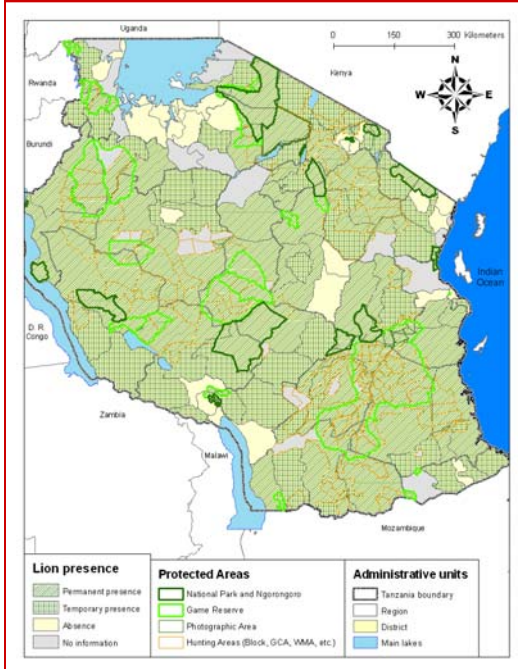
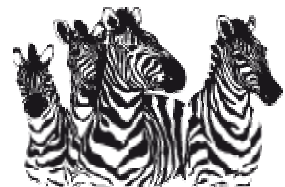


# CONSERVATION STATUS OF THE LION (*Panthera leo* Linnaeus, 1758) IN TANZANIA



JUNE 2010





**TITLE:** Conservation status of the lion (*Panthera leo* Linnaeus, 1758) in Tanzania

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## ABSTRACT

The IUCN SSC organized two regional workshops, one for West and Central Africa (2005) and one for Eastern and Southern Africa (2006), to produce regional conservation strategies for the lion. Tanzania authorities, together with local stakeholders, took part in the regional exercise for establishing the Regional Conservation Strategy for the Lion in Eastern and Southern Africa, and soon after organized the first national workshop to prepare a National Action Plan for lion and leopard. In 2009, the Tanzania authorities expressed the will to update the lion profile in the country and to hold the second national workshop for finalizing a Lion National Action Plan.

The present survey has attempted to update the conservation status of the lion in Tanzania. The final report of this survey is expected to bring comprehensive material for submission to the forthcoming National Action Plan workshop. The methods used are explained and results are provided and discussed. A georeferenced database has been set up to collect and analyse the information available (250 bibliographic references) as well as the information generated by specific inquiries (among 321 informants). Nine thematic maps have been drawn.

The lion range in Tanzania is still extensive with a surface of 750,000 km<sup>2</sup>, *i.e.* 92% of the terrestrial surface of the country, of which 335,000 km<sup>2</sup> (*i.e.* 45%) are located inside Protected Areas (National Parks and Hunting Areas). An assessment of the lion population size has been attempted with a tentative figure of about 16,800 individuals in Tanzania at this stage, a large majority of them living in Protected Areas (*i.e.* 80%). Tanzania hosts the largest lion population in Africa and is the first country in terms of lion trophy hunting with around 200 free-ranging lions legally harvested per year. This figure remains far smaller than the number of lions illegally killed for various reasons such as ritual killing, snaring for bushmeat, retaliation in reaction to human casualties and livestock losses, etc. Because lions largely range outside Protected Areas, human/lion conflicts are of great concern in this country, especially in central and southern Tanzania. Indeed, illegal killing of lions and habitat loss appear to most informants as the main threats to lion conservation.

**Cover picture:** *Lions in Ngorongoro Conservation Area* (©Philippe Chardonnet)

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We are also most grateful to the 321 informants who kindly contributed to the present survey (see Appendix IV for a list).

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## ACRONYMS

ALWG	African Lion Working Group
CBNRM	Community-Based Natural Resources Management
CDV	Canine Distemper Virus
CSG	Cat Specialist Group (IUCN SSC)
FAO	Food and Agriculture Organization of the United Nations
FR	Forest Reserve(s)
GCA	Game Controlled Area(s)
GDP	Gross Domestic Products
GR	Game Reserve(s)
HLC	Human/Lion Conflict
IGF Foundation	<i>Fondation Internationale pour la Gestion de la Faune</i> (International Foundation for the Management of Wildlife)
IUCN SSC	International Union for Conservation of Nature, Species Survival Commission
LCU	Lion Conservation Unit
MNRT	Ministry of Natural Resources and Tourism
MLDF	Ministry of Livestock Development and Fisheries
MLHSD	Ministry of Land and Human Settlement Development
NCA	Ngorongoro Conservation Area
NGA	Non-Gazetted Area(s)
NP	National Park(s)
OA <sub>h</sub>	Open Area(s) with tourist hunting
PAC	Problem Animal Control
PA	Protected Area(s) (comprising PA <sub>h</sub> and PA <sub>wh</sub> )
PA <sub>h</sub>	Protected Area(s) with tourist hunting
PA <sub>wh</sub>	Protected Area(s) without tourist hunting
SCI Foundation	Safari Club International Foundation
TAHOA	Tanzania Hunting Operators Association
TANAPA	Tanzania National Parks
TAWIRI	Tanzania Wildlife Research Institute
TPHA	Tanzania Professional Hunters Association
WCS	Wildlife Conservation Society
WD	Wildlife Division, Ministry of Natural Resources and Tourism
WMA	Wildlife Management Area(s)

# I. INTRODUCTION

## 1. BACKGROUND

Until mid XX<sup>th</sup> century, the conservation of the African lion (*Panthera leo*) was not a matter of great concern since the species was widespread and abundant. With a few local exceptions, the overall situation has largely changed. In 2004, the international community in general and the lion Range States in particular, decided to develop regional conservation strategies for the lion. IUCN SSC organized two regional workshops, one for West and Central Africa in 2005 and one for Eastern and Southern Africa in 2006, with the intention to gather major stakeholders and to produce two regional strategies which were published in 2006. These regional strategies state that “[they] must be followed by the development of national lion action plans because it is on this level that the strategy actions are implemented” (IUCN SSC Cat Specialist Group, 2006).

Tanzania authorities, together with local stakeholders, took part in the regional exercise for establishing the regional strategy. The regional workshop recognized Tanzania as crucial to the survival of the lion since it holds nearly half of the estimated African lion population (IUCN SSC Cat Specialist Group, 2006).

Soon after the regional workshop, the Tanzania authorities organized a national workshop to prepare a National Action Plan for the conservation of lion and leopard (February 2006, Arusha; TAWIRI, 2007).

In contrast to many other countries, much attention has always been paid in Tanzania to the lion as a species and cultural asset. For a long time now, a lot of information has been accumulated on the lion in Tanzania. However in 2009, the Government of Tanzania expressed the will to update the lion profile in the country and also to improve the knowledge on lion outside the emblematic National Parks which had attracted most of the lion research. This survey is attempting to provide comprehensive material for a forthcoming national workshop to finalize the National Action Plan for the conservation of lion.

## 2. PLANNING

The final purpose of the present survey is to review and update the conservation status of the lion in Tanzania. The survey comprised three phases:

- **Phase 1: Preliminary survey**

Phase 1 gathered existing and available information on the lion conservation status in Tanzania (between August and September 2009).

- **Phase 2: Filling the gaps in knowledge**

Phase 2 focused on collecting as many information as possible from resource persons through a specific inquiry (between October 2009 and January 2010).

- **Phase 3: Status review**

Phase 3 analyzed all the information collected by Phases 1 & 2 and led to the production of the current comprehensive evaluation of the conservation status of the lion in Tanzania (between January and February 2010). Expectedly, this final document will be presented as a contribution to the national workshop for establishing the National Action Plan for lion conservation in Tanzania.

### **3. FOLLOW UP**

The final product of Phase 3 is expected to propose a sound comprehensive status review of the lion in Tanzania within the obvious limits of the knowledge at that time.

Since this report is the product of a limited team of experts, it will be presented to the forthcoming national workshop participants as a contribution to their participative debate during the first session of the workshop (Status review). According to the IUCN SSC Species Conservation Planning Task Force, the classic academic structure of a species conservation planning workshop comprises the following sessions: 1. Status review; 2. Vision and goals; 3. Objectives; 4. Conservation actions.

The workshop will make use of the most recent participative approaches in conservation planning (IUCN SSC, 2008).

The purpose of the foreseen national workshop will be to produce a National Action Plan.



## II. METHODOLOGY

### 1. DATA ACQUISITION

Two categories of information have been collected during the survey (Table I):

- **Existing information**

The existing information originates from:

- Scientific and technical literature, either published or unpublished;
- Existing databases run by Tanzania authorities, mainly the Wildlife Division (WD, Ministry of Natural Resources and Tourism) and the Tanzania Wildlife Research Institute (TAWIRI).

- **Information generated**

The information specifically generated for this survey has been produced by a genuine inquiry conducted among Tanzania authorities, NGOs/researchers, the tourist hunting sector and local communities. The inquiry was based on:

- Direct inquiry by interviews with resource persons;
- Indirect inquiry, where questionnaire forms have been sent by mail.

The generated information was collected in Tanzania between the 19<sup>th</sup> of October and the 22<sup>nd</sup> of December 2009 by two teams:

- A field team, involving the WD, TAWIRI and IGF Foundation, covered around 8,000 km in western, northern and southern Tanzania during 4 weeks. The team mostly carried out direct interviews with District authorities and local communities outside Protected Areas (Photo 1).
- A supervisor team, involving the WD and IGF Foundation, based in between Dar Es Salaam and Arusha, and focused on direct interviews with the Tanzania authorities, the tourist hunting sector and NGOs/researchers.

Thanks to the support of the WD, TAWIRI and the livestock authorities, more questionnaires were collected at IGF Foundation headquarters (in France) up to the 29<sup>th</sup> of January 2010.

#### 1.1. Existing information

- **Literature**

Peer-reviewed literature and technical reports provide information on lion issues in Tanzania. To make it more convenient, information has been presented here by geographical scale: continental, regional, national and local. In all cases, only information related to Tanzania has been used. By convention, any information dated more than 5 years ago (before 2005) has been considered as historical account and not as contribution to the present status of the lion.

**Table I:** Sources of information used in the present survey

Source of information		Information	Type of information
Existing information	MNRT	Maps of Protected Areas	GIS tool
		Camera-trap surveys in Protected Areas	Technical report
		Human/lion conflicts	Existing database
		Lion hunting (quotas and offtakes)	Existing database
	MLHSD	Maps of Regions, Districts and main lakes	GIS tool
Various	Historical data, scientific papers	Literature	
Information generated	Survey team: the WD, TAWIRI & IGF Foundation	MNRT	Inquiry
		MLDF	Inquiry
		Tourist hunting sector	Inquiry
		NGOs, researchers, other	Inquiry
		Local communities	Inquiry



**Photo 1:** Interview with a Forest Officer by Rose Moshia (TAWIRI) ©Nolwenn Drouet

### ○ Continental scale

Information on lions in Tanzania may be found in two recent surveys conducted at continental scale (Chardonnet, 2002; Bauer & Van Der Merwe, 2004). Both surveys were based on published papers, unpublished reports and personal communications of informed persons (wildlife managers, experts, etc.). Bauer & Van Der Merwe (2004) compiled estimates of 100 known African lion populations, located within Protected Areas only (Map A, Appendix I). Lion populations of unknown or unestimated size were not included. Chardonnet (2002)

compiled estimates for 144 lion populations brought together into 36 isolated subpopulations (Map B, Appendix I) by considering both gazetted and non-gazetted areas.

Based on habitat suitability models, a putative lion range across Africa has been proposed by the African Mammal Databank (1999; <http://www.gisbau.uniroma1.it/amd/homespec.html>; Map C, Appendix I). More recently, a probabilistic model on continental lion distribution and abundance has been developed (Loveridge & Canney, 2009; Map D, Appendix I).

Information about human/lion conflicts throughout Africa was recently reviewed by the Food and Agriculture Organization (FAO), based on published papers, unpublished reports and personal communications of resource persons (Chardonnet *et al.*, 2010).

- **Regional scale**

A general lion distribution was proposed for Tanzania, Kenya and Uganda in the late 1980s (Kingdon, 1989; Map E, Appendix I).

The Eastern and Southern African Lion Conservation Workshop, held in Johannesburg in January 2006, provides the best available source of information at regional level (IUCN SSC Cat Specialist Group, 2006). A working paper was prepared on purpose by Bauer, Chardonnet & Nowell (2005) based on the continental surveys carried out by Chardonnet (2002) and Bauer & Van Der Merwe (2004). During the workshop, participants refined the formerly proposed lion ranges. Through a Range Wide Priority Setting exercise, workshop participants identified ecological units of importance for lion conservation (Lion Conservation Unit [LCU]; Map F, Appendix I).

- **National scale**

Information about lion attacks on people across non-gazetted areas in Tanzania (between 1990 and 2004) was compiled from WD records and the distribution of attacks was mapped (Baldus, 2004). At WD's instigation, this first set of information was then updated by interviewing local communities in 22 Districts (Packer, Ikanda & Kissui, 2005; Packer *et al.*, 2005). The same information was combined with published estimates of lion abundance within Protected Areas in a review of lion distribution and abundance in Tanzania (Ikanda & Packer, 2006). Another review of lion distribution and abundance was proposed during the Tanzania Lion and Leopard Conservation Action Plan Workshop held in Arusha, 20-22<sup>nd</sup> February 2006 (TAWIRI, 2007).

- **Local scale**

- **Protected Areas**

Long term monitoring of lion populations, based on individual recognition of known lions and/or radio-collaring, has been and is still conducted in a limited number of Protected Areas (PA) in Tanzania.

Such monitoring programmes date as far back as the 1960s in Serengeti National Park (NP), Lake Manyara NP and Ngorongoro Conservation Area (NCA) (Schaller, 1972). These programmes have accumulated the largest set of data on lions supporting numerous scientific publications (*e.g.* Adamson, 1964; Makacha & Schaller, 1969; Bertram, 1973; Elliott, Mc Taggart Cowan & Holling, 1977; Pusey & Packer, 1987; Packer *et al.*, 1991; Packer *et al.*, 1999; Maddox, 2003; Hofer & East, 2005; Kissui, Mosser & Packer, 2009).

The Tarangire Lion Project and the Selous Lion Project were then started in the 1990s (Bernard Kissui, *pers. com.*; Creel & Creel, 1997). More recently, lion surveys using call in stations were carried out in a few PAs such as Moyowosi Game Reserve (GR) in 2003 and 2009 (Viljoen *et al.*, 2004; Michel Allard, *pers. com.*), Muhesi and Kizigo GRs in 2008 (Michel Allard, *pers. com.*) and Katavi NP in 2005 (Kiffner *et al.*, 2009).

Since 2006, the Tanzania Mammal Atlas Project (run by TAWIRI) has been conducting camera trapping surveys in numerous PAs (*e.g.* Serengeti NP [Baran *et al.*, 2006a]; Saadani NP [Rwiza *et al.*, 2007]; Ugalla GR [Baran *et al.*, 2008a]; Lukwika Lumesure GR [Baran *et al.*, 2008b]; Lake Natron Game Controlled Area (GCA) [Baran *et al.*, 2008c]). Other studies, not targeting specifically on lion monitoring, have also reported evidence of lion occurrence in particular PAs (*e.g.* Katavi NP [Caro, 1999]; Liparamba GR [Shilunga, 2005]; Mahale Mountains NP [Moyer *et al.*, 2006]; Mikumi NP [Minja, 2008]; Kitulo NP [Jones, Caro & Davenport, 2009]).

- **Others**

To our knowledge, information on lion status outside PAs is scarce in Tanzania. During the second half of the XIX<sup>th</sup> century, information on lions in Tanzania was provided by early explorers and hunters.

The most recent information on lions outside PAs seems to originate from programmes focusing on human/lion conflicts (*e.g.* Baldus, 2004; Hofer *et al.*, 2004; Lichtenfeld, 2005; Holmern, Nyahongo & Roskaft, 2007; Dickman, 2008; Kissui, 2008a), and from the WCS work about wildlife corridors in Tanzania (*e.g.* Jones, Caro & Davenport, 2009).

- **Existing database**

The Tanzania authorities in charge of wildlife do record information on lion management issues, mainly on human/lion conflicts and lion hunting.

- **Human/lion conflict**

Most of the District Wildlife Officers keep records of human/wildlife conflicts in their respective areas of responsibility. Forwarded information is compiled at the WD.

- **Lion hunting quota/offtake**

All hunting quotas, including for lions, are set for each area where tourist hunting is permitted. Information on lion quota and lion offtake has been provided by the WD.

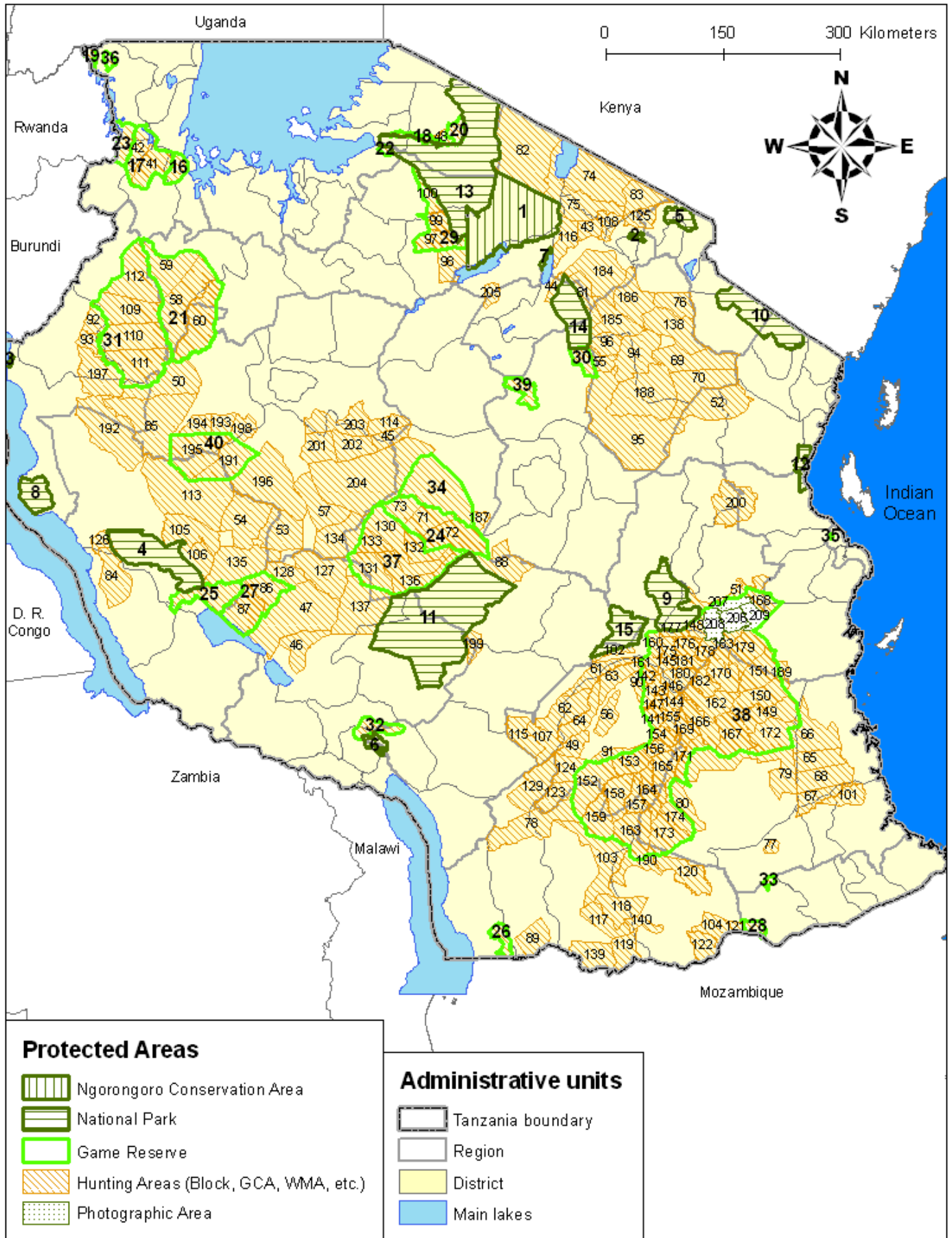
- **Digital maps**

The Survey and Mapping Division, Ministry of Land and Human Settlement Development, has provided the digital outlines (shapefiles) of Regions, Districts and main lakes (Map 1), and the Tanzania Wildlife Research Institute (TAWIRI) the digital outlines of all PAs (Map 2).

PAs in Tanzania comprise: NPs, the NCA, GRs, Wildlife Management Areas (WMA) and GCAs. Authorized activities in the various categories of PAs differ according to their status (Appendix II). Other PAs [understood as areas gazetted for conservation (IUCN, 1994)] comprise various categories of Forest Reserves that were not considered in this survey except the ones managed by private tourist hunting companies, where tourist hunting is carried out.



**Map 1:** Administrative network of Districts (source: the Survey and Mapping Division, MLHSD)



**Map 2:** Network of Protected Areas considered in this survey (source: TAWIRI). Please refer to extra-legend (p. 13) for details on Protected Areas identity.

Protected Areas considered in the present survey

Conservation Area and National Park	Hunting Areas (Block, GCA, WMA, etc.)		
1 Ngorongoro	41 Burigi East GR	105 Mlele North GCA	169 Selous ML1
2 Arusha	42 Burigi West GR	106 Mlele South GCA	170 Selous MS1
3 Gombe	43 Burko OA	107 Mnyera OA	171 Selous MT1
4 Katavi	44 Burunge GCA	108 Monduli Juu OA	172 Selous MT2
5 Kilimanjaro	45 Chaya OA	109 Moyowosi Central GR	173 Selous N1
6 Kitulo	46 Chunya East OA	110 Moyowosi Njingwe North GR	174 Selous N2
7 Lake Manyara	47 Chunya West OA	111 Moyowosi Njingwe South GR	175 Selous R1
8 Mahale Mts.	48 Fort Ikoma OA	112 Moyowosi North GR	176 Selous R2
9 Mikumi	49 Furua OA	113 Msima West GCA	177 Selous R3
10 Mkomazi	50 Gombe GCA	114 Msuluguda OA	178 Selous R4
11 Ruaha	51 Gonabisi Kidunda OA	115 Mtimba OA	179 Selous RU1
12 Saadani	52 Handeni GCA	116 Mto wa Mbu GCA	180 Selous U1
13 Serengeti	53 Inyonga East GCA	117 Mtungwe Central OA	181 Selous U2
14 Tarangire	54 Inyonga West GCA	118 Mtungwe North OA	182 Selous U3
15 Udzungwa Mountains	55 Irkishibor OA	119 Mtungwe South OA	183 Selous U4
	56 Itete OA	120 Muhuwesi GCA	184 Simajaro West GCA
	57 Ituru Forest OA	121 Muhuwesi OA	185 Simanjoro Kitangare GCA
<b>Game Reserve</b>	58 Kigosi Central GR	122 Mwambesi GCA	186 Simanjoro Naberera GCA
	59 Kigosi North GR	123 Mwatisi South OA	187 Simbanguru / Igwemadete OA
16 Biharamulo	60 Kigosi South GR	124 Mwatisi North OA	188 Talamai OA
17 Burigi	61 Kilombero North Mgeta GCA	125 Ngaserai OA	189 Tapika / Ngarambe OA
18 Grumeti	62 Kilombero North Mlimba GCA	126 Nkamba FR	190 Tunduru OA
19 Ibanda	63 Kilombero South Bomaulanga GCA	127 Piti East OA	191 Ugalla East GR
20 Ikorongo	64 Kilombero South Malinyi GCA	128 Piti West OA	192 Ugalla Niensi OA
21 Kigosi	65 Kilwa Central OA	129 Ruhudji / Ifinga OA	193 Ugalla North-East OA
22 Kijereshi	66 Kilwa North OA	130 Rungwa Ikili GR	194 Ugalla North-West OA
23 Kimisi	67 Kilwa South Mbwem OA	131 Rungwa Inyonga GR	195 Ugalla West GR
24 Kisigo	68 Kilwa South Nakiu OA	132 Rungwa Mpera GR	196 Ugunda GCA
25 Lake Rukwa	69 Kitwai North GCA	133 Rungwa Mwamagembe GR	197 Uvinza OA
26 Liparamba	70 Kitwai South GCA	134 Rungwa North OA	198 Uyumbu WMA
27 Lukwati	71 Kizigo Central GR	135 Rungwa River FR	199 Waga OA
28 Lukwika Lumesure	72 Kizigo East GR	136 Rungwa Rungwa GR	200 Wami Mbiki WMA
29 Maswa	73 Kizigo West GR	137 Rungwa South OA	201 Wembere Central 1 OA
30 Mkungunero	74 Lake Natron North GCA	138 Ruvu Masai GCA	202 Wembere Central 2 OA
31 Moyowosi	75 Lake Natron South GCA	139 Ruvuma OA	203 Wembere North OA
32 Mpanga Kipengere	76 Landanai GCA	140 Sasawara FR	204 Wembere South GCA
33 Msanjesi	77 Lihonja FR	141 Selous IH1	205 Yaeda Chini OA
34 Muhesi	78 Litumbandyosi / Gezamasua FR	142 Selous K1	
35 Pande	79 Liwale North OA	143 Selous K2	
36 Rumanyika	80 Liwale South OA	144 Selous K3	
37 Rungwa	81 Lokisale GCA	145 Selous K4	
38 Selous	82 Loliondo GCA	146 Selous K5	
39 Swaga Swaga	83 Longido GCA	147 Selous L1	
40 Ugalla	84 Luafi	148 Selous LA1	
	85 Luganzo GCA	149 Selous LL1	
	86 Lukwati North GR	150 Selous LL2	
	87 Lukwati South GR	151 Selous LL3	
	88 Lunda Mkwambi North GCA	152 Selous LU1	
	89 Magwamila OA	153 Selous LU2	
	90 Mahenge North OA	154 Selous LU3	
	91 Mahenge South OA	155 Selous LU4	
	92 Makere North FR	156 Selous LU5	
	93 Makere South FR	157 Selous LU6	
	94 Masai East OA	158 Selous LU7	
	95 Masai South OA	159 Selous LU8	
	96 Masai West OA	160 Selous M1	
	97 Maswa Kimali GR	161 Selous M2	
	98 Maswa Makao OA	162 Selous MA1	
	99 Maswa Mbono GR	163 Selous MB1	
	100 Maswa North GR	164 Selous MB2	
	101 Matapwa OA	165 Selous MB3	
	102 Matundu FR	166 Selous MH1	
	103 Mbarang'andu OA	167 Selous MJ1	
	104 Mischela OA	168 Selous MK1	
			<b>Photographic Area</b>
			206 Selous B1
			207 Selous KY1
			208 Selous Y1
			209 Selous Z1

For information, the direct technical management of Tanzania wildlife falls under the responsibility of various entities under the Ministry of Natural Resources and Tourism (MNRT) authority:

- The Tanzania National Parks (TANAPA) is a para-statal organization in charge of NPs;
- The Ngorongoro Conservation Area is a para-statal organization managing the Ngorongoro Conservation Area (NCA);
- The WD is a MNRT Department responsible for GRs, WMAs and GCAs. Moreover, the WD regulates wildlife hunting in open areas.

## **1.2. Information generated**

In preparation of the present survey, questionnaire forms (Appendix III) were designed in collaboration with the WD and TAWIRI. Two distinct forms targeted: (i) PAs, (ii) non-gazetted areas.

Informants were asked to provide information on:

- Lion presence over the past 5 years;
- Frequency of lion observations;
- Lion population size estimates when appropriate;
- Periodicity and type (livestock losses or human casualties) of human/lion conflicts;
- Hunting quota and offtake when appropriate;
- Lion population trends over the last 5 years and between 10 years to 50 years;
- Threats to lion survival;
- Most conflicting wild species with human population.

The resource persons who contributed to the generated information belong to the following networks:

- Public sector:
  - Natural resources network: WD, TANAPA, NCA, TAWIRI;
  - Livestock resources network: Ministry of Livestock Development and Fisheries (MLDF), Livestock Multiplication Units, National Ranching Company.
- Private sector:
  - The tourist hunting sector: Tanzania Hunting Operators Association (TAHOA), Tanzania Professional Hunters Association (TPHA), professional hunters;
  - Local communities: farmers, villagers, etc.
- NGOs.

Responses to the inquiry generated about 500 sets of information (Table II, Appendix IV) by either direct interviews or indirect inquiries (sent and received by mail).



**Table II:** Number of questionnaires filled in during the survey, according to the different networks of informants

Network of informants			Questionnaires	
			by mail	by interview
Public sector	Wildlife Division	Ministry, District and Field Officers	76	56
	TANAPA	Park Warden & Ecologist	10	0
	Ngorongoro CA		5	1
	TAWIRI		4	7
	Ministry of Livestock Development and Fisheries		27	1
Private sector	Local communities		13	130
	Tourist hunting sector		106	32
NGO	Researcher		4	25
<b>Total</b>			<b>245</b>	<b>252</b>
			<b>497</b>	

## 2. DATA ANALYSIS

### 2.1. Database

Every single information collected (technical or scientific reports, questionnaires, existing databases) was entered into a simple database. The database is made of three tables which have been combined and consolidated. Being georeferenced, the consolidated table has been used to draw synthetic thematic maps (see below):

- **Table at the level of the Districts (non-gazetted areas)**

Table A [111 lines & 178 columns (29.01.10)] gathered information from all the terrestrial Districts (N=110), excluding PAs, about lion presence, frequency of lion observations, frequency and type of conflicts and level of knowledge.

- **Table at the level of Protected Areas without tourist hunting activity**

Table B [20 lines & 120 columns (29.01.10)] gathered information on lions at the level of the PAs without tourist hunting activity (PA<sub>wh</sub>), namely the NPs (N=14), NCA (N=1) and the photographic areas inside the Selous GR (N=4).

- **Table at the level of Protected Areas with tourist hunting activity**

Table C [183 lines & 77 columns (29.01.10)] gathered information on lions at the level of the PAs with tourist hunting activity (PA<sub>h</sub>; N=182), namely the Game Reserves, the Wildlife Management Areas and the Game Controlled Areas. In this category, we included Open Areas (OA<sub>h</sub>) and Forest Reserves (FR) set aside for tourist hunting and managed by private hunting companies.

Hunting Areas are located either inside or outside GRs. GRs contain either a single or numerous Hunting Areas. Only Hunting Areas outside GRs are categorized as WMA, GCA or OA<sub>h</sub>.

Shapefiles were projected into a Universal Transversal Mercator system through a Geographic Information System platform (GIS; ArcMap 9.2), and their surfaces were

consequently evaluated. According to the GIS platform, the surface of Tanzania is around 945,000 km<sup>2</sup>. Islands and main lakes were not considered in the assessment of the lion conservation status in the country. The resulting area considered in the survey was 884,333 km<sup>2</sup>. Using the GIS platform, the surface of the PAs (353,500 km<sup>2</sup>) was excluded from the District surfaces in order to estimate the range of non-gazetted areas (530,833 km<sup>2</sup>).

## 2.2. Lion abundance assessment

The consolidated table served as a basis for estimating the abundance of lions in Tanzania. The lion abundance has been estimated as follows:

- Units (PAs or Districts) with documented lion numbers were used as bases of reference to extrapolate lion population size in units without specific information;
- For units (PAs or Districts) without specific information on lion numbers, the lion abundance has been extrapolated as follows:
  - For a given unit, the lion density estimate in the geographically closest unit informed has been used as a base of reference;
  - For a given unit, a correcting factor has been calculated based on two criteria (category of the area and estimated frequency of observation of lions in the given unit; Tables IIIa & b).

The lion density has been consequently extrapolated by using the following formula:

$$Dest = \frac{Dref \times CFest}{CFref}$$

Where : Dest: lion density of the unit to assess;  
 Dref: lion density of the reference unit;  
 CFest: correcting factor applied to the unit to assess;  
 CFref: correcting factor applied to the reference unit.

The rationale for the scoring of the criterion ‘category of area’ is that the conservation status of an area (Appendix II) is closely related to wildlife (including lion) abundance.

The rationale for the scoring of the criterion ‘frequency of observation’ is that lions are more frequently observed in a given area when the lion population is more abundant.

- Overall, a conservative approach has been adopted. As an example, where frequency of observation was not documented but lion permanent presence was attested, the smallest frequency of observation was considered.
- Two areas have not been used as reference areas for density extrapolation: NCA because of its unique Conservation Status and Manyara NP which hosts the highest density of lions in the world (*i.e.* 25 lions/100km<sup>2</sup>, Bernard Kissui & Yustina Kiwango, *pers. com.*).
- In photographic areas within the Selous GR, where lions were observed weekly, a correcting factor of 0.9 was applied because of their peculiar status and location.

**Table IIIa:** Criteria applied to calculate the correcting factor used to assess lion density in non-documented units and their scoring mechanism

Criterion	Category	Score per criterion
A: Category of Area	National Park	1
	Hunting Area within Game Reserve	0.75
	Hunting Area outside Game Reserve	0.4
	Non-gazetted Area	0.2
B: Frequency of observation of lions	Weekly	1
	Monthly	0.75
	Yearly	0.5
	Rarely	0.2

**Table IIIb:** Global scoring of the correcting factor used to assess lion density according to the characteristics of each non-documented unit

Correcting factor= Criterion A x Criterion B	Weekly	Monthly	Yearly	Rarely
<b>National Park</b>	1	0.75	0.5	0.2
<b>Hunting Area within Game Reserve</b>	0.75	0.5625	0.375	0.15
<b>Hunting Area outside Game Reserve</b>	0.4	0.3	0.2	0.08
<b>Non-gazetted Area</b>	0.2	0.15	0.1	0.04

### 2.3. Maps

The database has been used to produce thematic maps. The data gathered in each table have been used and superposed to draw thematic maps, with data concerning PAs being on the front layer. The ArcGis 9.2 software was used for data mapping and analysis. The following thematic maps have been produced:

- **Level of knowledge of lion range**

Since a very broad range and variety of information was used and different information was related to a given area, the level of knowledge in each area has been evaluated according to a classification which was applied to the whole database.

The classification of the level of knowledge was based on two criteria: (i) the number of information collected for a given area & (ii) whether or not the different information collected for a given area was consistent or showed discrepancies. Four levels of knowledge have been defined: high, medium, poor and questionable (Table IV). Each area has been classified accordingly.

**Table IV:** Criteria applied to evaluate the level of knowledge per site

Level of knowledge	Consistent information	Contradictory information
	Number of sources	Difference between numbers of sources for lion presence and absence (minimal number of sources)
<b>High</b>	≥ 6 with specific survey or ≥ 10	≥ 10 (12)
<b>Medium</b>	≥ 4	≥ 4 (6)
<b>Poor</b>	2 to 3	2 (4)
<b>Questionable</b>	1	0 or 1 (2)

- **Lion range**

The estimate of lion range originated from a binary system of presence or absence records. The lion was considered present when at least one direct (lion sighting) or indirect (spoor, roaring, prey carcass, etc.) observation had been recorded during the past 5 years only. The lion was considered absent when no observation had been made during the past 5 years.

Two categories of lion range have been proposed:

- **Permanent presence:** for units where lion presence was not questionable (with level of knowledge at least classified as ‘Poor’ and no report of temporary presence of lions);
- **Temporary presence:** for units where either lion presence was considered as questionable (with level of knowledge classified as ‘Questionable’) or several informants had reported episodic lion occurrence.

Within PAs with tourist hunting activity, the lion was considered as present as soon as a lion was hunted in the past five years.

- **Frequency of lion observations**

The frequency of observations (through direct sightings or detection of signs of presence) was recorded over the past 5 years and categorized into five classes defined as follows:

- **Absent:** lion presence not recorded in the area;
- **Rarely:** lions were not seen every year (temporary presence);
- **Yearly:** lions were seen only seasonally or a few times in a year;
- **Monthly:** lions were observed about every month;
- **Weekly:** lions were noticed on a regular basis throughout the year.

- **Level of human/lion conflict**

The level of human/lion conflict was estimated according to the frequency of conflicts reported since 2005 (5 years of data recording) and the impact of conflict (number of human casualties and/or livestock losses). It was categorized into five classes defined as follows:

- **Absent:** lion presence not recorded in the area;
- **None:** conflict occurrence not recorded in the area;
- **Low:** conflicts were reported once or twice and losses did not involve human death;
- **Medium:** conflicts were reported every year and/or involved at least one human death;
- **High:** conflicts were reported several times per year and involved human casualties and/or high number of livestock losses.

- **Level of tourist hunting on lions**

The level of tourist hunting on lions was assessed based on the data provided by the WD in respect to the quota received and the quota realized (offtake) per Hunting Area between 2005 and 2009. Information on quota realisation in 2009 was not available at the time of data analysis. Mean quota received over the past five years and mean quota realized between 2005 and 2008 were calculated, and expressed as a ratio per 1,000 km<sup>2</sup>. Results were categorized into six classes of values that were mapped.

- **Gaps in knowledge**

The gaps in knowledge have been identified by matching two criteria:

- **Criterion 1:** level of knowledge

A gap in knowledge was considered where the knowledge was insufficient. The rationale is that only Districts (or PAs) with low level of knowledge were worth investigating. A score was given to each District (or PA) in respect to this criterion: a high score was attributed where the knowledge was questionable, a low score where the knowledge was high.

- **Criterion 2:** frequency of observation

An area worth investigating was considered where the frequency of lion observation was high. The rationale is that it was not productive to investigate Districts (or PAs) with low frequency of observation. A score was given to each District (or PA) in respect to this criterion: a high score was attributed where the frequency of observation was high, a low score where lions were rarely observed.

Every single District (or PA) was scored 1°) for each of the two criteria, and then 2°) by multiplying both criteria. This scoring became a ranking mechanism for segregating the areas in need of being explored (major gaps) from the others (minor gaps) (Table Va & b).

**Table Va:** Criteria used for identifying gaps in knowledge (per District or Protected Area) and their scoring mechanism

Criterion	Class	Score per criterion
A: Level of knowledge	High	0
	Medium	0.25
	Poor	0.5
	Questionable	1
B: Frequency of observation of lions	Absent	0.25
	Rarely	0.25
	Yearly	0.5
	Monthly	1
	Weekly	1

**Table Vb:** Global scoring and ranking of the gap in knowledge for each District or Protected Area

For each area:	
Total score of the gap = criterion A x criterion B	Ranking of the gap
0	None
0.0625	Minor
0.125	Minor
0.25	Mild
0.5	Major
1	Major

The gaps in knowledge were systematically considered as ‘Major’ for units where the frequency of lion observations was not informed and where only a single information was available.

- **LCUs**

As a reminder, according to the IUCN SSC Cat Specialist Group (2006): “A *LCU* is defined as an area of known, occasional and/or possible lion range that can be considered an ecological unit of importance for lion conservation”.

The proposed national LCUs were obtained by matching regional LCUs (IUCN SSC Cat Specialist Group, 2006) with our assessment of the lion range.

### III. RESULTS

#### 1. LION RANGE

##### 1.1. Historical range

Unwritten knowledge on historical lion range in Tanzania exists within local communities with possible access through interviews. Written information on local presence of lions in Tanzania is provided by many early explorers, hunters and writers such as Francis Burton, David Livingstone, Sir Alfred Pease, Edouard Foa, John Howard Taylor, Sheila Mc Donald, Martin Johnson, Gerald Sayers, Friedrich Wilhelm Siedentopf, Ernest Hemingway, Bernhard Grzimek, etc. Most historical accounts tend to show a widespread distribution to the point that, anciently, very few locations in Tanzania did not have lions (Kingdon, 1989; Kingdon, 1997; Ikanda & Packer, 2006).

According to the criterion used in the present survey (§II.1.1.), the two recent continental surveys on lion status (Chardonnet, 2002; Bauer & Van Der Merwe, 2004) are recorded as historical accounts because they are older information than the threshold of 5 year-old. In both cases the information dated 2002 even though the publication of Bauer & Van Der Merwe dated 2004. The Chardonnet's survey (2002) estimated a lion range of about 460,000 km<sup>2</sup> in Tanzania (Map B, Appendix I) and considered 4 subpopulations of lions in the country (Map B, Appendix I):

- **Subpopulation n° 22:** in Maasailand Ecosystem, mostly in Mara, Arusha, Kilimanjaro and Manyara Regions (north-eastern of Tanzania);
- **Subpopulation n° 23:** mostly in Kagera and Kigoma Regions (north-western of Tanzania);
- **Subpopulation n° 24:** mostly in Rukwa, Tabora and Mbeya Regions (central and western Tanzania);
- **Subpopulation n° 25:** in Selous Ecosystem, mostly in Lindi, Morogoro and Tundura Regions (southern Tanzania)

Still from the same source (Chardonnet, 2002):

- **Transfrontier subpopulations:** 3 of the 4 subpopulations identified were regarded as transfrontier ones.

##### 1.2. Current range

- **Range**

The current lion range (or distribution area) in Tanzania has been estimated by using the database of information collected on lion records during the past 5 years (after 2004). Information on lion presence was available in 282 out of the 311 geographical units considered in this survey. As a result, the lion range in Tanzania has been assessed in an area of 816,790 km<sup>2</sup>, *i.e.* 92.4% of the terrestrial land in Tanzania.

The general lion range, with no distinction between permanent and temporary presence, encompassed (Map 3; Appendix V):

- A global surface of about 749,700 km<sup>2</sup>, *i.e.* 92% of the total documented surface of Tanzania, excluding lakes and islands;
- 72 out of the 97 documented Districts, *i.e.* 74% of the documented Districts; The lion was absent around Arusha, in the southern border of lake Victoria, in north-eastern Tanzania, in several Districts close to lake Malawi and in a few other Districts;
- 17 out of the 19 PA<sub>wh</sub> (without tourist hunting), *i.e.* 90% of the PA<sub>wh</sub>; the lion was absent only in Gombe and Arusha NPs;
- All documented PA<sub>h</sub> (with tourist hunting), *i.e.* 100% of the documented PA<sub>h</sub>;
- A surface of 414,500 km<sup>2</sup> in non-gazetted areas, *i.e.* 55.3% of the documented lion range and of 335,200 km<sup>2</sup> within PAs (57,692 km<sup>2</sup> in PA<sub>wh</sub> and 277,518 km<sup>2</sup> in PA<sub>h</sub>), *i.e.* 44.7% of the documented lion range.

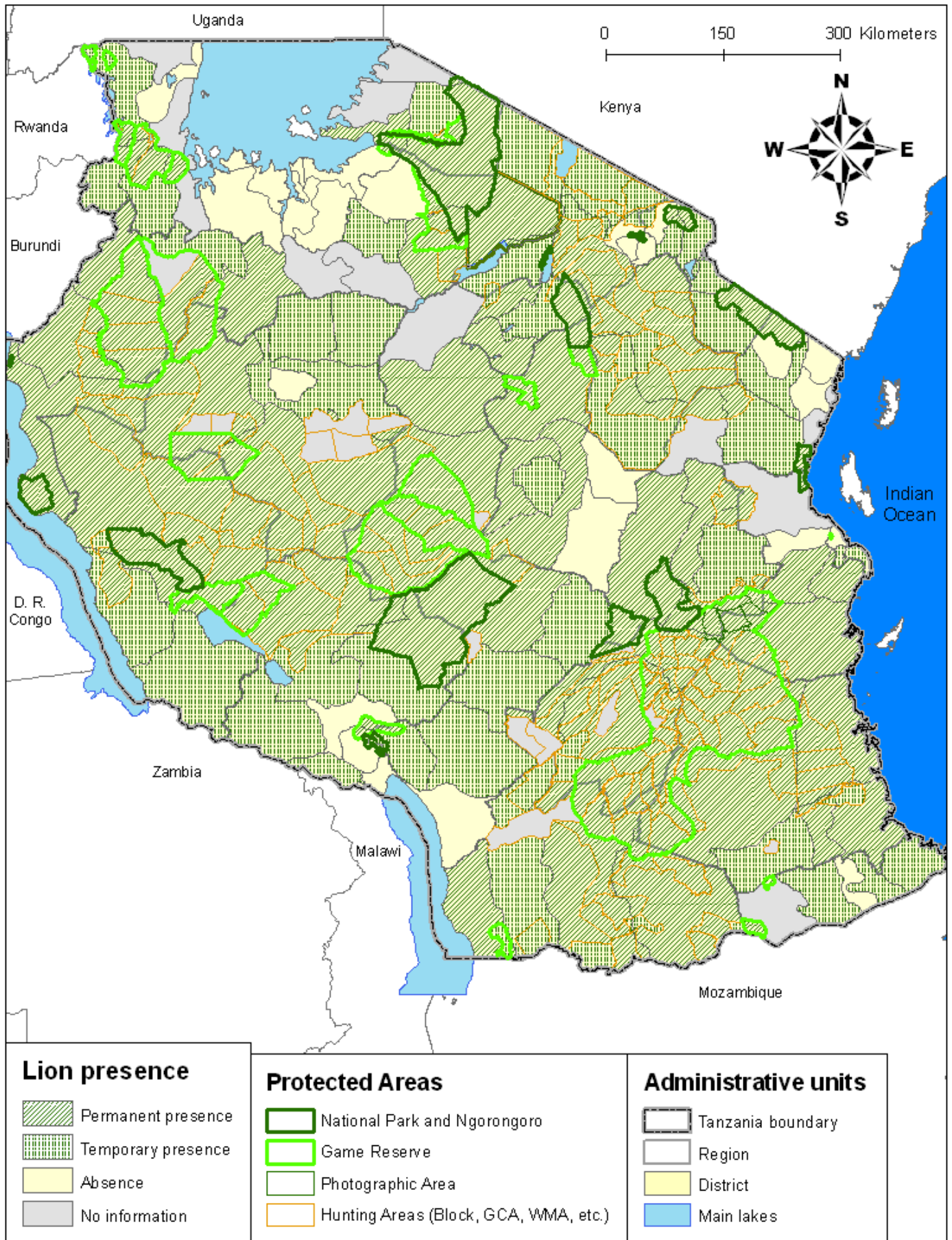
By distinguishing between permanent and temporary presence, the lion range was composed of (Map 3; Appendix V):

- A permanent presence range of 516,900 km<sup>2</sup>, *i.e.* 69% of the documented lion range and a temporary presence range of 232,800 km<sup>2</sup>, *i.e.* 31% of the documented lion range;
- 35 Districts with permanent lion populations and 37 Districts with temporary lion populations, *i.e.* a distribution of 49%/51% among documented Districts with lions;
- 16 PA<sub>wh</sub> with permanent lion populations, *i.e.* 94% of the PA<sub>wh</sub> hosting lions and a single PA<sub>wh</sub> with a temporary lion population (Kitulo NP);
- 143 PA<sub>h</sub> with permanent lion populations, *i.e.* 86% of the PA<sub>h</sub> hosting lions and 23 PA<sub>h</sub> with temporary lion populations, *i.e.* 14% of the PA<sub>h</sub> with lions;
- A permanent presence range of 219,520 km<sup>2</sup> and a temporary presence range of 194,980 km<sup>2</sup> in non-gazetted areas, *i.e.* 30.6% and 24.7% of the documented lion range respectively and 53% and 47% of the documented lion range in non-gazetted areas respectively;
- A permanent presence range of 57,267 km<sup>2</sup> and a temporary presence range of 425 km<sup>2</sup> in PA<sub>wh</sub>, *i.e.* 7.6% and 0.1% of the documented lion range respectively and 99% and 1% of the documented lion range in PA<sub>wh</sub> respectively;
- A permanent presence range of 240,117 km<sup>2</sup> and a temporary presence range of 37,401 km<sup>2</sup> in PA<sub>h</sub>, *i.e.* 32% and 5% of the documented lion range respectively and 87% and 13% of the documented lion range in PA<sub>h</sub> respectively.

#### • **Lion Conservation Units**

Regarding LCUs, the regional Eastern and Southern Africa Lion Workshop (Johannesburg, 8-13 January 2006) refined the subpopulations formerly proposed by Chardonnet (2002) by





**Map 3:** Lion range in Tanzania (by January 2010) during the last 5 years only

identifying 5 (five) LCUs in Tanzania (IUCN SSC Cat Specialist Group, 2006; Map F, Appendix I):

- **LCU 19:** the Serengeti and Maswa PA;
- **LCU 20:** the Maasai steppe;
- **LCU 23:** the Ruaha and Katavi NPs, the Moyowosi and Kigosi GRs and surroundings;
- **LCU 24:** the Selous GR and surroundings;
- **LCU 66:** the north-western Tanzania, and a strip of land linking Biharamulo GR and Dar Es Salaam in between the four above-mentioned LCUs.

LCUs 19, 20 & 66 were considered as transfrontier ones.

From the proposed lion ranges (Map 3), it seems that it would be valuable reconsidering the boundaries of LCUs 23 & 24.

- **LCU connections**

Two categories of connection were considered:

- **Connections beyond borders:** All the national LCUs proposed appear being transfrontier LCUs. Informants from Tanzania and bordering countries helped localizing main corridors used by transfrontier lion populations to cross Tanzania borders:
  - Kenya: lions move between Serengeti complex and Mara Complex in Kenya (Frank *et al.*, 2006a; TAWIRI, 2007);
  - Rwanda, Burundi & Uganda: lion movements occur between Kimisi GR in Tanzania and Akagera NP in Rwanda while movements between Tanzania, Uganda and Burundi do not seem to occur;
  - Zambia: although we did not find information on that matter, movements between Tanzania and Zambia are suspected;
  - Malawi: in 2005, lions coming from Malawi killed people in Tunduru District (Peter Mtani, *pers. com.*);
  - Mozambique: in the region of the Selous-Niassa Wildlife Corridor lions are crossing the Ruvuma river, as elephants and wild dogs do (Colleen Begg, *pers. com.*); lion movements across the border also occur eastwards nearby Negomano bridge (Colleen Begg, *pers. com.*) and westwards (Mohamed Madehele, Silvanus Okudo & Erasmus Tarimo, *pers. com.*).
- **Connections within Tanzania:** We considered that all the LCUs proposed are still interconnected in Tanzania, although most of wildlife corridors are threatened by human encroachment (Jones, Caro & Davenport, 2009).

## 2. LION ABUNDANCE

### 2.1. Historical abundance

No precise figure of historical estimates of Tanzania lion abundance was found before 2002 when two surveys supplied the first assessments of lion population sizes in Tanzania:

- 7,073 lions [min: 5,323 - max: 8,823] (Bauer & Van Der Merwe, 2004);
- 14,432 [10,409 - 18,215] (Chardonnet, 2002).

The discrepancy between both estimates originated from major methodological differences already explained, namely the extent of geographical coverage and the types of methods used (Bauer, Chardonnet & Nowell, 2005).

In their contribution to the continental lion survey (Chardonnet, 2002), Siege & Baldus (*pers. com.*, in Chardonnet, 2002) proposed an estimate of lion abundance slightly higher than the one finally published, *i.e.* 18,015 lions.

### 2.2. Current abundance

- **2006**

According to the Eastern and Southern African Lion Conservation Workshop (IUCN SSC Cat Specialist Group, 2006), the cumulative estimate for all LCUs related to Tanzania was 13,400 lions. However, because three of these LCUs included transfrontier lion populations, this value cannot be accepted as a figure for Tanzania since it comprises contiguous lions beyond Tanzania borders.

Ikanda & Packer (2006) proposed the most recent estimate of lion abundance in Tanzania only, *i.e.* 17,564 [12,208 - 19,320].

- **Present survey**

- **Lion population size**

This survey used the most accurate and recent figures available of lion abundance estimates (*i.e.* based on the most suitable monitoring methodology available, TAWIRI 2007) to define reference areas from which lion abundance was extrapolated for non-documented areas (§II.2.2.; Table VI).

Ngorongoro CA and Manyara NP were not considered for extrapolating density estimates because of respectively the peculiar conservation status of Ngorongoro CA and the outstanding high lion density of lions recorded in Manyara NP (Bernard Kissui & Yustina Kiwango, *pers. com.*).

A call-in survey was carried out in Moyowosi GR in 2009 (Michel Allard, *pers. com.*) but results were not available for inclusion in the present survey. So, we consequently used the lion density assessed in 2003 (Viljoen *et al.*, 2004). Because lions were considered as more abundant in Moyowosi GR than in Muhesi/Kizigo GRs in 2008 (Michel Allard, *pers. com.*), the estimate used has probably underestimated lion abundance in Moyowosi GR.

**Table VI:** Last available accurate estimates of lion densities in Protected Areas used as reference areas

Area	Survey methodology	Lion density estimate (/100km <sup>2</sup> )	Source
Katavi National Park	Call-in	4.0	Kiffner <i>et al.</i> , 2009
Moyowosi Game Reserve	Call-in	3.3	Viljoen <i>et al.</i> , 2004
Muhezi and Kizigi Game Reserves	Call-in	5.5	René Warburg, <i>pers. com.</i>
Selous photographic blocks	Individual identification	14.0	Henry Brink, <i>pers. com.</i>
Serengeti National Park	Individual identification	15.5	Ingela Jackson & Candida Mwingira, <i>pers. com.</i>
Tarangire National Park	Individual identification	6.9	Bernard Kissui, <i>pers. com.</i>
Wami Mbiki Wildlife Management Area	Transect	2.1	Bengt Kvitzau, <i>pers. com.</i>

Based on data available (Table VI) and by using the method previously described (§II.2.2.), the tentative estimate of the total lion population size in Tanzania was about 16,800 individuals (Table VII).

Most lions were found in PAs, with a population size estimated to be around 13,600 (*i.e.* 81%) against around 3,200 individuals in non-gazetted areas (*i.e.* 19%).

#### ○ Frequency of lion observations

In documented non-gazetted areas hosting lions, the species was observed (Map 4; Appendix V):

- Monthly in 23 Districts (*i.e.* 14% of Districts);
- Yearly in 10 Districts (*i.e.* 33% of Districts);
- Rarely in 37 Districts (*i.e.* 53% of Districts).

Due to the lack of information, the frequency of lion observation could not be assessed in 15 Districts. In documented PA with lions, lions were observed (Map 4; Appendix V):

- Weekly in 11 PA<sub>wh</sub> (*i.e.* 68% of PA<sub>wh</sub>) and 62 PA<sub>h</sub> (*i.e.* 46% of PA<sub>h</sub>);
- Monthly in 2 PA<sub>wh</sub> (*i.e.* 13% of PA<sub>wh</sub>) and 40 PA<sub>h</sub> (*i.e.* 30% of PA<sub>h</sub>);
- Yearly in 2 PA<sub>wh</sub> (*i.e.* 13% of PA<sub>wh</sub>) and 10 PA<sub>h</sub> (*i.e.* 7% of PA<sub>h</sub>);
- Rarely in 1 PA<sub>wh</sub> (*i.e.* 6% of PA<sub>wh</sub>) and 23 PA<sub>h</sub> (*i.e.* 17% of PA<sub>h</sub>).

Forty-eight PAs (1 PA<sub>wh</sub> and 47 PA<sub>h</sub>) were not documented in terms of frequency of lion observation.

Units where lions were most often observed (lion strongholds) were located (Map 4):

- In and around the Selous GR;
- In the Serengeti complex (Serengeti NP, NCA and surrounding GRs);
- In and around Tarangire NP;
- In western Tanzania: Moyowosi GR, Ruaha complex (Ruaha NP, Rungwa GR, Kisigo GR, Muhesi GR and surrounding Hunting Areas), Ugalla complex (Ugalla GR and surrounding Hunting Areas) and Katavi complex (Katavi NP, Lake Rukwa GR, Lukwati GR and surrounding Hunting Areas).

**Table VII:** Lion range and population size estimates in Tanzania (January 2010); NGA: non-gazetted area, HA: Hunting Area, NP: National Park, NCA: Ngorongoro Conservation Area; Photo: Photographic block in Selous GR; \* Not included in the density extrapolation; \*\* Speculated Density divided by ten because of the unsuitable mountain habitat - *continued*

Region	Area	Type of area	Surface (km <sup>2</sup> )	Frequency of lion observation	Correcting Factor (CF)	Available density (/100km <sup>2</sup> )	source of data	Area used as reference	Speculated density (/100km <sup>2</sup> ) $D_{est}=D_{ref}*CF_{est}/CF_{ref}$	Speculated population size
Arusha	Karatu	NGA	3962	Rarely	0.04			Tarangire NP	0.28	11
	Monduli	NGA	1713	Monthly	0.15			Tarangire NP	1.03	18
	Burko OA	HA	713	Monthly	0.30	0.84	Derek Hurt, <i>pers. com.</i>	Tarangire NP	2.06	15
	Lake Natron North GCA	HA	3569	Rarely	0.08	0.56	René Warburg, <i>pers. com.</i> ; Wayne Hendry, <i>pers. com.</i>	Tarangire NP	0.55	20
	Lake Natron South GCA	HA	3117	Rarely	0.08			Tarangire NP	0.55	17
	Loliondo GCA	HA	6038	Rarely	0.08			Serengeti NP	1.24	75
	Longido GCA	HA	1456	Rarely	0.08			Tarangire NP	0.55	8
	Monduli Juu OA	HA	696	Rarely	0.08			Tarangire NP	0.55	4
	Mto wa Mbu GCA	HA	1208	NA	0.20			Tarangire NP	1.38	17
	Ngaserai OA	HA	889	Rarely	0.08			Tarangire NP	0.55	5
	Simajaro West GCA	HA	2936	NA	0.20			Tarangire NP	1.38	40
	Yaada Chini OA	HA	500	Rarely	0.08			Tarangire NP	0.55	3
	Lake Manyara*	NP	86	Weekly	1.00	25.65	Yustina Kiwango, <i>pers. com.</i> ; Ikanda & Packer, 2006			22
	Ngorongoro*	NCA	8068	Weekly		1.67	Ikanda, 2006			135
<i>Sub-total</i>										388
Dar Es Salaam	Ilala	NGA	344	Rarely	0.04			Wami Mbiki WMA	0.17	1
	Temeke	NGA	727	Rarely	0.04			Wami Mbiki WMA	0.17	1
	Pande GR	HA	13	Rarely	0.15			Wami Mbiki WMA	0.64	1
<i>Sub-total</i>										3
Dodoma	Bahi	NGA	4630	NA	0.10			Muhesi and Kizigo GR	0.73	34
	Chamwino	NGA	9055	Monthly	0.15			Muhesi and Kizigo GR	1.10	100
	Dodoma	NGA	3223	Rarely	0.04			Muhesi and Kizigo GR	0.29	9
	Kondoa	NGA	10374	Yearly	0.10			Tarangire NP	0.69	71
	Mkungunero GR	HA	732	Monthly	0.56			Tarangire NP	3.87	28
	Swagaswaga GR	HA	851	Monthly	0.56			Tarangire NP	3.87	33
<i>Sub-total</i>										276
Iringa	Iringa	NGA	7332	NA	0.10			Muhesi and Kizigo GR	0.73	54
	Kilolo	NGA	7861	Rarely	0.04			Selous photographic blocks	0.63	49
	Makete	NGA	3669	Rarely	0.04			Selous photographic blocks	0.63	23
	Mufindi	NGA	9486	Rarely	0.04			Selous photographic blocks	0.63	60
	Njombe	NGA	11389	Rarely	0.04			Selous photographic blocks	0.63	71
	Lunda Mkwambi North GCA	HA	1966	Weekly	0.40			Muhesi and Kizigo GR	2.93	58
	Kitulo	NP	426	Rarely	0.20			Katavi NP	0.80	3
	Udzungwa Mountains**	NP	2089	Monthly	0.75	1.20	Trevor Jones, <i>pers. com.</i>	Selous photographic blocks	1.18	25
	<i>Sub-total</i>									
Kagera	Biharamulo	NGA	4175	Rarely	0.04			Moyowosi Njingwe South GR	0.18	7
	Karagwe	NGA	4447	Rarely	0.04			Moyowosi Njingwe South GR	0.18	8
	Ngara	NGA	3225	Rarely	0.04			Moyowosi Njingwe South GR	0.18	6
	Biharamulo GR	HA	723	Monthly	0.56			Moyowosi Njingwe South GR	2.48	18
	Burigi East GR	HA	1739	Monthly	0.56			Moyowosi Njingwe South GR	2.48	43
	Burigi West GR	HA	1112	Monthly	0.56			Moyowosi Njingwe South GR	2.48	28
	Ibanda GR	HA	307	Rarely	0.15			Moyowosi Njingwe South GR	0.66	2
	Ibanda Rumanyika GR	HA	245	Rarely	0.15			Moyowosi Njingwe South GR	0.66	2
	Kimisi GR	HA	966	Monthly	0.38			Moyowosi Njingwe South GR	1.65	16
<i>Sub-total</i>										129
Kigoma	Kasulu	NGA	6209	Yearly	0.10			Moyowosi Njingwe South GR	0.44	27
	Kibondo	NGA	4336	Yearly	0.10			Moyowosi Njingwe South GR	0.44	19
	Kigoma	NGA	8663	Yearly	0.10			Moyowosi Njingwe South GR	0.44	38
	Makere North FR	HA	797	Yearly	0.10			Moyowosi Njingwe South GR	0.44	4
	Makere South FR	HA	581	Yearly	0.10			Moyowosi Njingwe South GR	0.44	3
	Moyowosi Central GR	HA	2512	Monthly	0.56	2.39	René Warburg, <i>pers. com.</i>	Moyowosi Njingwe South GR	2.48	62
	Moyowosi Njingwe North GR	HA	2695	Monthly	0.56	2.23	René Warburg, <i>pers. com.</i>	Moyowosi Njingwe South GR	2.48	67
	Moyowosi Njingwe South GR	HA	3018	Weekly	0.75	3.30	Viljoen <i>et al.</i> , 2004			100
	Moyowosi North GR	HA	3163	NA	0.38			Moyowosi Njingwe South GR	1.65	52
	Uvinza OA	HA	2561	Yearly	0.20	0.31	René Warburg, <i>pers. com.</i>	Moyowosi Njingwe South GR	0.88	23
<i>Sub-total</i>										397

**Table VII:** Lion range and population size estimates in Tanzania (January 2010); NGA: non-gazetted area, HA: Hunting Area, NP: National Park, NCA: Ngorongoro Conservation Area; Photo: Photographic block in Selous GR; \* Not included in the density extrapolation; \*\* Speculated Density divided by ten because of the unsuitable mountain habitat - *continued*

Region	Area	Type of area	Surface (km <sup>2</sup> )	Frequency of lion observation	Correcting Factor (CF)	Available density (/100km <sup>2</sup> )	source of data	Area used as reference	Speculated density (/100km <sup>2</sup> ) $D_{est}=D_{ref}*CF_{est}/CF_{ref}$	Speculated population size
Kilimanjaro	Hai	NGA	1126	Rarely	0.04			Tarangire NP	0.28	3
	Mwanga	NGA	1523	Rarely	0.04			Tarangire NP	0.28	4
	Rombo	NGA	2326	Rarely	0.04			Tarangire NP	0.28	6
	Same	NGA	4436	Rarely	0.04			Tarangire NP	0.28	12
	Kilimanjaro	NP	795	Yearly	0.50			Tarangire NP	3.44	27
	Mkomazi	NP	3446	Monthly	0.75			Tarangire NP	5.16	178
<i>Sub-total</i>										237
Lindi	Kilwa	NGA	6693	Yearly	0.10			Selous photographic blocks	1.57	105
	Lindi	NGA	6362	Yearly	0.10			Selous photographic blocks	1.57	100
	Liwale	NGA	12868	Yearly	0.10			Selous photographic blocks	1.57	202
	Nachingwea	NGA	6537	Rarely	0.04			Selous photographic blocks	0.63	41
	Ruangwa	NGA	2350	Yearly	0.10			Selous photographic blocks	1.57	37
	Kilwa Central OA	HA	1418	NA	0.20			Selous photographic blocks	3.14	45
	Kilwa North OA	HA	2367	Weekly	0.40			Selous photographic blocks	6.28	149
	Kilwa South Mbwele OA	HA	1160	NA	0.20			Selous photographic blocks	3.14	36
	Kilwa South Nakuu OA	HA	1845	NA	0.20			Selous photographic blocks	3.14	58
	Liwale North OA	HA	3673	Monthly	0.30			Selous photographic blocks	4.71	173
	Liwale South OA	HA	1109	Monthly	0.30			Selous photographic blocks	4.71	52
	Matapwa OA	HA	975	Rarely	0.08			Selous photographic blocks	1.26	12
	Selous LL1	HA	1709	Weekly	0.75	2.93	Philippe Clero, pers. com.	Selous photographic blocks	11.77	201
	Selous LL2	HA	1745	Weekly	0.75	7.00	Henry Brink, pers. com.	Selous photographic blocks	11.77	205
	Selous LL3	HA	1709	Weekly	0.75	7.00	Henry Brink, pers. com.	Selous photographic blocks	11.77	201
	Selous MA1	HA	1687	Weekly	0.75	1.07	Dominique Maartens, pers. com. ; Leon Lamprecht, pers. com.	Selous photographic blocks	11.77	199
	Selous MH1	HA	1368	Weekly	0.75	3.66	Philippe Clero, pers. com.	Selous photographic blocks	11.77	161
	Selous MJ1	HA	1941	Weekly	0.75	2.58	Philippe Clero, pers. com.	Selous photographic blocks	11.77	228
	Selous ML1	HA	792	Monthly	0.56	1.26	Philippe Clero, pers. com.	Selous photographic blocks	8.83	70
	Selous MS1	HA	1345	NA	0.38			Selous photographic blocks	5.89	79
	Selous MT1	HA	873	Monthly	0.56	1.14	Philippe Clero, pers. com.	Selous photographic blocks	8.83	77
	Selous MT2	HA	2016	Weekly	0.75	2.48	Philippe Clero, pers. com.	Selous photographic blocks	11.77	237
	Selous N1	HA	1803	Monthly	0.56	0.55	Philippe Clero, pers. com.	Selous photographic blocks	8.83	159
	Selous N2	HA	1032	Monthly	0.56	0.78	Philippe Clero, pers. com.	Selous photographic blocks	8.83	91
Selous U3	HA	777	Weekly	0.75	1.93	Dominique Maartens, pers. com. ; Leon Lamprecht, pers. com.	Selous photographic blocks	11.77	91	
<i>Sub-total</i>										3,010
Manyara	Babati	NGA	3441	Rarely	0.04			Tarangire NP	0.28	9
	Hanang	NGA	3815	Monthly	0.15			Tarangire NP	1.03	39
	Mbulu	NGA	2055	Yearly	0.10			Tarangire NP	0.69	14
	Simanjiro	NGA	2863	Monthly	0.15			Tarangire NP	1.03	30
	Burunge GCA	HA	355	Rarely	0.08			Tarangire NP	0.55	2
	Irkishibor OA	HA	718	NA	0.20			Tarangire NP	1.38	10
	Kitwai North GCA	HA	2476	Weekly	0.40			Tarangire NP	2.75	68
	Kitwai South GCA	HA	2618	Weekly	0.40			Tarangire NP	2.75	72
	Landanai GCA	HA	1295	NA	0.20			Tarangire NP	1.38	18
	Lokisale GCA	HA	1318	Monthly	0.30	1.37	Brian Van Blerk, pers. com.	Tarangire NP	2.06	27
	Masai East OA	HA	2555	Rarely	0.08			Tarangire NP	0.55	14
	Masai South OA	HA	7638	Rarely	0.08			Tarangire NP	0.55	42
	Masai West OA	HA	985	Weekly	0.40	0.71	Brian Van Blerk, pers. com.	Tarangire NP	2.75	27
	Ruvu Masai GCA	HA	2439	Weekly	0.40	0.49	François de Grossoure, pers. com. ; Philippe Clero, pers. com.	Tarangire NP	2.75	67
	Simanjiro Kitangare GCA	HA	1750	Monthly	0.30			Tarangire NP	2.06	36
	Simanjiro Naberera GCA	HA	2184	NA	0.20			Tarangire NP	1.38	30
	Talamai OA	HA	4433	Yearly	0.20			Tarangire NP	1.38	61
Tarangire	NP	2616	Weekly	1.00	6.88	Dennis Minja, pers. com. ; Bernard Kissui, pers. com.			180	
<i>Sub-total</i>										747
Mara	Bunda	NGA	2009	Monthly	0.15			Serengeti NP	2.33	47
	Serengeti	NGA	3520	Rarely	0.04			Serengeti NP	0.62	22
	Fort Ikoma OA	HA	253	Monthly	0.30	4.00	Sue Van Rensburg, pers. com.	Serengeti NP	4.65	12
	Grumeti GR	HA	434	Monthly	0.56			Serengeti NP	8.72	38
	Ikorongo GR	HA	558	Monthly	0.56			Serengeti NP	8.72	49
	Serengeti	NP	13039	Weekly	1.00	15.50	Candida Mwingira, pers. com. ; Ingela Jansson, pers. com.			2,021
<i>Sub-total</i>										2,188

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Region	Area	Type of area	Surface (km <sup>2</sup> )	Frequency of lion observation	Correcting Factor (CF)	Available density (/100km <sup>2</sup> )	source of data	Area used as reference	Speculated density (/100km <sup>2</sup> ) $D_{est}=D_{ref}*CF_{est}/CF_{ref}$	Speculated population size
Mbeya	Chunva	NGA	6985	Rarely	0.04			Katavi NP	0.16	11
	Ileja	NGA	2328	Rarely	0.04			Katavi NP	0.16	4
	Mbarali	NGA	8632	Rarely	0.04			Katavi NP	0.16	14
	Mbozi	NGA	9476	Rarely	0.04			Katavi NP	0.16	15
	Chunya East OA	HA	1551	Monthly	0.30			Katavi NP	1.20	19
	Chunya West OA	HA	5673	Weekly	0.40			Katavi NP	1.60	91
	Lukwati North GR	HA	1427	Weekly	0.75			Katavi NP	3.00	43
	Lukwati South GR	HA	2054	Weekly	0.75			Katavi NP	3.00	62
	Mpanga Kipengere GR	HA	957	Yearly	0.38			Katavi NP	1.50	14
	Piti East OA	HA	2670	Weekly	0.40			Katavi NP	1.60	43
	Piti West OA	HA	1088	Weekly	0.40			Katavi NP	1.60	17
	Rungwa South OA	HA	3831	Weekly	0.40	0.91	Derek Hurt, <i>pers. com.</i>	Katavi NP	1.60	61
	Ruaha	NP	14507	Weekly	1.00			Katavi NP	4.00	580
<i>Sub-total</i>										974
Morogoro	Kilombero	NGA	2721	Monthly	0.15			Selous photographic blocks	2.35	64
	Kilosa	NGA	11797	Yearly	0.10			Selous photographic blocks	1.57	185
	Morogoro	NGA	7313	Rarely	0.04			Selous photographic blocks	0.63	46
	Mvomero	NGA	5386	Yearly	0.10			Selous photographic blocks	1.57	85
	Ulanga	NGA	4496	Yearly	0.10			Selous photographic blocks	1.57	71
	Furua OA	HA	813	Rarely	0.08			Selous photographic blocks	1.26	10
	Gonabisi Kidunda OA	HA	1092	NA	0.20			Selous photographic blocks	3.14	34
	Kilombero North Mgeta GCA	HA	1281	NA	0.20			Selous photographic blocks	3.14	40
	Kilombero North Mlimba GCA	HA	2021	Weekly	0.40	0.59	Michel Mantheakis, <i>pers. com.</i>	Selous photographic blocks	6.28	127
	Kilombero South Bomaulanga GCA	HA	1134	NA	0.20			Selous photographic blocks	3.14	36
	Kilombero South Malinyi GCA	HA	1358	NA	0.20			Selous photographic blocks	3.14	43
	Mahenge North OA	HA	449	NA	0.20			Selous photographic blocks	3.14	14
	Mahenge South OA	HA	560	NA	0.20			Selous photographic blocks	3.14	18
	Mwatisi North OA	HA	1013	Rarely	0.08			Selous photographic blocks	1.26	13
	Mwatisi South OA	HA	1110	NA	0.20			Selous photographic blocks	3.14	35
	Selous K1	HA	332	Weekly	0.75	22.60	Gamshad Gamdust, <i>pers. com.</i>	Selous photographic blocks	11.77	39
	Selous K2	HA	642	Weekly	0.75	9.35	Gamshad Gamdust, <i>pers. com.</i>	Selous photographic blocks	11.77	76
	Selous K3	HA	455	NA	0.38			Selous photographic blocks	5.89	27
	Selous K4	HA	379	NA	0.38			Selous photographic blocks	5.89	22
	Selous K5	HA	586	NA	0.38	7.00	Henry Brink, <i>pers. com.</i>	Selous photographic blocks	5.89	35
	Selous L1	HA	464	NA	0.38			Selous photographic blocks	5.89	27
	Selous LA1	HA	549	Weekly	0.75			Selous photographic blocks	11.77	65
	Selous LU1	HA	2353	NA	0.38			Selous photographic blocks	5.89	139
	Selous LU2	HA	1156	Monthly	0.56	4.00	Henry Brink, <i>pers. com.</i>	Selous photographic blocks	8.83	102
	Selous LU3	HA	613	Monthly	0.56			Selous photographic blocks	8.83	54
	Selous LU4	HA	373	Weekly	0.75			Selous photographic blocks	11.77	44
	Selous LU5	HA	510	NA	0.38			Selous photographic blocks	5.89	30
	Selous LU6	HA	883	Monthly	0.56			Selous photographic blocks	8.83	78
	Selous LU7	HA	1459	Monthly	0.56	0.55	Philippe Clero, <i>pers. com.</i>	Selous photographic blocks	8.83	129
	Selous M1	HA	530	Yearly	0.38			Selous photographic blocks	5.89	31
	Selous M2	HA	395	Weekly	0.75			Selous photographic blocks	11.77	47
	Selous MB2	HA	1054	Weekly	0.75	6.00	Henry Brink, <i>pers. com.</i>	Selous photographic blocks	11.77	124
	Selous MB3	HA	1686	Weekly	0.75	2.97	Philippe Clero, <i>pers. com.</i>	Selous photographic blocks	11.77	198
	Selous MK1	HA	823	NA	0.38			Selous photographic blocks	5.89	48
	Selous R1	HA	455	Monthly	0.56			Selous photographic blocks	8.83	40
	Selous R2	HA	688	Yearly	0.38			Selous photographic blocks	5.89	40
	Selous R3	HA	330	Weekly	0.75	4.84	Michel Mantheakis, <i>pers. com.</i>	Selous photographic blocks	11.77	39
	Selous R4	HA	582	Weekly	0.75			Selous photographic blocks	11.77	68
	Selous U1	HA	589	NA	0.38			Selous photographic blocks	5.89	35
	Selous U2	HA	520	NA	0.38			Selous photographic blocks	5.89	31
	Wami Mbiki WMA	HA	2361	Weekly	0.50	2.12	Bengt Kvitza, <i>pers. com.</i>			50
Mikumi	NP	3234	Weekly	0.75			Selous photographic blocks	11.77	381	
Selous KY1	Photo	539	Weekly	0.90	14.13	Henry Brink, <i>pers. com.</i>			76	
Selous Y1	Photo	867	NA	0.38			Selous photographic blocks	5.89	51	
<i>Sub-total</i>										2,944
Mtwara	Masasi	NGA	4872	Rarely	0.04			Selous photographic blocks	0.63	31
	Mtwara	NGA	4045	Rarely	0.04			Selous photographic blocks	0.63	25
	Tandahimba	NGA	2177	Rarely	0.04			Selous photographic blocks	0.63	14
	Lukwika Lumesule GR	HA	424	Weekly	0.75	3.00	Michel Mantheakis, <i>pers. com.</i>	Selous photographic blocks	11.77	50
Msanjesi GR	HA	142	Monthly	0.56			Selous photographic blocks	8.83	13	
<i>Sub-total</i>										132

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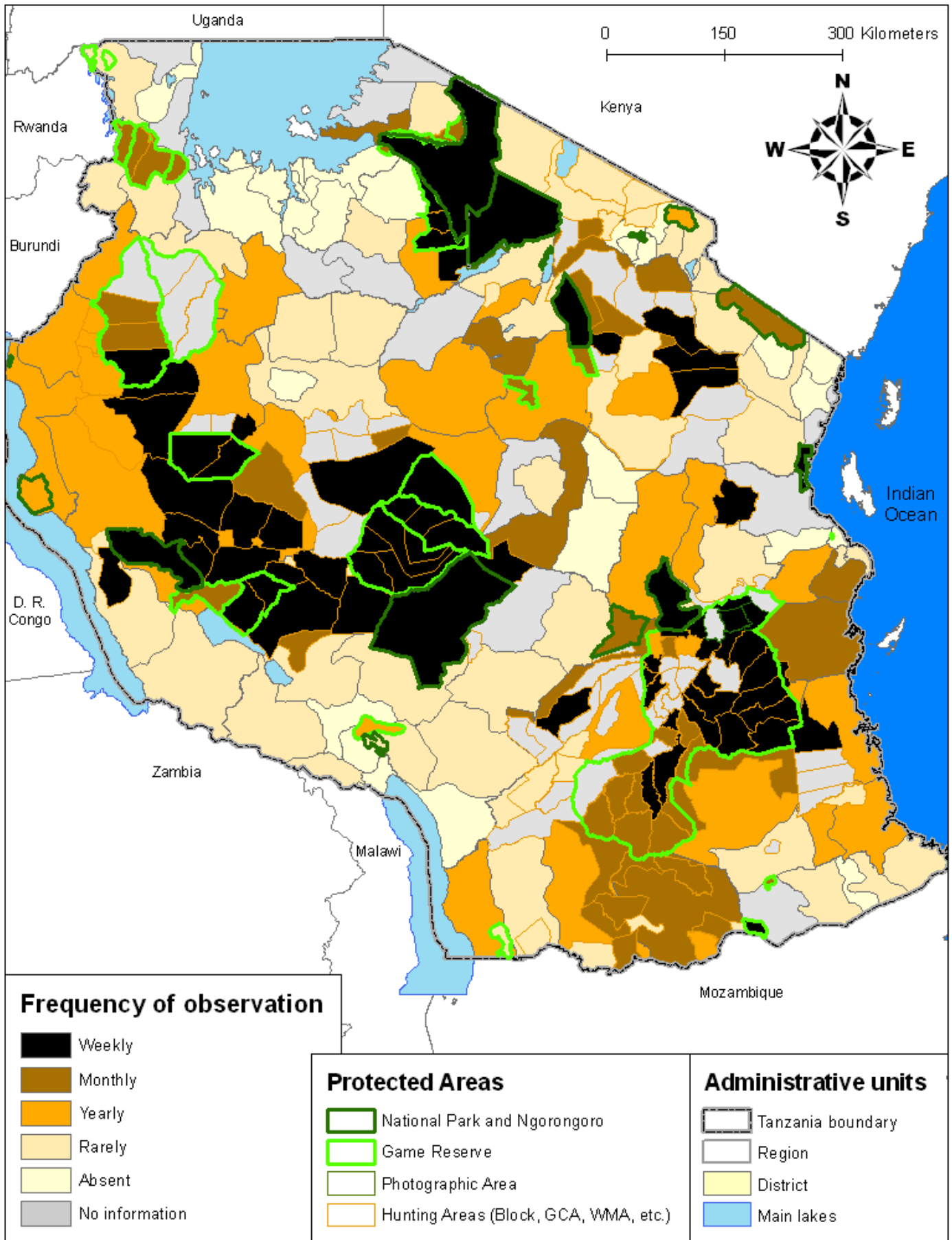
Region	Area	Type of area	Surface (km <sup>2</sup> )	Frequency of lion observation	Correcting Factor (CF)	Available density (/100km <sup>2</sup> )	source of data	Area used as reference	Speculated density (/100km <sup>2</sup> ) $D_{est}=D_{ref}*CF_{est}/CF_{ref}$	Speculated population size
Mwanza	Kijeleshi GR	HA	145	Monthly	0.56			Serengeti NP	8.72	13
<i>Sub-total</i>										
Pwani	Kisarawe	NGA	3828	Yearly	0.10			Selous photographic blocks	1.57	60
	Mkuranga	NGA	2870	Monthly	0.15			Selous photographic blocks	2.35	68
	Rufiji	NGA	10229	Monthly	0.15			Selous photographic blocks	2.35	241
	Selous RU1	HA	1709	Weekly	0.75			Selous photographic blocks	11.77	201
	Selous U4	HA	785	Weekly	0.75			Selous photographic blocks	11.77	92
	Tapika / Ngarambe OA	HA	316	Weekly	0.40	7.00	Henry Brink, <i>pers. com.</i>	Selous photographic blocks	6.28	20
	Selous B1	Photo	845	Weekly	0.90	14.13	Henry Brink, <i>pers. com.</i>			119
Selous Z1	Photo	762	Weekly	0.90	14.13	Henry Brink, <i>pers. com.</i>			108	
<i>Sub-total</i>										
Rukwa	Mpanda	NGA	15775	Yearly	0.10			Katavi NP	0.40	63
	Nkasi	NGA	7814	Rarely	0.04			Katavi NP	0.16	13
	Sumbawanga	NGA	13594	Rarely	0.04			Katavi NP	0.16	22
	Invonga West GCA	HA	2964	Weekly	0.40	1.01	Mike Angelides, <i>pers. com.</i>	Katavi NP	1.60	47
	Lake Rukwa GR	HA	1952	Monthly	0.56			Katavi NP	2.25	44
	Luafi	HA	2133	Weekly	0.40			Katavi NP	1.60	34
	Mlele North GCA	HA	2301	Weekly	0.40	2.17	Mike Angelides, <i>pers. com.</i>	Katavi NP	1.60	37
	Mlele South GCA	HA	1244	Weekly	0.40	1.61	Derek Hurt, <i>pers. com.</i>	Katavi NP	1.60	20
	Msimba West GCA	HA	6133	Weekly	0.40	0.98	Mike Angelides, <i>pers. com.</i> ; Richard Ramoni, <i>pers. com.</i>	Katavi NP	1.60	98
	Nkamha FR	HA	531	Rarely	0.08			Katavi NP	0.32	2
	Rungwa River FR	HA	3153	Weekly	0.40	1.59	Mike Angelides, <i>pers. com.</i>	Katavi NP	1.60	50
	Ugalla Niensi OA	HA	4374	Yearly	0.30			Katavi NP	1.20	52
	Katavi	NP	4279	Weekly	1.00	4.00	Kiffner <i>et al.</i> , 2009			171
<i>Sub-total</i>										
Ruvuma	Mbinga	NGA	7175	Yearly	0.10			Selous photographic blocks	1.57	113
	Namtumbo	NGA	8083	Yearly	0.10			Selous photographic blocks	1.57	127
	Songea	NGA	9537	Rarely	0.04			Selous photographic blocks	0.63	60
	Tunduru	NGA	11019	Monthly	0.15			Selous photographic blocks	2.35	259
	Liparamba GR	HA	605	Rarely	0.15			Selous photographic blocks	2.35	14
	Magwamila OA	HA	1349	Rarely	0.08			Selous photographic blocks	1.26	17
	Mbarang'andu OA	HA	3056	Monthly	0.15			Selous photographic blocks	2.35	72
	Misechela OA	HA	1040	Monthly	0.15	3.00	Michel Mantheakis, <i>pers. com.</i>	Selous photographic blocks	2.35	24
	Mtungwe Central OA	HA	1275	Monthly	0.15			Selous photographic blocks	2.35	30
	Mtungwe North OA	HA	1677	Monthly	0.15			Selous photographic blocks	2.35	39
	Mtungwe South OA	HA	1247	Monthly	0.15			Selous photographic blocks	2.35	29
	Muhuwesi GCA	HA	1812	Monthly	0.15			Selous photographic blocks	2.35	43
	Muhuwesi OA	HA	233	Rarely	0.08			Selous photographic blocks	1.26	3
	Mwambesi GCA	HA	1021	Yearly	0.20			Selous photographic blocks	3.14	32
	Ruhudji / Ifinga OA	HA	2215	Rarely	0.08			Selous photographic blocks	1.26	28
	Ruvuma OA	HA	1729	Rarely	0.08			Selous photographic blocks	1.26	22
	Sasawara FR	HA	563	Rarely	0.08			Selous photographic blocks	1.26	7
	Selous LU8	HA	1623	Monthly	0.56	0.62	François Lyonnet, <i>pers. com.</i> ; Philippe Clero, <i>pers. com.</i>	Selous photographic blocks	8.83	143
	Selous MB1	HA	2149	Monthly	0.56	0.47	Philippe Clero, <i>pers. com.</i>	Selous photographic blocks	8.83	190
	Tunduru OA	HA	1018	Monthly	0.30			Selous photographic blocks	4.71	48
<i>Sub-total</i>										
Shinyanga	Bukombe	NGA	4384	Rarely	0.04			Moyowosi Njingwe South GR	0.18	8
	Kahama	NGA	8281	Yearly	0.10			Moyowosi Njingwe South GR	0.44	36
	Maswa	NGA	4106	Rarely	0.04			Serengeti NP	0.62	25
	Meatu	NGA	3403	Yearly	0.10			Serengeti NP	1.55	53
	Kigosi Central GR	HA	3677	NA	0.38			Moyowosi Njingwe South GR	1.65	61
	Maswa Kimali GR	HA	1341	Weekly	0.75	4.10	René Warburg, <i>pers. com.</i> ; Wayne Hendry, <i>pers. com.</i> ; Ernst Scholz, <i>pers. com.</i>	Serengeti NP	11.63	156
	Maswa Makao OA	HA	1333	Weekly	0.40	2.25	Derek Hurt, <i>pers. com.</i>	Serengeti NP	6.20	83
	Maswa Mbono GR	HA	707	Weekly	0.75	6.50	René Warburg, <i>pers. com.</i> ; Wayne Hendry, <i>pers. com.</i> ; Ernst Scholz, <i>pers. com.</i>	Serengeti NP	11.63	82
Maswa North GR	HA	751	Weekly	0.75	4.00	Withman, 2006	Serengeti NP	11.63	87	
<i>Sub-total</i>										

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Region	Area	Type of area	Surface (km <sup>2</sup> )	Frequency of lion observation	Correcting Factor (CF)	Available density (/100km <sup>2</sup> )	source of data	Area used as reference	Speculated density (/100km <sup>2</sup> ) $D_{est}=D_{ref}*CF_{est}/CF_{ref}$	Speculated population size
Singida	Manyoni	NGA	7204	Yearly	0.10			Katavi NP	0.40	29
	Singida	NGA	13096	Yearly	0.10			Katavi NP	0.40	52
	Kizigo Central GR	HA	1367	Weekly	0.75	5.50	René Warburg, <i>pers. com.</i>			75
	Kizigo East GR	HA	2470	Weekly	0.75	5.50	René Warburg, <i>pers. com.</i>			136
	Kizigo West GR	HA	1120	Weekly	0.75	5.50	René Warburg, <i>pers. com.</i>			62
	Muhesi GR	HA	4433	Weekly	0.75	5.50	René Warburg, <i>pers. com.</i>			244
	Rungwa Ikili GR	HA	2870	Weekly	0.75	0.77	Craig Middleton, <i>pers. com.</i> ; Leon Lamprecht, <i>pers. com.</i>	Katavi NP	3.00	86
	Rungwa Inyonga GR	HA	1786	Weekly	0.75	1.96	Derek Hurt, <i>pers. com.</i>	Katavi NP	3.00	54
	Rungwa Mpera GR	HA	1223	Weekly	0.75	4.09	Michel Mantheakis, <i>pers. com.</i>	Katavi NP	3.00	37
	Rungwa Mwamagembe GR	HA	903	Weekly	0.75	1.11	Nicolas Gazelle, <i>pers. com.</i>	Katavi NP	3.00	27
	Rungwa Rungwa GR	HA	2193	Weekly	0.75	3.65	Nicolas Gazelle, <i>pers. com.</i>	Katavi NP	3.00	66
<i>Sub-total</i>										867
Tabora	Igunga	NGA	6765	Rarely	0.04			Katavi NP	0.16	11
	Nzega	NGA	6343	Rarely	0.04			Katavi NP	0.16	10
	Sikonge	NGA	4954	Yearly	0.10			Katavi NP	0.40	20
	Urambo	NGA	7879	Yearly	0.10			Katavi NP	0.40	32
	Uvui	NGA	9627	Rarely	0.04			Katavi NP	0.16	15
	Chaya OA	HA	877	Monthly	0.30			Katavi NP	1.20	11
	Gombe GCA	HA	2703	Weekly	0.40			Katavi NP	1.60	43
	Inyonga East GCA	HA	2321	Weekly	0.40	2.15	Mike Angelides, <i>pers. com.</i>	Katavi NP	1.60	37
	Inuru Forest OA	HA	2173	NA	0.20			Katavi NP	0.80	17
	Kigosi South GR	HA	3181	NA	0.38			Katavi NP	1.50	48
	Luganzo GCA	HA	5118	Weekly	0.40	0.49	Derek Hurt, <i>pers. com.</i>	Katavi NP	1.60	82
	Rungwa North OA	HA	2593	NA	0.20			Katavi NP	0.80	21
	Ugalla East GR	HA	2142	Weekly	0.75	2.80	René Warburg, <i>pers. com.</i>	Katavi NP	3.00	64
	Ugalla West GR	HA	3050	Weekly	0.75	1.31	René Warburg, <i>pers. com.</i>	Katavi NP	3.00	91
	Ugunda GCA	HA	4836	Monthly	0.30			Katavi NP	1.20	58
Uyumbu WMA	HA	837	Weekly	0.40			Katavi NP	1.60	13	
Wembere South GCA	HA	8434	Weekly	0.40	0.18	Gamshad Gamdust, <i>pers. com.</i>	Katavi NP	1.60	135	
<i>Sub-total</i>										708
Tanga	Handeni	NGA	7587	Rarely	0.04			Katavi NP	0.16	12
	Korogwe	NGA	3974	Rarely	0.04			Tarangire NP	0.28	11
	Handeni GCA	HA	2860	NA	0.20			Wami Mbiki WMA	0.85	1
	Saadani	NP	645	Weekly	1.00			Wami Mbiki WMA	4.24	1
<i>Sub-total</i>										25
<b>Total</b>										<b>16,830</b>



**Map 4:** Frequency of lion observations in Tanzania (by January 2010). Absent: lion presence not recorded in the area; Rarely: lions not recorded every year; Yearly: lions recorded only seasonally or a few times a year; Monthly: lions recorded every month; Weekly: lions recorded regularly throughout the year.

## 2.3. Population trends

Historical global estimates of lion abundance in Tanzania are lacking, which prevents performing documented population trend analysis. However, informants to the present survey have provided information on lion population trends at the scale of PAs and Districts.

- **Historical trends (end of last century)**

The lion abundance has been perceived by two-third of the informants as decreasing by the end of the XX<sup>th</sup> century in most of the geographical units considered in the survey (*i.e.* in 71% of the PAs and 66% of the Districts; Table VIII).

- **Contemporary trends (last five years)**

The lion abundance has been perceived as:

- stable or increasing within PAs by two-thirds of the informants (*i.e.* around 35% of informants considered lion as increasing and around 33% as decreasing; Table VIII);
- decreasing outside PAs by nearly three quarters of the informants.

**Table VIII:** Historical and contemporary trends of lion abundance in Tanzania: perception by informants (source: present inquiry)

Area category	Lion population trends	Contemporary (5 years)		Historical (10years+)	
		N	% within area category	N	% within area category
Protected Areas	Increasing	50	35.2	18	18.0
	Stability	45	31.7	11	11.0
	Decreasing	47	33.1	71	71.0
Districts (Outside Protected Areas)	Increasing	25	23.2	32	33.0
	Stability	5	4.6	1	1.0
	Decreasing	78	72.2	64	66.0

## 3. HUMAN/LION CONFLICT

### 3.1. Magnitude of the conflict

By hosting the world's largest population of lions, the Republic of Tanzania is exposed to human/lion conflicts as defined by the World's Park Congress in 2004 in Durban: "Human/lion conflict occurs when the needs and behaviour of lion impact negatively on the goals of humans or when the goals of humans negatively impact the needs of lion. These conflicts may result when lion injure or kill people and domestic animals" (adapted from: IUCN, 2004).

- **Historical account**

As underlined by many authors (*e.g.* Kingdon, 1989; Songorwa, 1999; Skuja, 2002; Baldus, 2004; Hofer *et al.*, 2004; Hahn, 2008), incidents and accidents between lions and people living side by side with the predator have a long history in Tanzania. During the English colonial period the control of so-called marauding lions was one of the major tasks of the

Department of Wildlife and Vermin Control. As far back as one studies the historical relationship between humans and lions in Tanzania, severe conflicts resulting from the cohabitation with lion came out as prevalent throughout the country.

The southern part of the country is well known to be affected by human/lion conflicts (Baldus, 2004, Packer *et al.*, 2005; Packer *et al.*, 2007). One of the worst human-eating cases on record in Africa occurred in the Njombe District in southern Tanzania: the game ranger George Rushby (1965) reported that between 1932 and 1946 as many as 1,500 people were killed by lions in an area of not more than 2,000 km<sup>2</sup> (Baldus, 2004). According to the first warden of the Selous Game Reserve, Brian Nicholson, these man-eaters were more after cattle and most people killed were not eaten; during the same period some 3,000 heads of cattle were killed by these lions; southern Tanzania was particularly affected by human-eaters with about 200 deaths per year, which is considered higher than nowadays (Baldus, 2004). Also in southern Tanzania, in Tunduru District, human-killers are known for decades. In the same region again, in Lindi District, an outbreak of 140 people killed by lions was reported during the mid 1930s (Kingdon, 1989). To quote a last case in this region, between August 2002 and April 2004 a single lion killed 37 victims in an area of 350 km<sup>2</sup> just 150 km south-west of Dar es Salaam between the Rufiji River and the Selous Game Reserve (Baldus, 2009a).

Other regions of Tanzania have also to face human/lion conflicts. Significant cases have been reported in the Maasai Steppe of northern Tanzania (*e.g.* Maddox, 2003; Ikanda, 2006; Lichtenfeld, 2005, Kissui, 2008a).

Baldus (2004) estimated that over 200 people were killed in Tanzania every year by dangerous animals, of which around one third on average could be by lions. According to Packer *et al.* (2005 & 2007), the problem may have increased dramatically between 1990 and 2004, with the majority of cases occurring in the southern part of the country: the extent of lion attacks in Tanzania may have resulted in more than 560 lethal attacks between 1990 and 2004 and injured at least 308 human beings.

- **Current situation of human/lion conflicts throughout Tanzania**

Today, the human/lion conflict remains a real problem in Tanzania. According to a recent FAO survey (Chardonnet *et al.*, 2010), southern Tanzania - together with northern Mozambique – still appears nowadays on top of the list of all African regions with most human casualties to lion.

This section presents the results of an inquiry on human/lion conflicts (HLC) between 2005 and 2009 which was conducted during the current survey.

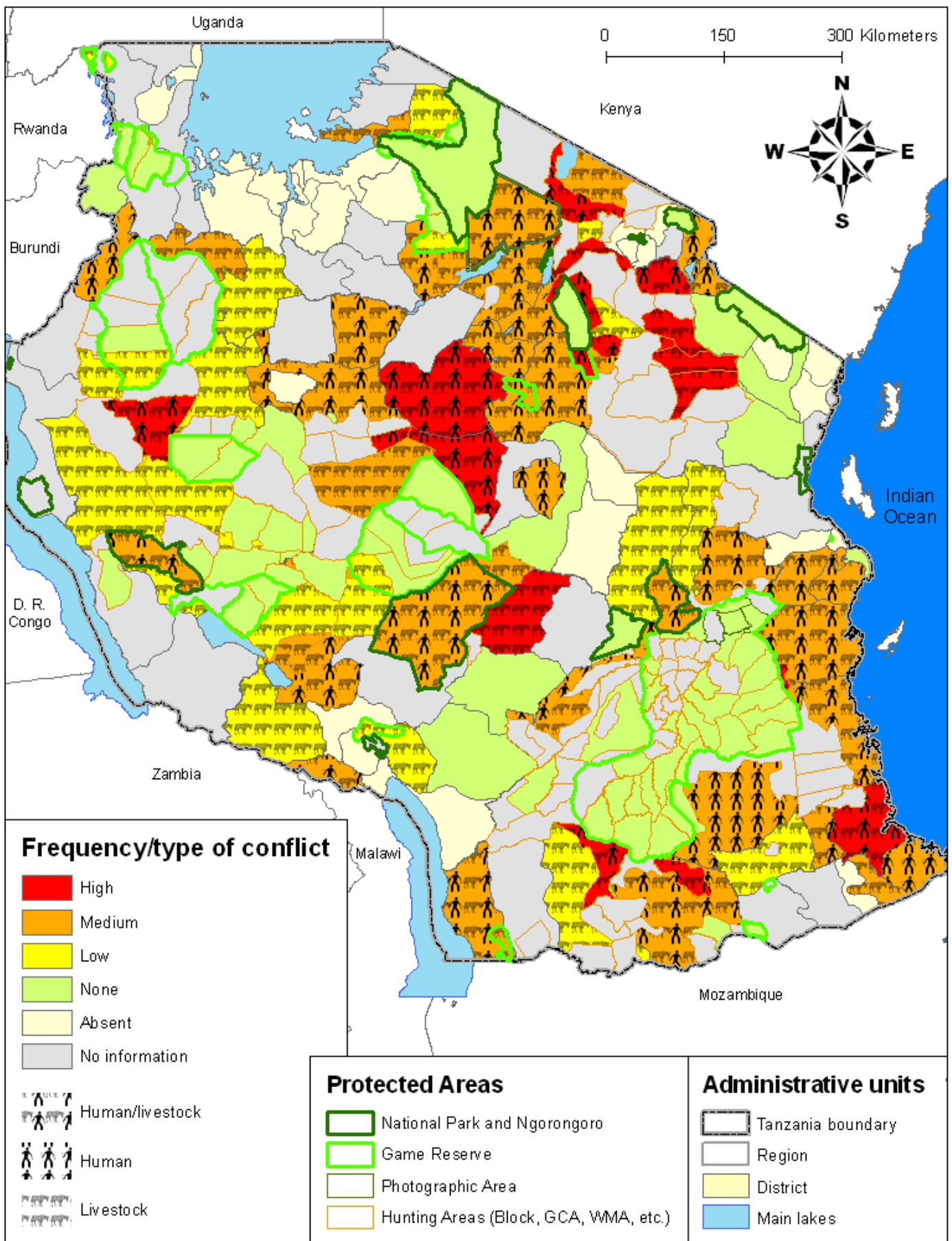
- **Distribution of human/lion conflicts**

The distribution of human/lion conflicts (Map 5, Appendix V) is presented inside and outside Protected Areas. The distribution by regions is described in the next section.

- **In Protected Areas**

The HLC inquiry covered 106 PAs (sample, Table IX):

- 40 PAs (38% of the sample) were affected by HLC;
- 97.5% of the PAs with HLC faced livestock depredation and 42.5% encountered human casualties.



**Map 5:** Frequency and type of human/lion conflicts in Tanzania (by January 2010). Absent: lion presence not recorded in the area; None: conflict presence not recorded in the area; Low: conflicts reported once or twice without human death; Medium: conflicts reported every year and/or with at least one human death; High: conflicts reported several times per year and with human casualties and/or a high number of livestock losses.

The 106 PAs sample was made of 13 PA<sub>wh</sub> and 93 PA<sub>h</sub>:

- Human/lion conflicts were reported in 5 out of the 13 documented PA<sub>wh</sub> (38%), all cases with human casualties and 4 PA<sub>wh</sub> with livestock damages;
- Human/lion conflicts were reported in 35 out of the 93 documented PA<sub>h</sub> (38%); only livestock depredation was recorded.

**Table IX:** Coverage and results of the inquiry on human/lion conflicts inside Protected Areas during the present survey in Tanzania for the 2005-2009 period

Protected Areas (N=201)					
Information				No information	
Lion range	present			absent	16
	183				
Human/lion conflict	existing		none	2	93
	40				
Nature of conflict	human	human&livestock	livestock	66	
	1	16	23		

#### ▪ Outside Protected Areas [in Districts]

The HLC inquiry was carried out in 56 Districts (sample, Table X), *i.e.* 60% of the 97 Districts covered by the present survey:

- 46 Districts (82% of the sample) reported HLC;
- 87% of the Districts with HLC met with livestock depredation difficulties and 67% with human casualty problems.

**Table X:** Coverage and results of the inquiry on human/lion conflicts outside Protected Areas (*i.e.* in Districts) during the present survey in Tanzania for the 2005-2009 period

Districts (N=110)					
Information				No information	
Lion range	present			absent	13
	72				
Human/lion conflict	existing		none	25	29
	46				
Nature of conflict	human	human&livestock	livestock	10	
	6	25	15		

#### ○ Ranking of the lion as problem animal

In the present inquiry, the lion was considered as the most conflicting predator by 42% of the informants (N=272), while leopard and spotted hyena were mentioned as the most conflicting predators by respectively 15% and 16% of the informants. However the lion does not come first in the list of problem animal: the elephant was mentioned as the most conflicting animal by 54% of the informants (N=272). Baboon, other primates, antelopes, hippopotamus, crocodile, wild dog, jackal and porcupine were other species identified as problem animals.

- **Frequency of human/lion conflicts**

- **In Protected Areas**

The frequency of HLC was assessed in all PAs where HLC were reported (40 PAs comprising 5 PA<sub>wh</sub> and 35 PA<sub>h</sub>):

- In PA<sub>wh</sub>, only conflicts of medium intensity were recorded;
    - In PA<sub>h</sub>, the conflict frequency categories were evenly distributed: low in 12 PA<sub>h</sub>; medium in 10 PA<sub>h</sub> and high in 13 PA<sub>h</sub>.

- **Outside Protected Areas [in Districts]**

The frequency of HLC was assessed in all Districts where HLC were recorded (46 Districts). The frequency of HLC was reported as high in 7 Districts (15%), as medium in 29 Districts (63%) and as low in 10 Districts (22%).

- **Nature of the conflict**

- **Overall**

The global picture inside and outside PAs is given by consolidating both sampling units (*i.e.* PAs and Districts) with reports of HLC (N=86):

- Livestock losses occurred in 38 units (44%);
    - Human casualties in 7 units (8%);
    - Both kinds of damages in 41 units (48%).

- **Human casualties**

Within Protected Areas, human casualties were reported in 17 PAs (42% of the PAs with HLC) including 5 PA<sub>wh</sub> and 12 PA<sub>h</sub>.

Outside PAs, human casualties were reported in 31 Districts (67% of the Districts with HLC).

The present inquiry recorded a minimum of 424 human attacks over the past five years in the sampled area of the survey (Table XI), a result which appeared quite consistent with former assessments by Baldus (2004) and Packer *et al.* (2005 & 2007) (see above).

- **Livestock losses**

Within Protected Areas, livestock damages occurred in 39 PAs (37% of the PAs sample). Livestock attacks affected 4 of the 5 PA<sub>wh</sub> with HLC and all the PA<sub>h</sub> with HLC (35).

Outside PAs, 40 Districts out of the 56 sampled (71.5%) experienced cattle depredation with 15 Districts where only livestock was affected by HLC.

A limited number of 29 Districts provided quantitative figures for the number of domestic animals killed by lions. The present inquiry recorded a minimum of 3,405 livestock (cattle, goat, sheep, donkey, pig and dog) lost to lions over the past five years in the sampled area of the survey (Table XII), a result which is quite in accordance with a former assessment of

**Table XI:** Human casualties due to lions reported during the present survey for the 2005-2009 period

Region	District	Protected Area	Human casualties*										Source		
			2005		2006		2007		2008		2009				
			killed	injured	killed	injured	killed	injured	killed	injured	killed	injured			
Arusha	Karatu			1		1	2	1		2				WD	
	Longido	Lake Natron South			1			1		2	1	1	1	Hunting sector	
	Ngorongoro	NCA										2		NCA	
Dar es salaam	Ilala											4		WD	
Dodoma	Dodoma			1				1						WD	
	Kondoa	Swagaswaga GR						2	3	1				WD	
Kigoma	Kibondo					1	2			1				Local Com.	
Kilimandjaro	Mwanga		1	1										Local Com.	
	Rombo									1				WD	
Lindi	Kilwa									1		1		WD	
											1			Local Com.	
	Lindi		1		1		2							WD	
			1	1	1		1							Local Com.	
	Liwale		2		3				1		1			WD	
Ruangwa		3	5	4		1		2		1			WD		
			10	5	28	11								Local Com.	
Manyara	Babati & Hanang	Tarangire NP's border								1		3		ONG	
	Mbulu		2	6		5	1	3				9		WD	
	Simanjiro		2					2	1			3		WD	
		Lokisale GCA				4	1		3	3	11	3	8		WD
							2				4			Local Com.	
Mara	Serengeti	Ikona WMA	1							2				Hunting sector	
Mbeya	Chunya				1									WD	
	Ileje											3		WD	
	Mbarali	Ruaha NP& Usangu GR		2		2								WD	
Morogoro	Kilombero					3								Local Com.	
									1					WD	
	Kilosa	Mikumi NP						1						TANAPA	
	Morogoro								2					WD	
							1								Local Com.
								1						ONG	
Mtwara	Mtwara										1			WD	
Pwani	Kisarawe									1				WD	
	Mkuranga				1										Local Com.
									1						Local Com.
				1				1							Local Com.
	Rufiji										1			WD	
			5						2					WD	
Rukwa	Mpanda	Katavi NP				2	5	7				12		Local Com.	
Ruvuma	Mbinga						1	4						TANAPA	
		Liparamba GR			1	1								WD	
	Tunduru	Muhuwesi GCA	2		5	1	3	4						WD	
Shinyanga	Meatu			7				4		1				Local Com.	
Singida	Manyoni		9		3		11	1	14	3	1			WD	
			1				6	1	7	3	4	2		Local Com.	
	Chaya OA					3								WD	
Singida			6		2		8		8					WD	
Tabora	Igunga		1	1										WD	
			10	4	4	1								Local Com.	
	Sikonge	Ipole WMA						2	1	1				WD	
	Uyui				3									WD	
Countrywide			58	34	59	35	49	39	59	35	26	30			
<b>Total</b>		<b>424</b>		<b>92</b>		<b>94</b>		<b>88</b>		<b>94</b>		<b>56</b>			

\*Figure: number of persons killed or injured by lions



**Table XII:** Livestock depredation to lions reported during the present survey for the 2005-2009 period

Region	District	Protected Area	Livestock depredation*					Source (inquiry)
			2005	2006	2007	2008	2009	
Arusha	Karatu				3	2		WD
	Longido					6 cattle, 11 donkeys		WD
		Lake Natron South GCA		52 cattle	30 goats	25 cattle, 50 goats, 13 sheep	10 cattle, 140 goats, 25 sheep	Local Com.
	Ngorongoro	NCA		5-10	5-10	5-10	>10	Hunting sector
Dodoma	Kondoa		12	7 cattle, 20 goats	3 cattle, 3 goats	3		WD
	Swagawaga GR					1 cattle		WD
Iringa	Makete					10	50	WD
	Njombe	Mpanga/Kipengere GR					8 goats	WD
Kilimanjaro	Mwanga		3 cattle, 10 goats	6 goats	1 cattle	3 cattle	2 cattle	Local Com.
Lindi	Kilwa						1 cattle	Local Com.
	Lindi		2	4	16	7	9	Local Com.
	Nachingwea		4	1	6		2	WD
	Ruangwa		54 goats, 20 sheep, 6 dogs					
				8 goats				Local Com.
Manyara	Babati			3 cattle				Local Com.
	Babati/Simanjiri		(+) 100	(+) 100	(+) 100	(-) 100	(+) 100	ONG
	Hanang		20	10	12	24	30	WD
				7 cattle	3 cattle, 1 donkey	6 cattle		Local Com.
	Mbulu			7 donkeys	4 cattle	1 cattle	4 cattle	WD
	Simanjiri				>100	>100	>100	
Lokisale GCA			7		12 goats	32 cattle	20 cattle, 42 goats, 54 sheep	Local Com.
Mara	Bunda		7	8	14	23	30	Local Com.
	Serengeti	Ikona WMA			3			WD
Mbeya	Chunya		5	2	1	9		WD
	Ileje						3 cattle	Local Com.
	Mbarali	Ruaha NP/ Usangu GR		3 goats				WD
Morogoro	Kilosa	Mikumi NP			4			TANAPA
	Morogoro			1 cattle, 3 goats	18 cattle		10 goats	WD
Mtwara	Tandahimba		15	10	6	4	5	WD
Pwani	Kisarawe				2	23	2	WD
	Mkuranga		10	9	11	7, 6 goats	2, 4 goats	Local Com.
	Rufiji					3		WD
Ruvuma	Mbinga		19	27	6	14	8	WD
		Liparamba GR		21				WD
	Namtumbo						2	WD
	Tunduru	Muhuwesi GCA	59	58	27	1		WD
Shinyanga	Bukombe		15 goats	2 cattle, 4 goats	20 cattle	12 cattle		Local Com.
	Meatu	Makawa Village	11 cattle, 6 goats			24 cattle		Local Com.
Singida	Manyoni				221	89	21	WD
			19 cattle, 15 goats	9 cattle	18 cattle, 15 dogs	2 cattle	5 goats	Local Com.
	Chaya OA		109		202			WD
Tabora	Igunga		3 cattle, 54 goats	3 cattle				Local Com.
	Sikonge	Ipole WMA		17 cattle	9 cattle, 1 goat	19 cattle	29 cattle	WD
	Urambo		16 cattle, 3 goats, 3 dogs	4 cattle, 59 goats, 3 sheep, 1 dog	17 cattle, 4 goats, 1 pig			WD
	Uyui			6				WD
						5 cattle	Local Com.	
<b>Countrywide</b>	<b>Total Livestock</b>	<b>3,405</b>	<b>607</b>	<b>499</b>	<b>924</b>	<b>640</b>	<b>735</b>	

\*Figure: number of livestock killed or injured by lion, the species is indicated when the information is available only

cattle losses estimated at around 500 heads a year (WD records, unpublished, *in* Ikanda, 2006).

- **Current situation of human/lion conflicts at regional level**

The highest figures of human casualties were found in southern Tanzania (33% of cases reported, N=424; Table XI) and in central Tanzania (33% of cases reported), while 27% of the accidents were reported in the northern part of the country and 7% in the western part. The general pattern looks quite in accordance with Packer *et al.* (2005) findings, the differences observed in terms of conflict magnitude within the Districts maybe reflecting more an evolution of the situation rather than discrepancies or methodological differences.

Livestock depredation by lions was widespread across the country (Table XII). Central Tanzania then northern Tanzania, where livestock abundance is high, experienced the most attacks. Fewer incidents were reported in the southern part of the country where livestock is not as abundant for a number of reasons including the tse tse fly constraint.

- **Central and western Tanzania**

The Singida-Manyoni District area is historically known to have experienced major outbreaks in the past, with over 100 people recorded killed in the mid 1940s (Kingdon, 1989). Even recently a high level of conflict still existed. Poussin & Poussin (2004) reported the case of four people killed and one injured within a few days only in Sikonge District, in response eight lions were killed. In our inquiry the human/lion conflict appeared more severe in central Tanzania than in any other parts of the country for the period of 2005-2009, this was to our surprise since southern Tanzania was ranked first by most publications. Both human casualties and livestock depredation particularly affected Manyoni, Singida and Igunga Districts. 93 people had been reported killed or injured by lions during this period in the Singida Region only (Table XI, Map 5).

In central Tanzania (Singida, Dodoma and Morogoro Regions) 24 lions were recorded killed or injured by Problem Animal Control operations during this period (Table XIII) and 31 lion PAC in western Tanzania (Kigoma and Tabora Regions).

- **Southern Tanzania**

In our inquiry, human/lion conflicts were reported on a regular basis every year in southern Tanzania, confirming that the conflict was still pronounced in this part of the country (Map 5). 88 human casualties were recorded in the past five years in the Lindi Region only (Table XI).

49 lion PAC were reported in Lindi, Mtwara and Pwani Regions for the period of 2005-2009 (Table XIII), illustrating the magnitude of the problem.

- **Northern Tanzania**

Our inquiry showed that northern Tanzania experienced severe human casualties by lions during the past five years. 80 people were reported killed or injured in the Manyara Region only (Table XI). Until now only little information was available for northern Tanzania, partly due to lack of proper records at District level (Packer *et al.*, 2005): although an outbreak of

man-eating lions was documented in Babati District (Manyara Region) in the early 1990s, no other outbreak was documented in the north of Tanzania over the past 15 years or so.

12 lion PAC were recorded in Manyara and Kilimanjaro Regions for the period of 2005-2009 (Table XIII).

**Table XIII:** Number of lions killed as Problem Animal Control in Tanzania reported by informants to the present survey

Region	District	Protected Area	Lion killed as PAC*					Source (inquiry)
			2005	2006	2007	2008	2009	
Dodoma	Kondoa					1		WD
Kigoma	Kasulu &	Uvinza OA	(+)-8	(+)-5	(+)-3	(+)-3	(+)-3	Hunting sector
Kilimanjaro	Rombo					1		WD
Lindi	Kilwa					1		WD
	Lindi		1	1	2			Local Com.
	Liwale		4	4	6/3	2		WD
	Ruangwa		3/3	3	3/2	3		WD
Manyara	Hanang					2	4	WD
	Simanjiro	Lokisale GCA					1	Hunting sector
							4	WD
Morogoro	Kilombero				1		WD	
Mtwara	Mtwara						1	WD
	Mkuranga						1	WD
Pwani	Rufiji					3		WD
				1	1			Local Com.
Singida	Manyoni					3		WD
	Singida		5	2	6	6		WD
Tabora	Igunga		2					WD
			5		2			Local Com.
<b>Countrywide</b>	<b>Total lions killed &amp; injured</b>		<b>28/3</b>	<b>16</b>	<b>23/5</b>	<b>27</b>	<b>14</b>	

\*First number: lion killed, Second number: lion injured

### • Predation on endangered species

One neglected aspect of the potential conflict between lions and humans is that of predation by lion on endangered species. Although this is part of a natural process, it may happen that rare species stuck in a 'predator pit' require intervention from managers to escape extinction. The lion may impact the conservation of other large wild carnivores. In the Serengeti ecosystem, lions as well as spotted hyenas regularly kill young cheetahs which have only a 5% chance of surviving to adulthood (Laurenson, 1994). The extinction risk for cheetah is considered high at high lion density (Kelly, 2001). Similarly in Botswana, the lion may account for up to 80% of the mortality in hunting dog (*Lycaon pictus*) and may represent the main limit to the species distribution (McNutt, 2001).

The lion is also known to prey on other rare species such as the chimpanzee (*Pan troglodytes*) (Inagoki & Tsukahara, 1993; Tsukahara, 1993) or even certain antelopes such as the Roan antelope (*Hippotragus equinus*) as it is the case in Kruger National Park, South Africa, where lion predation has been suspected as contributing to the decline of the species (Harrington *et al.*, 1999).

### 3.2. Circumstances of lion attacks

The factors driving the human/lion conflict originate from different sides: man, lion, prey and habitat.

- **The human factor**

In South-Eastern Tanzania, human population densities are low. Precisely because of this low human density, lion populations are widespread outside Protected Areas and the level of incidence of attacks on humans in the region is high. Since 1990, some villages in Tanzania have suffered dramatic attacks by lions on people, probably due to the human population growth (Packer *et al.*, 2005) leading to increasing poaching pressure and decreasing lion prey availability.

The African lion has a tendency to attack humans opportunistically and the victim is usually an easy target, such as a lone individual. While engaged in hunting-related activities, isolated men are more often taken by lions than men in groups. In Tanzania, attacks on men are less often lethal than attacks on women and children (18% of 538 victims in Tanzania were children aged under 10; Packer *et al.*, 2005).

Some human activities and behaviours are associated with increased risk of lion attacks:

- Protection of crops: in some regions, farmers stay in their field to prevent problem animals during the day [birds such as the dioch (*Quelea quelea*), primates such as the baboon (*Papio cynocephalus*)] and during the night [bushpig (*Potamochoerus larvatus*), elephant (*Loxodonta africana*)] from damaging standing crops. In Southern Tanzania, 39% of lion attacks occurred during the harvest seasons and 27% occurred in the fields themselves. The most common context of lion attacks is crop-tending particularly for people sleeping in makeshift huts or platforms made of sticks and branches to protect their crops against nocturnal pests; prey scarcity and bushpig abundance account for over 75% of the variance in the number of lion attacks (Packer *et al.*, 2005).
- Walking at night and sleeping outside in lion country: lions are generally less fearful of man at night than during the day and attacks on people occur more frequently at night (Mike La Grange, *pers. com.*). In Tarangire National Park, Tanzania, human victims were mainly taken at night, *i.e.* 76% of the casualties (Skuja, 2002), which is consistent with lion predatory behaviour, since ambush and escape are easier in the dark.
- Also, the absence of proper latrines in villages is recognized as a risk factor (Packer *et al.*, 2005).

- **The prey factor**

Man and lion are competing for food: lion preys are also bushmeat for people. During the 1980s, fatal attacks by lions in southern Tanzania were attributed to heavy poaching of wild ungulates, so that lions, deprived of natural prey, turned to livestock and entered villages (Nowell & Jackson, 1996). End of XIX<sup>th</sup> century, an outbreak of rinderpest disease killed millions of buffalo (*Syncerus caffer*), antelopes and other African wildlife. Lions had to look elsewhere for food, and attacks on humans increased across a number of countries such as Kenya.

Philippe Chardonnet hypothesises that attacks on humans are likely to be higher in tsetse infested areas where domestic stock, the primary prey choice after wild species, is often missing: as a matter of fact, one of today's prime area with human-eating lions is the contiguous area of south-eastern Tanzania and north-eastern Mozambique where very few cattle occur due to tsetse fly occurrence.

- **The lion factor**

Numerous authors invoke the infirmity theory that injured, sick or old lions are likely to attack humans and cattle (*e.g.* Kruuk, 1980; Patterson & Neiburger, 200; Baldus, 2004).

Sub-adult males may be more likely to kill livestock, but all lions are potential livestock killers (Frank *et al.*, 2008). Attacks on stock are usually carried out by individual animals of either sex or by small groups of young and inexperienced males, possibly animals expelled from prides that have moved out of their range. Culprits might also be mature lions forced out of prides that are no longer capable of killing wild animals as a result of old age or damage to paws or teeth (La Grange, 2005).

One aspect of lion behaviour is “surplus killing”: a lion breaking into a fenced enclosure may kill more, sometimes many more, domestic animals than it can eat (Nowell & Jackson, 1996).

Lions usually prefer to distance themselves from developed areas. However, lions may occur close to human settlements where favourable habitat and adequate prey base in the form of domestic animals are found. Lions’ preference for dense habitat, for example, may increase the likelihood of encounters with humans by giving the opportunity for lions to ambush people and livestock (Saberwal *et al.*, 1994).

- **The habitat factor**

Africa’s vast rangelands are being gradually transformed, mostly by humans though some natural factors are significant. The African lion, like other large carnivores, requires vast areas in which to roam that are currently gradually degraded by people through land conversion for agriculture and livestock development.

Where human encroachment within lion land occurs, human/lion encounters and conflicts are bound to increase.

### **3.3. Biases in conflict assessment**

Both under-reporting and overestimation of human/lion conflicts are common throughout the world because complaints of victims tend to be exaggerated, whereas reactions of non-stakeholders tend to minimize the damage caused.

- **Under-reporting**

For many reasons, under-reporting of human/lion conflicts is huge in many tropical countries such as Tanzania. Generally, reporting is discouraged by the little capacity available for monitoring, recording and compensating damages. The existing reporting system is seldom consistent between Districts as well as between different local cultures. More specifically, illegal cattle herders grazing inside NPs and GRs are not very keen to report depredation and are inclined to solve the problem by themselves. Also, casualties of isolated persons in remote wilderness are likely overlooked. Furthermore, some people might be reluctant to report a given casualty when witchcraft is suspected.

- **Overestimation**

Recent reports assume that, in some rural societies of the sub-region including Tanzania, witchcraft may still be responsible for disguised casualties unduly attributed to the lion, thus overestimating the number of accidents due to real lions.

In December 2009, in Milola Village Lindi Rural, A. B. Maliwata (*pers. com.*) explained that “in 1986 the lion from Newale District (Nyangamara) passed through 9 villages and in each village he ate 2 people until he was killed in Legezamwendo village [Lindi rural]. This was associated with cultural belief. But since that time people believe that lions come from the forest”. Also in December 2009, in Itumba Village, Igunga District, Tabora Region, Juma Kabuta (*pers. com.*) said: “I know two types of lions. Some of them are permanent, they are living in the forest and they are polite; others come from the Reserve. Those lions are in groups and they are not polite at all: they eat people”.

In Southern Tanzania, Baldus (2004) described the connection for local people between human-eating by lions and superstition: a “*simba-mtu*” (a human lion) is an invisible person turned into a lion and killing for revenge. When reported, these cases are real human/lion conflicts although perceived as magical. However, the same author reports opposite situations where real men carried out killings disguised as if they had been done by lions. When reported, these cases tend to overestimate the human/lion conflict and to accuse the lion unfairly.

Similar situations occur in neighbouring countries as well. In Mozambique in the 1980s, some lion attacks were believed to be the work of witchcraft and “spirit-lions” not bush lions; this appears to have declined within the Niassa National Reserve in the 1990s, due to the death of the powerful traditional healer who lived in Mecula (Begg, Begg & Muemedi, 2007). In the 2000s, the same phenomenon appeared in Cabo Delgado Province, and led to a sort of political rebellion (Israel, *in prep.*). In the Niassa National Reserve, spirit lions are named “*lisimba liancuzunza*” in KiCiyao language, “*caramo otantusia*” in KiMakua language and “*simba wa kuzusha*” in KiSwahili language (Colleen Begg, *pers. com.*). In Malawi, so-called “spirit-lions” are named “*walenga*” and are locally regarded as former revengeful chiefs (Carr, 1969).

Interestingly, this phenomenon is known for long. In the late XIX<sup>th</sup> century, David Livingstone, travelling along the Zambezi river, found himself in a district where there were “a great many lions and hyenas, and there is no check upon the increase of the former, for the people, believing that the souls of their chiefs enter into them, never attempt to kill them; they even believe that a chief may metamorphose himself into a lion, kill anyone he chooses and then return to the human form; therefore when they see one they commence clapping their hands, which is the usual mode of salutation here...” (Livingstone, 1857).

### **3.4. Conflict mitigation**

- **General approach in Tanzania**

In Tanzania, the mitigation of human/wildlife conflicts remains a constant source of worries for all stakeholders including the victims themselves as well as the authorities at all levels. The management of human/lion conflicts is a matter of special concern in this particular country because of the dramatic magnitude of the problem and its psychological impact on

local communities coexisting with the large predator. As stated by Shemwetta & Kideghesho (2000), the costs inflicted by wildlife to people and the human problems constraining the wildlife sector in Tanzania have made human/wildlife conflicts one of the major challenges to conservation. High levels of conflicts have the potential to affect global lion conservation in the country (Kushnir, 2006).

Like in many other countries, the control of problem animals in Tanzania is addressed by the Law (Wildlife Conservation Act, 1974; Wildlife Policy, 1998; Wildlife Conservation Act currently under revision; Appendix VI). The legal framework also addresses the defence of people and people's assets. As stated in the Wildlife Policy of Tanzania (1998), holistic approaches are recognised and recommended to solve the problem. For the time being there is no compensation scheme or insurance system for wildlife damages. The Tanzania authorities are exploring new options to mitigate human and wildlife conflicts.

- **Problem Lion Control**

Problem Animal Control (PAC) in Tanzania is achieved through an administrative and technical mechanism falling under the authority of the WD. Records of attacks on people and livestock are kept at District level then transferred to Dar Es Salaam WD headquarters. However, the reporting system needs to be improved by setting up a comprehensive database with standard protocols. According to TAWIRI (2007), data monitoring for livestock attacks is seldom consistent between Districts while official records for man eating are more reliable over most of the country.

When a lion attack is reported to District authorities, the official procedure consists in dispatching game scouts for tackling the issue. As a matter of fact this happens on a regular basis despite the extremely difficult challenge to react appropriately, *i.e.* timely, efficiently, accurately, etc. In case of serious conflicts the District authorities may receive the assistance of the dedicated regional PAC unit. In the recently created Wildlife Management Areas (WMA), village game scouts are employed to defend life and property against wildlife; this is a service to the community which cannot be underestimated; Districts where community-based conservation is introduced now rely heavily on such village scouts (Baldus, 2009b).

However, a number of informants to the present inquiry identified several limits to the system such as late and non-ad hoc response generally attributed to logistical and financial constraints (lack of manpower, transport, ammunitions, funds, etc.). As mentioned by Baldus (2004), the scouts tend to chase away every single lion they succeed to find which may be keeping other more dangerous individuals out.

Problem lions are subject to be removed and eliminated. In the present HLC inquiry, 116 problem lion control cases (lion PAC) have been declared in the sample of 56 documented Districts for the past five years (2005-2009; Table XIII). As a comparison, Baldus (2004) estimated the number of lions killed countrywide under PAC as less than 50 per year.

As mentioned earlier, problem lion control is difficult to carry out. PAC cases happen with lions ending injured or only chased away. During the present inquiry several cases were described of people killed while trying to chase away lions from villages or livestock.

However, when properly implemented, PAC may be an efficient tool and some success stories can be mentioned. In December 2009, in Rufiji District, Salim Malinga (*pers. com.*)

declared: “In 2004, 7 people were killed; the game officers killed 6 lions as PAC; from that time there were few incidents”. Nine lions were killed as PAC after the sadly notorious “Osama case” that killed 35 people in villages along the Selous GR (Baldus, 2006). During the present HLC inquiry, informants from this area confirmed that the situation had really improved since the removal of lions with only a few cases reported since then. In 2008, in the same area, two people were killed but it was associated with the arrival of livestock-keepers in the area. Livestock encroachment is regarded as a factor of risk for lion attacks: the recent arrival of cattle-herders with their stock in the vicinity of rural villages bordering the Selous GR was mentioned by several informants as raising the danger for lions to attack people (e.g. Edmund Kilapilo, Terewa Ndeonansia, *pers. com.*).

It is worth noting that, for some informants, PAC and other conflict mitigation programs should take into account the traditional beliefs on “spirit lions”. According to them, any preventive and deterrent measures would fail if traditional beliefs were neglected.

- **Recent developments in human/wildlife conflict mitigation**

The Tanzanian Government is constantly requested by local communities to solve lion related problems. As a global response, the Tanzanian Government has been encouraging long term integrated approaches for human/lion conflict mitigation, such as Community Based Natural Resources Management. More specific responses, case by case, are given by the various administrations in charge. The WD and TAWIRI are very much involved in developing mitigation strategies, especially by testing both lethal and non-lethal lion control techniques. One example is the WD/TAWIRI joint operation for controlling the man-eating outbreak in Singida region in 2007-2008. TAWIRI has developed a method for monitoring problem animals in five human/wildlife conflict zones with an initial interest in elephant (Hoare & Fyumagwa, 2005).

Furthermore, some progress is currently achieved by several on the ground research projects on human/lion conflict mitigation.

In the Tarangire ecosystem, Laly Lichtenfeld and her colleagues (People & Predators Fund) are studying both ecological and sociological aspects of the human/lion relationship (Lichtenfeld, 2005). The team works in close collaboration with local stakeholders including Maasai communities, wildlife authorities, ecotourism operators, hunting companies etc.

In the framework of the Tarangire Lion Project, Bernard Kissui (African Wildlife Foundation) is studying the dynamic of lions and human/lion conflicts and is looking at reducing lion killing (retaliation and ritual killing) through various means such as improving enclosures (boma) where livestock is parked during the night (Bernard Kissui, *pers. com.*). Steven Kiruswa oversees all related aspects with the local communities.

For decades the Lion Serengeti Project led by Craig Packer has been studying many aspects of the lion ecology in the western corridor of the Serengeti NP as well as elsewhere.

Within this project, Tomas Holmern with colleagues and the Norwegian Institute for Nature Research are studying human/wildlife interactions and take notably into account the economic dimension of the conflicts (Holmern, Nyahongo & Roskaft, 2007).

The Community Conservation Services of TANAPA works on development issues with the local communities bordering the Serengeti National Park (Holmern *et al.*, 2004).

The Ruaha Landscape Program - Carnivore Conflict Project is exploring the driving forces of the conflicts between human activities and five large carnivore species (lion, cheetah, leopard,



wild dog and spotted hyena). The Tanzania Carnivore Unit with Amy Dickman (WCS) and colleagues attempt to quantify the levels of damages experienced by pastoralists around the Ruaha National Park, to inquire on attitudes and perceptions and to investigate the most effective mitigation techniques (Dickman, 2005 & 2008). Other important aspects of the study include training and capacity-building of local people. The results of this work should help improving conservation strategies for large carnivores across a mosaic of situations.

Research works are conducted by Hadas Kushnir on human/lion conflicts in southern Tanzania by analysing the environmental and human factors driving human/lion conflicts in Rufiji and Lindi Districts, two Districts hardly hit by lion attacks (Kushnir, 2006).

#### **4. LION HUNTING**

The lions are protected by legislation wherever they occur in Tanzania (Wildlife Conservation Act, 1974; Wildlife Policy, 1998; Wildlife Conservation Act currently under revision). Informal harvesting of lion is not allowed in Tanzania. If practised, it is treated as poaching and subject to fines and penalties as any illegal activity. Lions are hunted in Tanzania through tourist or sport hunting by foreign tourist hunters while recreational hunting by national citizens is not allowed. Formal harvesting of lion is strictly controlled in Tanzania. Lion hunting is governed by law (Wildlife Conservation Act, 1974; Wildlife Policy, 1998; Wildlife Conservation Act currently under revision). The lions are managed within the context of the ecological systems in which they occur, on the basis of General Management Plans (GMP) in all National Parks, Game Reserves, GCAs and WMAs. The lion is legally considered as a game species. Lion hunting is only permitted in Hunting Areas duly registered as such and comprising Hunting Areas either within GRs, or outside GRs (GCAs, WMAs, or OA<sub>h</sub>). Hunting permits are issued by the WD for the legal hunting season (from July to December). The number of lions hunted is regulated with a fixed annual quota per Hunting Area established by the WD.

Tourist hunting largely contributes to the wildlife sector in Tanzania. According to Baldus (2004), a gross amount of US\$ 27 million is yearly generated by the hunting industry in Tanzania, which includes income to outfitters, auxiliary services taxation, Wildlife Division earnings etc. Tourist hunting generates approximately US\$ 10 million taxes per annum for the Wildlife Division. Lion hunting makes an important contribution to the industry with approximately US\$ 1 million earned directly from lion trophy fees, but a total of US\$ 2.4 million generated through permit fees, daily fees, etc. Lion hunting in Tanzania therefore generates a gross amount of US\$ 6 – 7 million per annum for the hunting industry. Moreover, lions are certainly the major draw that attracts hunting clients to Tanzania (Baldus, 2004). According to Booth (2009), a lion hunt in Tanzania is only available on a 21-day safari at an average cost of US\$40,000 [which is higher than in most other countries with lion tourist hunting]; as a rule, Tanzania does not offer lion hunting only packages since most outfitters have access to large buffalo quotas [since Tanzania hosts the most important population of buffalo in Africa], which provides Tanzania with a competitive edge over outfitters in surrounding countries.

- **Lion quota**
  - **Quota setting**

The annual lion hunting quota is attributed:

- For each specific area where hunting is permitted;
- Per hunting season;
- Revised annually by the relevant wildlife authority (WD);
- For adult male lions only.

The approach used by the WD to allocate quotas relies on field information provided by District Game Officers and other relevant stakeholders, together with past hunting records and recommendations of outfitters and resource persons. Where available, population sizes are obviously taken into account.

- **Quota figures**
  - **Global figure**

According to the WD, the evolution of the national quota for lion was 525 in 2005, 486 in 2006, 511 in 2007, 520 in 2008 and 519 in 2009 (Table XIV).

- **Breakdown**

14% of Hunting Areas did not receive hunting quota for lion. Based on the mean quota of lions per 1,000 km<sup>2</sup> over the past five years (2005-2009):

- 48% of Hunting Areas received a quota under 2.5 lions per 1,000 km<sup>2</sup>;
- 28% of Hunting Areas received a quota between 2.5 and 5 lions per 1,000 km<sup>2</sup>;
- 5% of Hunting Areas received a quota between 5 and 7.5 lions per 1,000 km<sup>2</sup>;
- 5% of Hunting Areas received a quota over 7.5 lions per 1,000 km<sup>2</sup>.

The highest levels of lion quota were recorded in eastern and northern Selous GR, GRs bordering the Serengeti NP, as well as some PA<sub>n</sub> bordering the Tarangire NP (Map 6).

- **Lion hunting offtake**
  - **Global figure**

The recent evolution of the national hunting offtake (realisation) of lion was (Table XIV):

- In 2005: 185 lions, for an overall offtake of 35.2% of the quota allocated;
- In 2006: 278 lions, for an overall offtake of 57.2%;
- In 2007: 176 lions, for an overall offtake of 34.4%;
- In 2008: 160 lions, for an overall offtake of 30.8%.

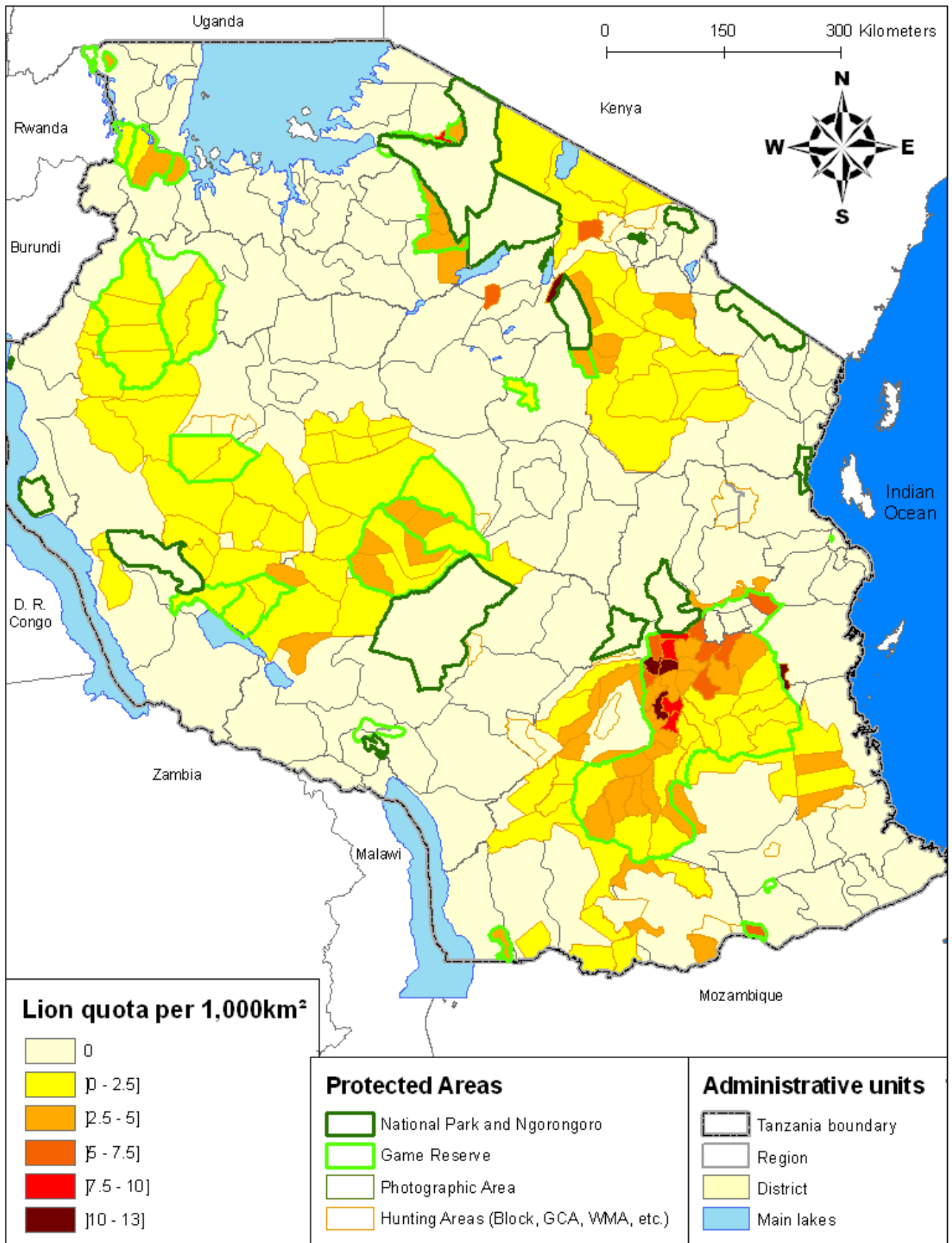
Considering our estimate of lion population size in Tanzania (*i.e.* 16,800; §III.2.2.), tourist hunting in Tanzania harvested a yearly mean of 1.2% (min: 0.95; max: 1.7%) of lions ranging in the country over the past four years.

**Table XIV:** Hunting quotas and lion offtake between 2005 and 2009 (Source: WD); N/A: Non-Available - *continued*

Area Name	Company Name	Quota 2005		Quota 2006		Quota 2007		Quota 2008		Quota 2009	
		Attributed	Realized	Attributed	Realized	Attributed	Realized	Attributed	Realized	Attributed	Realized
Biharumulo GR	Royal Frontiers of Tanzania	2		2		2		2		2	N/A
Burigi East GR	Northern Hunting Enterprises	5		4		5	1	5		5	N/A
Burigi West GR	Kilimanjaro Game Trails	1		1		2		2		2	N/A
Burko OA	Robin Hurt Safaris	4		4		4		4		2	N/A
Burunge GCA	Northern Hunting Enterprises	4	1	4	1	4	1	4		4	N/A
Chaya OA	Marera safari Lodge					3	2	3	1	3	N/A
Chunya East OA	Safari Royal Holdings	4		4		4	4	4	2	4	N/A
Chunya West OA	Old Nyika Safaris	5		4	4	4		4		4	N/A
Fort Ikoma OA	VIP Hunting Safaris LTD	2		2		2		2		2	N/A
Furua OA	Bushman Hunting Safaris	4		2		4	1	4		4	N/A
Gombe GCA	Saidi Kawawa Hunting Safaris				4			5		5	N/A
Gonabisi Kidunda OA	Intercon Adventure Safaris	5	3	4		4	7	4	1	4	N/A
Grumeti GR	VIP Hunting Safaris LTD	2		2		2		2		2	N/A
Handeni GCA	Masailand Hunting Company	2	1	2	1	2		2		2	N/A
Ibanda Rumanyika GR	Tanzania Big Game Safaris	1		1		1		1		1	N/A
Ikorongo GR	VIP Hunting Safaris LTD	2		2		2		2		2	N/A
Inyonga East GCA	Tanzania Safaris and Hunting	4	1	4	3	4	2	4		4	N/A
Inyonga West GCA	Tanzania Safaris and Hunting	5	2	4	4	4	1	4	1	4	N/A
Irkishibor OA	Traditional African Safaris	3		3	3	3	1	3		3	N/A
Iuru Forest OA	Kilimanjaro Game Trails	3		3		2		2	1	2	N/A
Kigosi Central GR	Malagarasi Hunting Safaris	5	1	4	3	4	1	4	1	4	N/A
Kigosi South GR	Malagarasi Hunting Safaris	5	2	4	2	4	1	4		4	N/A
Kilombero North Mgeta GCA	Kilombero North Safaris		1	3	2	3		3		3	N/A
Kilombero North Mlimba GCA	Kilombero North Safaris		2	3	1	3		3	2	3	N/A
Kilombero South Bomaulanga GCA	Wild Footprints	5	1	4	1	4		4	1	4	N/A
Kilombero South Malinyi GCA	Wild Footprints	4	1	4	1	4		4		4	N/A
Kilwa Central OA	Coastal Wilderness	4	1	4	2	4	3	4	1	4	N/A
Kilwa North OA	Coastal Wilderness	4	3	4	4	4		4		4	N/A
Kilwa South Mbweem OA	Safari Club Tanzania	4	4	4	2	3	1	3	5	4	N/A
Kilwa South Nakiu OA	Coastal Wilderness	4	3	4	3	4		4	1	4	N/A
Kimisi GR	Gulf Holding (T) Ltd							5	2	5	N/A
Kitwai North GCA	Gerald Pasanis Safaris Corporation	3		3	2	3	1	3		3	N/A
Kitwai South GCA	Barlette Safaris Corporation	2	3	2	4	4	3	4		4	N/A
Kizigo Central GR	Wengert Windrose Safaris	4	1	4		4		4	1	4	N/A
Kizigo East GR	Wengert Windrose Safaris	4	1	4	1	4	1	4		4	N/A
Kizigo West GR	Tanzania Game Tracker Safaris	3	2	3	1	3	1	3		3	N/A
Lake Natron North GCA	Wengert Windrose Safaris	2		2		2		2		2	N/A
Lake Natron South GCA	Tanzania Wildlife Corporation	3	1	3		3		3		3	N/A
Lake Rukwa GCA	Tanzania Safaris and Hunting	5		4	3	4	1	4	1	4	N/A
Landanai GCA	Luke Samaras Safaris	4		4	1	4	1	4	2	4	N/A
Liparamba GR	Safari Club Tanzania			2		2		2		2	N/A
Litumbandiyosi / Gezamasua FR	Wembere Hunting Safaris			4		2		2		2	N/A
Liwale North OA	Barlette Safaris Corporation	5	2	4	4	4	1	4	4	4	N/A
Liwale South OA	Barlette Safaris Corporation	5	1	4	3	4		4	2	4	N/A
Lokisale GCA	Tanzania Bundu Safaris	4		4		4	1	4	3	4	N/A
Loliondo GCA	Ortello Business Corporation	8		7		7	2	7	3	7	N/A
Longido GCA	Northern Hunting Enterprises	2		2		2	2	2		2	N/A
Luafi	Usangu Safaris	5	1	4	3	4	2	4		4	N/A
Luganzo GCA	Robin Hurt Safaris	7		6	1	6		6		6	N/A
Lukwati North GR	Safari Royal Holdings	3	1	3		3	1	3	4	3	N/A
Lukwati South GR	Safari Royal Holdings	4	2	4	3	4	2	4		4	N/A
Lukwika Lumusule GR	Miombo Safaris	2	1	2	2	3	3	3	1	3	N/A
Lunda Mkwambi North GCA	Foa Adventures Safaris	3	2	2	3	3	3	3		3	N/A
Magwamila OA	Itiryio Hunting Co. LTD	5				3		3		3	N/A
Mahenge North OA	Tanzania Bundu Safaris	3	2	3	2	3		3		1	N/A
Mahenge South OA	Rana Tours and Hunting LTD	3	1	3	2	2		2	2	2	N/A
Makeere Forest Reserve/Uvinza OA	Tanzania Game Tracker Safaris	2		2	1	2		2			N/A
Masai East OA	Tanzania Safaris and Hunting	3		3	2	3	1	3		3	N/A
Masai South OA	Tanzania Safaris and Hunting	2		2	1	2		2		2	N/A
Masai West OA	Tanzania Bundu Safaris	4	1	4	2	4	2	4	2	4	N/A
Maswa Kimali GR	Tanzania Game Tracker Safaris	4		4		4		4	1	4	N/A
Maswa Makao OA	Robin Hurt Safaris	6	1	5	3	5	2	5	4	6	N/A
Maswa Mbono GR	Tanzania Game Tracker Safaris	3	1	3		3		3	2	3	N/A
Maswa North GR	Tanzania Big Game Safaris	3	1	3	2	3	2	3	2	3	N/A
Mbarangandu OA	Game Frontiers of Tanzania	4	1	4	2	4	1	4	1	4	N/A
Mbomipa						2		2			N/A
Mkungunero GR	Western Frontiers Tanzania	4		3		3	4	3		3	N/A
Mlele North GCA	Tanzania Big Game Safaris	4	2	4	1	4	1	4		3	N/A
Moyowosi Central GR	Tanzania Game Tracker Safaris	3	1	3		3	1	3		3	N/A
Moyowosi Njingwe North GR	Tanzania Game Tracker Safaris	3		3		3		3	1	3	N/A
Moyowosi Njingwe South GR	Wengert Windrose Safaris	3		3		3	3	3	1	3	N/A
Moyowosi North GR	Royal Frontiers of Tanzania	6	1	5	1	5	2	5	3	5	N/A
Msanjesi/Lihonja FR	Miombo Safaris		2		2						N/A
Msimba West GCA	Tandala Hunting Safaris	5	2	4				4	2	4	N/A
Msuluguda OA	Kulungu Hunting Safaris LTD					1		1		1	N/A
Mto wa Mbu GCA	Intercon Adventure Safaris	2	1	2	2	2	1	2		2	N/A
Mtungwe Central OA	Western Frontiers Tanzania	3		3		3		3		3	N/A
Mtungwe South OA	M.S.K. Tours & Hunting Safaris Company			2		2		2		2	N/A
Muhsi GR	Wengert Windrose Safaris	3	2	3	3	3		3	1	3	N/A
Muhuwesi GCA	Masailand Hunting Company	4	2	4	3	4	2	4		4	N/A
Mwambesi GCA	Tandala Hunting Safaris	4	3	4		2		2		2	N/A
Mwatisi South OA	Enzagi Safaris	4	1	2		2		2		2	N/A
Mwatisi North OA	Bushman Hunting Safaris				3	4	1	4	1	4	N/A
Ngasera OA	Old Nyika Safaris				1						N/A
Nkamba FR	Saidi Kawawa Hunting Safaris					1	3	1		3	N/A
Piti East/Mlele South GCA	Robin Hurt Safaris	6	2	5	5	5	1	5	5	5	N/A
Piti West OA	Old Nyika Safaris	4	1	4	3	4	1	4	4	4	N/A
Ruhudji / Hinga OA	Rungwa Game Safaris	3		3	3	2		2	1	2	N/A
Rungwa Ikili GR	Tanzania Wildlife Corporation	6	1	4	3	4	2	4	3	4	N/A
Rungwa Inyonga GR	Robin Hurt Safaris	6		5	6	5	4	5	3	5	N/A

**Table XIV:** Hunting quotas and lion offtake between 2005 and 2009 (Source: WD); N/A: Non-Available - *end*

Area Name	Company Name	Quota 2005		Quota 2006		Quota 2007		Quota 2008		Quota 2009	
		Attributed	Realized	Attributed	Realized	Attributed	Realized	Attributed	Realized	Attributed	Realized
Rungwa Mpera GR	Miombo Safaris	4	1	4	4	5	3	6	5	6	N/A
Rungwa Mwangembe GR	Foa Adventures Safaris	4	2	3	2	4	2	4		4	N/A
Rungwa North OA	Mwanauta and Company	2		2	1	2	1	2	1	3	N/A
Rungwa River FR	Tanzania Safaris and Hunting	5		4	2	5	1	5	3	5	N/A
Rungwa Rungwa GR	Foa Adventures Safaris	5	1	3	3	4	4	4		4	N/A
Rungwa South OA	Robin Hurt Safaris	5		4	4	4	4	4	3	4	N/A
Ruvu Masai GCA	Gerald Pasanisi Safaris Corporation	2		2		2		2		2	N/A
Ruvuma OA	Bushman Hunting Safaris			2		2		2		2	N/A
Sasawara FR	Morogoro Hunting Company	5		2		2		2		2	N/A
Selous IH1	Masailand Hunting Company	2	1	2	2	2	1	2		2	N/A
Selous K1	Kiboko Hunting Safaris	3	1	3	4	2		2	1	2	N/A
Selous K2	Kiboko Hunting Safaris	3	2	3	3	1		1	1	1	N/A
Selous K3	Game Frontiers of Tanzania	3	3	3	4	4	1	4		4	N/A
Selous K4	African Trophy Hunting Safaris	5	2	4	2	5	1	5	2	5	N/A
Selous K5	Tanzania Big Game Safaris	2	2	2		2		2		2	N/A
Selous L1	Bright Tours and Safaris	6	2	5	4	5		5	1	5	N/A
Selous LA1	Pori Trackers of Africa	3	2	3	4	3	2	3		3	N/A
Selous LL1	Barlette Safaris Corporation	5	3	4	4	4		4	3	4	N/A
Selous LL2	Barlette Safaris Corporation	5	1	4	2	4	1	4	3	4	N/A
Selous LL3	Luke Samaras Safaris	4	3	4	2	4	2	4	2	4	N/A
Selous LU1	Mwanauta and Company	5	3	4	2	4		4		4	N/A
Selous LU2	Masailand Hunting Company	3	2	3	3	3	2	3		3	N/A
Selous LU3	Traditional African Safaris	3	3	3	1	3		3		3	N/A
Selous LU4	Tanzania Wildlife Corporation	4	3	4	2	4		3		3	N/A
Selous LU5	Tanganyika Game, Fish + Photo	2	4	2		2		2	2	2	N/A
Selous LU6	Tanganyika Wildlife Safari Corporation	5	2	4	2	4	2	4	2	4	N/A
Selous LU7	Tanganyika Wildlife Safari Corporation	5	2	4	4	4	1	4	1	4	N/A
Selous LU8	Tanganyika Wildlife Safari Corporation	5		4		4		4	3	4	N/A
Selous M1	Malagarasi Hunting Safaris	3	3	3	3	3	1	2	1	3	N/A
Selous M2	Pori Trackers of Africa	4	1	4	4	4		4	1	4	N/A
Selous MA1	Tanzania Wildlife Corporation	5	4	4	4	4		4	1	4	N/A
Selous MB1	Tanganyika Wildlife Safari Corporation	5	2	4	3	5	6	5	2	5	N/A
Selous MB2	Tanganyika Wildlife Safari Corporation	5	2	4	2	5	2	5	2	5	N/A
Selous MB3	Gerald Pasanisi Safaris Corporation	2	2	2	2	2	1	2	1	2	N/A
Selous MH1	Gerald Pasanisi Safaris Corporation	1	3	1	2	1	1	1	1	1	N/A
Selous MJ1	Gerald Pasanisi Safaris Corporation	1	2	1	3	1	2	1	1	1	N/A
Selous MK1	Intercon Adventure Safaris	5	3	4	3	4	1	4	4	4	N/A
Selous ML1	Gerald Pasanisi Safaris Corporation	2	1	2	2	2	4	2		2	N/A
Selous MS1	Luke Samaras Safaris	5	3	4	3	5	3	5	5	5	N/A
Selous MT1	Gerald Pasanisi Safaris Corporation	1	2	1	2	1	3	1	1	1	N/A
Selous MT2	Bartlette Safari Corporation	5	2	4	3	4		4	3	4	N/A
Selous N1	Tanganyika Wildlife Safari Corporation	5	1	2	3	4	1	2	1	4	N/A
Selous N2	Gerald Pasanisi Safaris Corporation	2	3	4	4	2		4	2	2	N/A
Selous R1	African Trophy Hunting Safaris	4	2	4	3	4	2	4		4	N/A
Selous R2	Eco Hunting Safaris	3	1	3	2	3	1	3		3	N/A
Selous R3	Miombo Safaris	2	3	2	2	3	2	3		3	N/A
Selous R4	Eco Hunting Safaris	3	3	3	3	3		3		3	N/A
Selous RU1	Luke Samaras Safaris	5	2	4	4	5	3	5	3	5	N/A
Selous U1	African Bush Company	2	2	2	2	2		2	1	2	N/A
Selous U2	African Bush Company	2	1	2	3	2	1	2	1	2	N/A
Selous U3	Tanzania Wildlife Corporation	5	3	4	3	4	1	4	1	4	N/A
Selous U4	Luke Samaras Safaris	4	2	4	3	4	3	4	2	4	N/A
Simajaro West GCA	Tandala Hunting Safaris	3		3	2	3		2	3	2	N/A
Simanjoro Kitangare GCA	Luke Samaras Safaris	3	1	3	2	3	2	3		3	N/A
Simanjoro Naberera GCA	Tanzania Safaris and Hunting	3	1	3	3	2	1	2		2	N/A
Swagaswaga GR	Milanzi Wild Animals Zoo	2		2		2		2		2	N/A
Talamai OA	Royal Frontiers of Tanzania	3		3		3	2	3		3	N/A
Tapika / Ngarambe OA	Game Frontiers of Tanzania	4	1	4	2	4	1	4	2	4	N/A
Tundurua OA	Masailand Hunting Company	4	3	4	4	4	3	4	2	4	N/A
Ugalla East GR	Tanzania Game Tracker Safaris	4	2	4		4	1	4		4	N/A
Ugalla Niensi OA	Robin Hurt Safaris	6		5		5		5		5	N/A
Ugalla West GR	Tanzania Game Tracker Safaris	4	1	4		4	2	4		4	N/A
Ugunda GCA	Northern Hunting Enterprises	5	2	4	2	4	3	4	2	4	N/A
Usangu East GR	Usangu Safaris	5	2	4	2	4	9	4		4	N/A
Usangu West GR	Usangu Safaris	5	3	4	4	4		4		4	N/A
Wembere Central 1 OA	Joyful Adventure					4		4		4	N/A
Wembere Central 2 OA	Safari Club Tanzania					3		3		3	N/A
Wembere North OA	Wembere Hunting Safaris					1		1		1	N/A
Wembere South GCA	Rungwa Game Safaris	3	1	3	3	2	1	2	1	2	N/A
Yaeda Chini OA	Tanzania U.A.E. Hunting Safaris			4		4		4		4	N/A
<b>TOTAL</b>		<b>525</b>	<b>185</b>	<b>486</b>	<b>278</b>	<b>511</b>	<b>176</b>	<b>520</b>	<b>160</b>	<b>519</b>	<b>N/A</b>



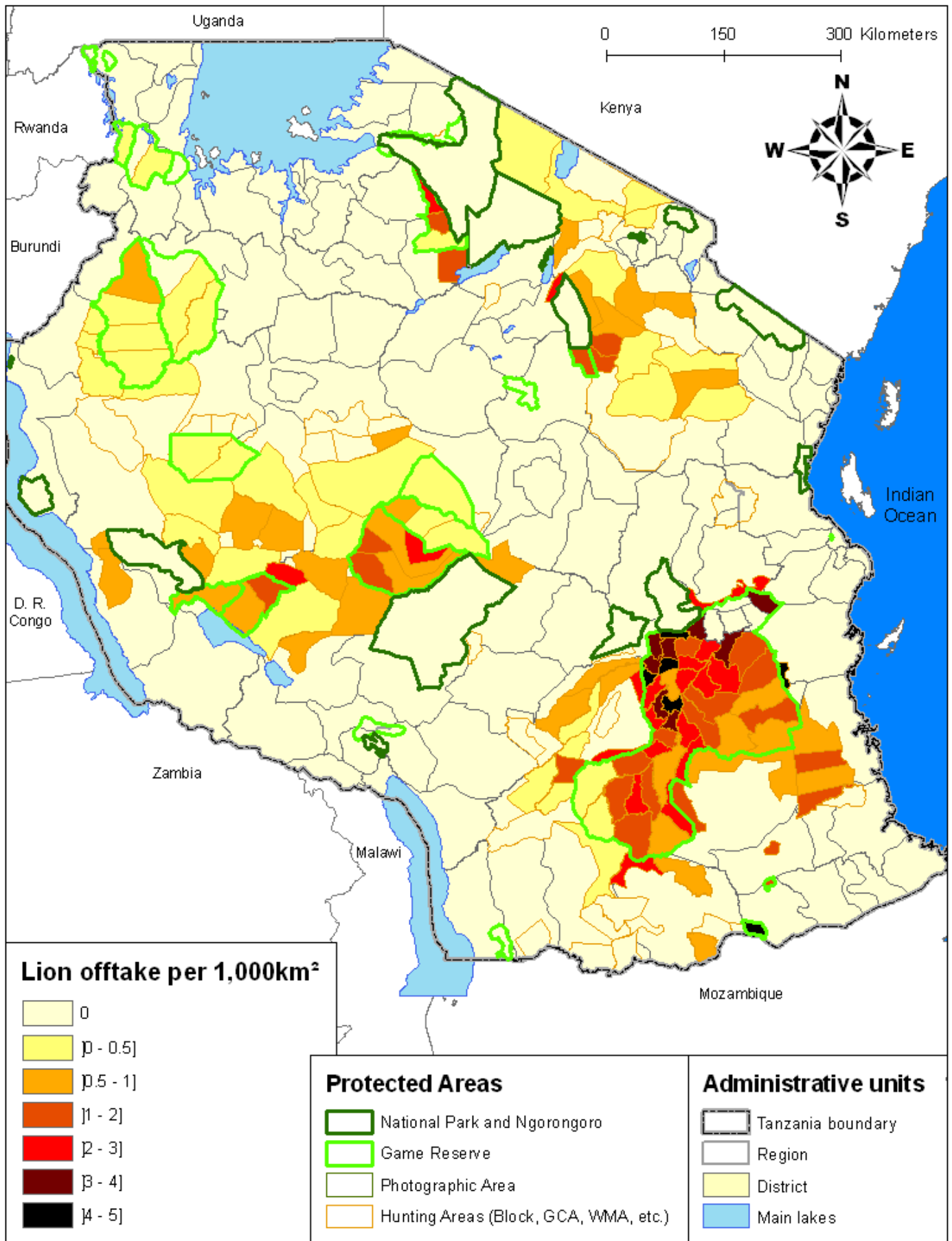
**Map 6:** Distribution of the mean level of lion hunting quota for the past 5 years (per 1,000km<sup>2</sup>) in Tanzania

○ **Breakdown**

26% of Hunting Areas did not hunt lion over the past four years (2005-2008). Based on the mean offtake of lions per 1,000 km<sup>2</sup> over the same period:

- Less than 0.5 lion per 1,000 km<sup>2</sup> was removed in 22% of Hunting Areas;
- Between 0.5 and 1 lion was removed in 19% of Hunting Areas; Between 1 and 2 lions were removed in 14% of Hunting Areas;
- Between 2 and 3 lions were removed in 11% of Hunting Areas;
- More than 3 lions were removed in 7% of Hunting Areas;

The highest mean levels of lion offtake were recorded in and around Selous GR, in the southern border of the Serengeti NP, around the Tarangire NP, in northern border of the Lukwati GR, as well as some PA<sub>h</sub> within Rungwa GR (Map 7).



**Map 7:** Distribution of the mean level of lion hunting realisation (offtake) for the past 4 years (per 1,000km<sup>2</sup>) in Tanzania (figures not available for 2009)

## 5. LEVEL OF KNOWLEDGE OF LION RANGE AND RESULTING GAPS IN KNOWLEDGE

- **Level of knowledge**

- **In non-gazetted areas**

Districts with more than 3 converging sources of information represented 22% of the Districts for the medium level of knowledge category and 4% for the high level category (Map 8; Appendix V; §II.2.3.). The level of knowledge was considered as questionable or poor in 63% of the Districts, while information on lion presence was lacking in 12% of the Districts.

- **In Protected Areas**

The level of knowledge was considered as medium or high in 38% of the PA, as questionable or poor in 54% of the PA while information on lion presence was lacking in 9% of the PA (Map 8; Appendix V).

The level of knowledge was significantly higher in PA<sub>wh</sub> than in PA<sub>h</sub> (Table XV).

**Table XV:** Comparative level of knowledge within Protected Areas (PA), according to their categories (without or with tourist hunting), expressed as a percentage of the concerned Protected Areas

Level of knowledge	PA without hunting	PA with hunting	PA overall
High	42%	1%	5%
Medium	32%	33%	33%
Poor	5%	41%	37%
Questionable	21%	17%	17%
No information	0%	9%	8%

- **Gaps in knowledge**

- **In non-gazetted areas**

Gaps in knowledge were considered as non-existent or minor in 29% of the Districts, as mild in 34% of the Districts and as major in 37% of the Districts (Map 9; Appendix V; §II.2.3.).

- **In Protected Areas**

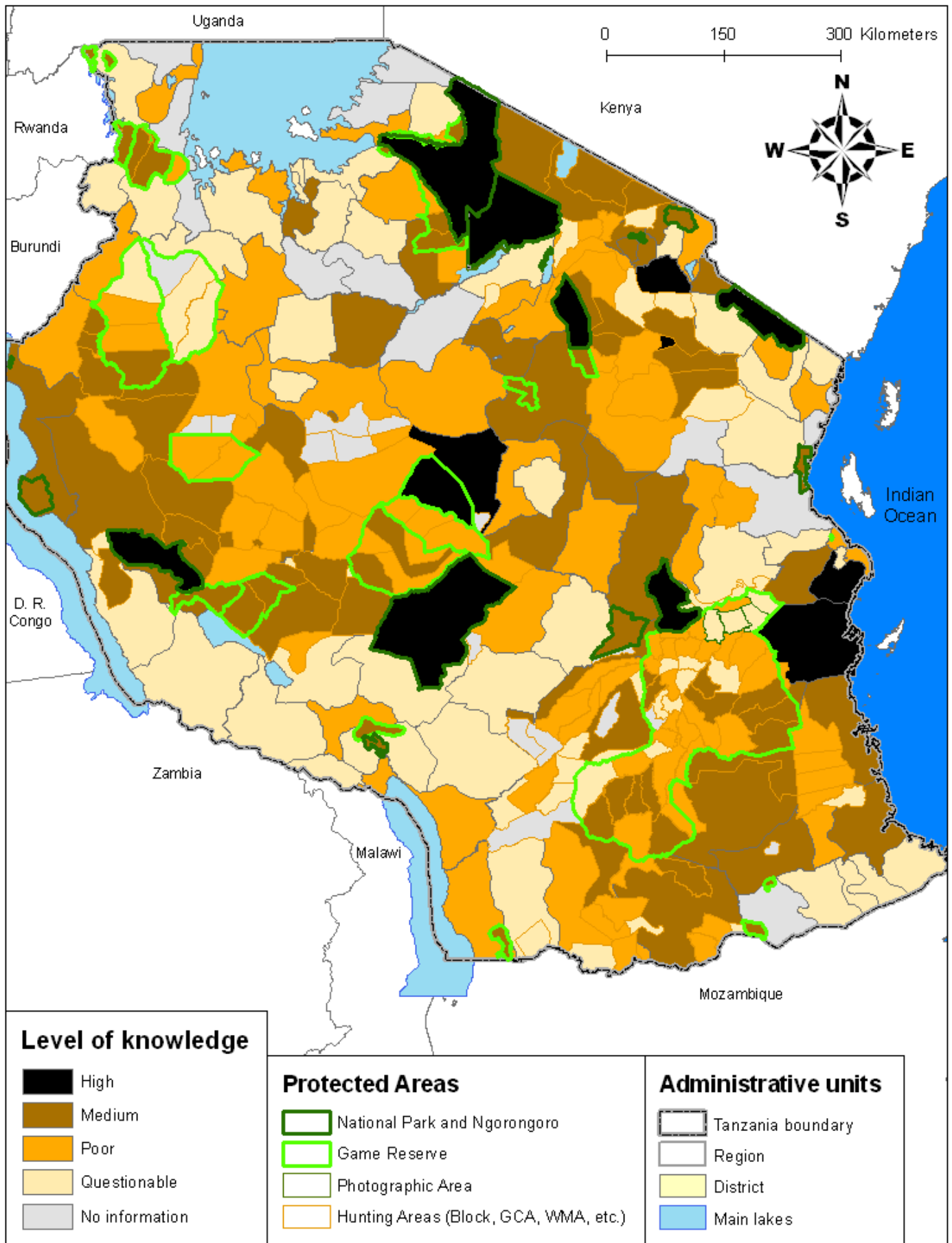
Gaps in knowledge were considered as non-existent or minor in 14% of the PA (Map 9; Appendix V), as mild in 28% of the PA and as major in 58% of the PA.

In relation with the level of knowledge in the two categories of PA, gaps in knowledge were significantly smaller in PA<sub>wh</sub> than in PA<sub>h</sub> (Table XVI).

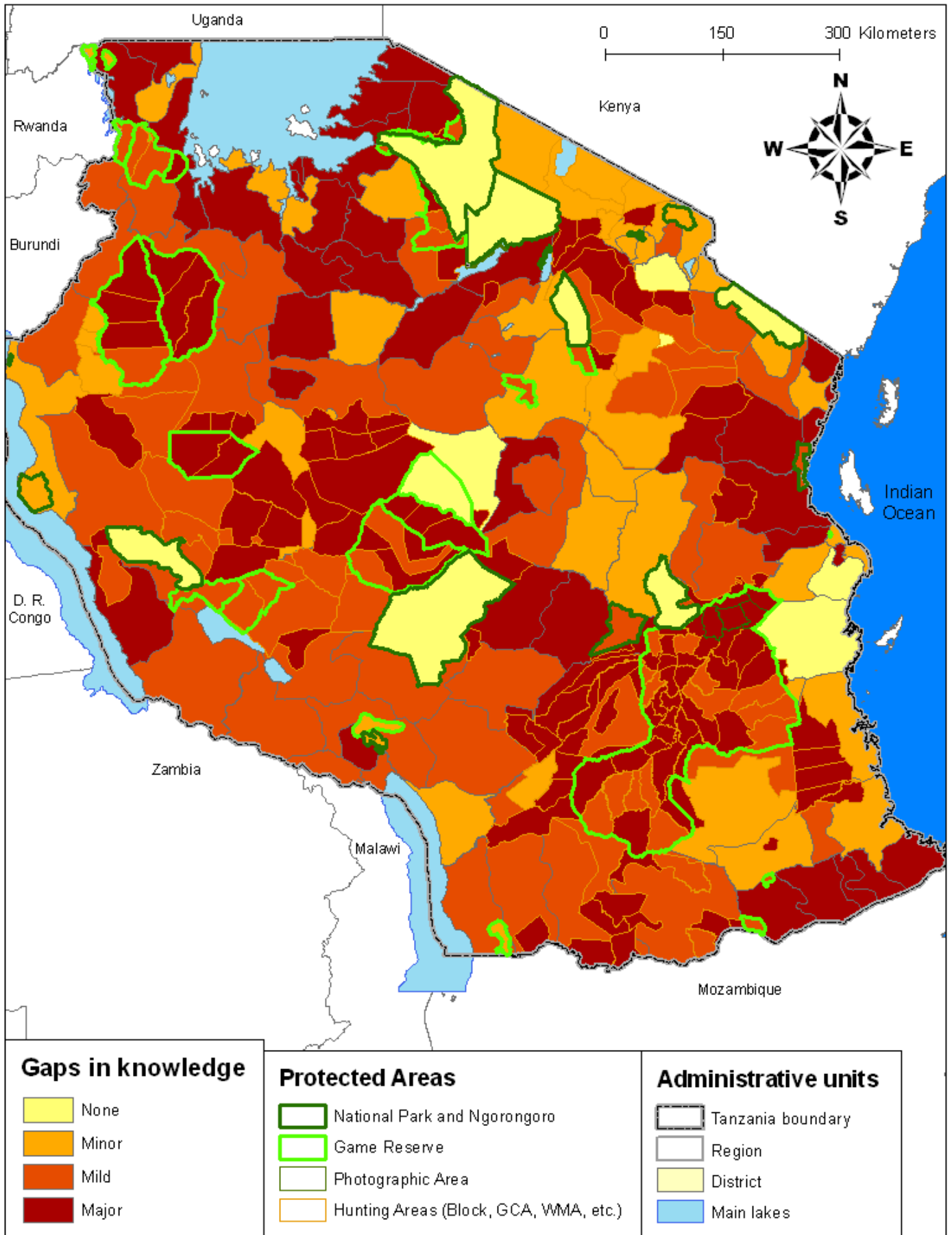


**Table XVI:** Comparative gaps in knowledge within Protected Areas (PA), according to their categories (without or with tourist hunting), expressed as a percentage of the concerned Protected Areas

<b>Gaps in knowledge</b>	<b>PA without hunting</b>	<b>PA with hunting</b>	<b>PA overall</b>
<b>None</b>	42%	1%	4%
<b>Minor</b>	21%	9%	10%
<b>Mild</b>	16%	29%	28%
<b>Major</b>	21%	62%	58%



**Map 8:** Level of knowledge of collated information (by January 2010). Questionable: only one information or two contradictory information; Poor: two or three unpublished information; Medium: four or more information; High: six or more information including a specific lion survey or more than ten information without specific lion survey.



**Map 9:** Gaps in knowledge (by January 2010) that were assessed by combining level of knowledge and frequency of lion observation (refer to §II.2.3.)

## IV. DISCUSSION

### 1. COMMENTS ON METHODS AND RESULTS

- **Data acquisition**

Compared to most lion range countries, Tanzania is granted with a good level of knowledge of its lion populations. The present survey came across around 250 peer-reviewed papers, books and reports addressing Tanzania lion issues.

However, the documentation just mentioned appears quite specific in terms of either location or topic, with very little comprehensive coverage. As a result, according to the present survey, the general level of knowledge on lion in Tanzania appeared medium to poor (Map 8).

The difficulty to collate data is clearly understandable, which explains the strategy of this survey, not to rely solely on existing data, but rather to also generate new information by meeting resource persons and conducting inquiries. The bottom-line of this survey is the genuine georeferenced database which has been set up. The information feeding the database has been collected through:

- The collection of existing information;
- The interviews with informed persons and the questionnaires sent by mail, involving 321 informants across various networks (Appendix IV) and distributed as follows: 51% of informants belonged to natural resources networks (WD, TAWIRI, TANAPA, etc.), 21% to local communities, 16% to the tourist hunting sector, 7% to livestock resources networks and 5% to the NGO/research community.

This approach offers a more cost-effective and less time-consuming alternative to field inventories and censuses. Gros *et al.* (1996) have considered this kind of method as the most accurate indirect method to assess carnivore density in areas which are visited. No other method appeared suitable with limited means at the scale of an entire country.

- **Data analysis**

A first bias for estimating the lion range is the choice of the sampling units which have been used for this survey.

The database and the maps have been established at (i) the level of PAs and (ii) the level of Districts. As a result, the entire surface of a given District or PA was included in the lion range as soon as lion observations were reported in that particular District or PA, even though it does not always imply that lions occur in the entire given District or PA. As a consequence, the proposed lion range might be slightly overestimated.

On the other hand, other parts of the lion range without information might also have been overlooked. Overall, the proposed lion range estimate can still be refined.

- **Gaps in knowledge**
  - **Gaps regarding the lion range**

Districts and PAs have been ranked according to the method previously described (§II.2.3.) for identifying major gaps in knowledge. Most Districts had mild to major gaps in knowledge (*i.e.* 72%; Map 9; Appendix V). Most PA<sub>h</sub> had major gaps in knowledge while most PA<sub>wh</sub> had no gaps in knowledge (Map 9; Table XVI).

Areas with questionable information (N=75, *i.e.* 24% of the areas considered in the survey; Appendix V) have not been prioritized when lions were rarely observed. However, these areas still need some investigation to cross-check the little existing information with additional data.

- **Gaps regarding the lion abundance**

In respect to lion abundance, the gaps in knowledge are huge and higher than the gaps identified in the lion range estimate. The rationale of this result is that it is much more difficult to estimate a lion population size in a given area than to attest the presence of the lion there.

- **Historical account**

Historical reports on lion presence in Tanzania are numerous, although, to our knowledge, little information is available on a precise historical distribution. Most historical accounts tend to show a widespread distribution to the point that, anciently, very few locations in Tanzania did not have lions.

No quantitative figure of historical estimates of Tanzania lion population size was found before 2002, when two surveys brought the first assessments of lion population sizes in Tanzania (Chardonnet, 2002; Bauer & Van Der Merwe, 2004); estimates ranged from 5,300 to 18,200 lions for the whole country.

- **Lion range**

According to the present survey, the lion is still widespread in Tanzania (Map 3): the current lion range covers 92% of the total documented surface of Tanzania (§III.1.2.). A contraction of the lion range is likely due to urbanization and other human encroachments. However, with such a high figure of 92%, a substantial decline could not have happened, which provides evidence for a very small decline in lion range over the years in Tanzania.

The distinction between ranges of permanent and temporary presence remains difficult. When lions are frequently observed, their permanent presence is obvious. However, when lions are rarely seen, it does not readily mean that their presence is not permanent (absence of lion observation is not an evidence of absence of lion). It is especially the case outside Protected Areas where lions can be resident while being highly mobile, extremely elusive and more nocturnal than usual. As a consequence, resident lions might have been mistakenly considered as temporary in some of the non-gazetted areas.

About half of the lion range lies in non-gazetted areas (*i.e.* ~55% of its national distribution; Map 3), confirming that Tanzania is unique in Africa for hosting a large number of lions outside Protected Areas (TAWIRI, 2007).

Comparing ancient maps (*e.g.* Kingdon, 1989; Kingdon, 1997; Chardonnet, 2002; Bauer & Van Der Merwe, 2004; IUCN SSC Cat Specialist Group, 2006) with Map 3 is misleading by giving the impression of an increase in lion range since then. The present survey investigated lion distribution (i) throughout the whole country and (ii) at the relatively fine scale of both sampling units, Districts and PAs. This was not the case for ancient maps which most probably overlooked some of the poorly known areas, thus underestimating the global range.

- **Lion abundance**

- **Population size**

Lion abundance has been extrapolated to around 16,800 individuals for the whole country, a value lying within the range of previous estimates recently published, taking into account the different scales of the various surveys (Chardonnet, 2002; Bauer & Van Der Merwe, 2004; Ikanda & Packer, 2006).

Tanzania lion populations are well monitored in a few areas only, and mostly in NPs (§II.1.1.). Since most lion populations are not yet documented in terms of abundance, the population size proposed in this survey is considered as tentative and subject to refinement.

Where available the estimated figures provided by informants (N = 54) were compared with the calculated figures resulting from our approach (§III.2.2., Table VII). Overall the estimated figures appeared lower than the calculated figures with a mean ratio of estimated figures to speculated estimates of 0.56. Since the lion is reputedly difficult to census (Schaller, 1972), estimated figures by observers are likely less accurate than specific surveys by scientists and tend to underestimate exact population sizes for such a semi-nocturnal carnivore, especially outside NPs where lions tend to become cryptic and elusive. As a consequence, the approach adopted by the present survey made use of calculated figures based on recent data issued from specific surveys by scientists (Table VI) rather than estimated figures by observers.

Several areas came up with extremely low abundance even though the lion presence was confirmed, such as for instance in Saadani NP where the present survey calculated a population size of a single individual (Table VII) while 10 informants confirmed weekly sightings of lions! Such cases suggest that the overall population size might have been underestimated. However, other cases evoke that the overall population might as well have been overestimated (*e.g.* a lion population size of 100 individuals in Chamwiro District). Interestingly, the Selous GR lion population has been estimated at 4,549 individuals in the present survey (Table VII), a value which falls within the range suggested by Henry Brink (*pers. com.*: 3,325 - 6,650).

As any method, the simple model used in the present survey may be further elaborated and improved: additional factors could be considered in a similar way as for a habitat suitability model. However, adding new factors would require considerable investigations out of scope for the present survey. By using such a model, we can hardly conclude whether the figures were overestimated or underestimated: some indications (*e.g.* Saadani NP) suggest

conservative estimates and others optimistic estimates (e.g. Chamwiro District). Anyway, this model can always be repeated for drawing trends.

- **Abundance distribution**

As previously suggested by Chardonnet (2002) who estimated that 92% of lions were located in PAs, the present survey found that a large majority of lions were in PAs (*i.e.* 81%).

- **Population trend**

The absence of ancient estimates of lion abundance in Tanzania prevents performing documented population trend analysis. However, it must be noted that absolute population sizes are not considered as compulsory to properly manage and conserve a given species. Trends are often regarded as more efficient tools. The monitoring of trends requires a set of valuable indicators to be applied on a long enough period of time. This is especially true for hunting quota setting: the results given on population sizes are not much relevant for setting hunting quotas, which emphasizes the need for establishing a proper monitoring scheme in all Hunting Areas.

According to the informants to the present survey (Table VIII):

- lion populations seem to have recovered or stabilized in many PAs since 2005;
- lion populations ranging in non-gazetted areas have mostly decreased over the same period.

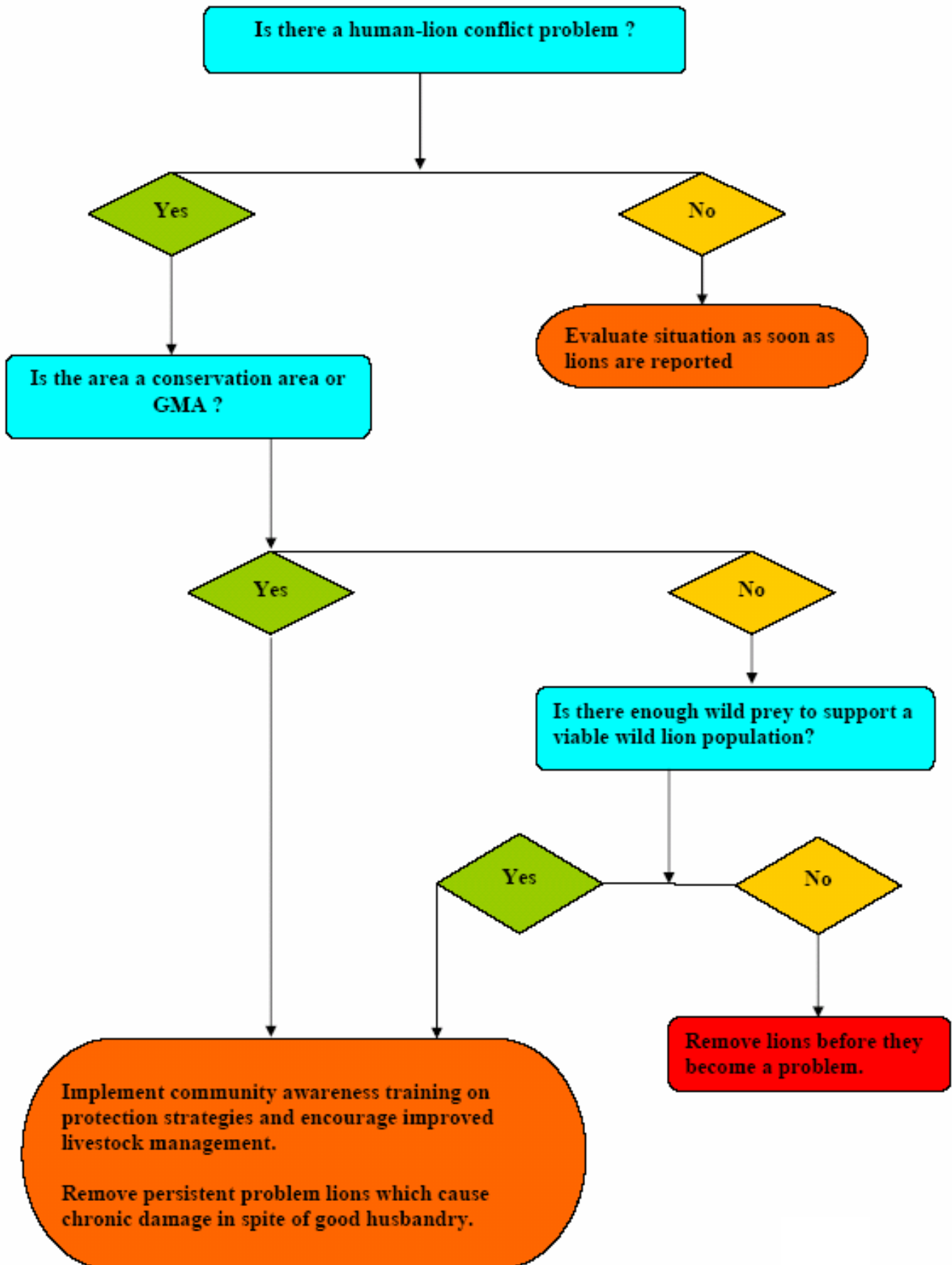
These trend indications are mainly perceptions of local stakeholders with good knowledge of their respective areas and would require further monitoring.

Of the 5 lion populations with long-term data, the Serengeti population has increased since 1966, the Matambwe population (northern Selous GR) has been stable since 1996 and the Katavi, Ngorongoro and Tarangire populations have decreased respectively since 1998, 1982 and 2006 (Packer *et al.*, *submitted*).

Overall, it cannot be rigorously concluded at this stage whether the global lion population in Tanzania is currently declining, stable or thriving.

- **Lion PAC**

The number of lions reported as killed by PAC operations is quite high (Table XIII) and below the real figure because of unreported PAC cases (Linus Chuwa, *pers. com.*). Relying solely on PAC for solving the problem of human/lion conflicts remains questionable in terms of wildlife conservation. PAC is likely to have a great negative effect on lion population because PAC is indiscriminate, often poorly controlled and eliminates all sexes and ages, which is not the case of sport hunting strictly targeting adult males only in controlled and limited numbers. Anderson and Pariela (FAO, 2005a) recognize that: “*while lions are a sought after species for tourists and trophy hunters, under the present circumstances [in Mozambique] it is obvious that costs exceed benefits for lions living amongst people in communal areas*”. However, the same authors have proposed a logical framework for a decision making process to improve the management of problem lions (Figure 1). Recently, a



**Figure 1:** Recommendation for a decision making process to manage human/lion conflict (Courtesy FAO, 2005a & J. Anderson); GMA = Game Management Area.



comprehensive review of alternative methods to PAC has been published by FAO (Chardonnet *et al.*, 2010).

- **Lion hunting**

- **Lion quota**

Hunting quota setting for lion as well as for other game species are set through a procedure of data analysis and consultation: it is essentially based on the quota and offtake of previous years as well as information received from game scouts, tourist hunting companies and other stakeholders. With the exception of the call-in surveys carried out in Moyowosi, Muhesi and Kizigo GRs (Viljoen *et al.*, 2004; Michel Allard, *pers. com.*), very few surveys of lion populations are conducted in PA<sub>h</sub>. In the absence of specific lion census, a set of indirect criteria can be efficiently used for monitoring the lion conservation status and trend in Hunting Areas, and for setting quotas, *e.g.* lion trophy size and trend, lion hunting effort parameters, direct and indirect lion signs and their indices. Participatory methods for setting quotas have been designed and are well known in southern Africa (WWF, 1997; WWF, 2000).

Recent advances suggest that hunting quotas might be replaced by targeted harvests selected upon biological criteria such as minimum tusk length and weight for elephant and minimum body length for leopard. Similarly for lion, Whitman *et al.* (2004) developed a model showing that trophy hunting is likely to have minimal impact on the whole lion population if the offtake is restricted to males older than 6 years of age, regardless of the level of offtake. The rationale is to let enough time for pride males to produce cubs old enough to become independent (*i.e.* to escape infanticide) when incoming males take over the prides. Soon after the publication of the 6 year rule, TAHOA adopted a resolution to apply the rule (TAWIRI, 2007). While some companies do strictly apply the rule, others still need to be trained for ageing lions in the field. However, whether the visual standards used in northern Tanzania for ageing live lions at a distance (Whitman & Packer, 2007) are accurate when applied to other lion populations elsewhere remains questionable. For instance, preliminary results from the Zambia Lion Project provide evidence that the lion nose pigmentation pattern differs between Zambia and northern Tanzania (Paula White, *pers. com.*).

- **Lion offtake**

During the last few years (since 2005), the average yearly lion offtake represented around 1.2% of the lions ranging in Tanzania. This value appears below:

- the 3-10% offtake recommended for sustainable harvest in a lion population when only mature males are hunted (Creel & Creel, 1997; Greene *et al.*, 1998);
- the offtake value of 1.8% assessed in Tanzania for previous years between 2000 and 2004 (Loveridge, Packer & Dutton, 2009). Although the decrease in lion trophy offtake over the past 10 years may have been attributed to former excessive trophy hunting (Packer *et al.*, *submitted*), some important additional factors were not considered in the analysis (*e.g.* clear rising awareness and professionalism, progressive implementation of the 6 year rule, increase in the lion trophy fee, tourism marketing situation, etc.);
- the offtake values recorded in South Africa, Zimbabwe, Cameroon and Burkina-Faso (Loveridge, Packer & Dutton, 2009).

It must be noticed that over the past five years, more than 60% of Hunting Areas outside the Selous GR have harvested less than a lion per 2,000 km<sup>2</sup> (§III.4.; Map 7), while 23% of Hunting Areas inside the Selous GR have harvested less than a lion per 1,000 km<sup>2</sup>. A majority of Hunting Areas outside the Selous GR were therefore already applying a proposed suggestion of limiting the offtake to 1 lion per 2,000 km<sup>2</sup> while a quarter of Hunting Areas inside the Selous GR were already applying the suggested limitation to 1 lion per 1,000 km<sup>2</sup> for the Selous GR (Henry Brink, *pers. com.*; Packer *et al.*, *submitted*).

Implementing a reliable mechanism for controlling lion trophies before exportation would certainly improve hunting management and efficiency.

- **Catch rate**

The annual lion quota has been unchanged for the last 4 years.

The lion offtake has remained stable for the last 4 years (~170 per year) with the exception of a higher figure in 2006.

Thus, the catch rate (lion offtake/lion quota) was constant for the last 4 years (*i.e.* 35% in 2005, 34% in 2007 and 31% in 2008) with the exception of a higher rate in 2006 (*i.e.* 57%).

However, a detailed breakdown analysis per Hunting Area would provide a more useful management tool than a global assessment.

- **Trophy fees**

The trophy fee for lion hunting has increased over the generation, *i.e.* US\$ 2,000 in 2003 and 2004, US\$ 2,500 between 2005 and 2007 and US\$ 4,900 in 2008 and 2009.

Trophy fees for fixed quotas are paid regardless of whether the animals are hunted or not. This system of fixed fees does not provide incentive for hunting operators to avoid young or lions in breeding prides. Placing lions on optional quota, with fees only paid if animals are shot, would encourage a more sustainable offtake.

- **Concession lease**

Outfitters regularly bring up the issue that the short lease issued by the WD (*i.e.* 5 years) is a major obstacle to investment and optimal management of Hunting Areas. Ensuring a longer lease for a sufficient period of time seems to be a key issue for improving the standard of hunting management.

- **Overall lion mortality**

Lion mortality has both natural and anthropogenic origins.

- **Natural mortality**

The main sources of natural lion mortality are diseases, intra-specific and inter-specific competitions (Schaller, 1972). Adult males engage in fierce combats to take over reproductive prides of females (Schaller, 1972). Incoming males taking over prides may be responsible for infanticides (Packer *et al.*, 1988; Stander, 1991). Lion cubs may also be killed by other

predators such as leopard (*Panthera pardus*), hyena (*Crocuta crocuta*) and wild dog (Schaller, 1972).

- **Man-induced mortality**

Loveridge, Packer & Dutton (2009) stated that “Problem animal control, whether legal or illegal, together with loss of habitat, have significantly more impact on lion populations than legalised hunting”.

- **Illegal killing**

Killing of lion by people is considered as mostly due to poaching, either unintentional in the quest of bushmeat or intentional in retaliation and for ritual purposes (*e.g.* TAWIRI, 2007). However accurate figures are not available except in a few particular areas, *e.g.* at least 120 lions ranging in and around Tarangire NP were poached between 2005 and 2009 (Bernard Kissui, *pers. com.*).

- **Legal harvest**

Legal harvest includes PAC operations and tourist hunting. Tourist hunting harvests about 200 lions per year. Lion PAC operations are officially harvesting less than 50 lions every year (Baldus, 2004).

## **2. THREATS TO LIONS**

Tanzania probably holds between a third and a half of the whole African lion population as well as a great share of the Lion Conservation Units (IUCN SSC Cat Specialist Group, 2006). Consequently, any factor affecting lion conservation in Tanzania becomes a threat challenging the conservation of the species over the continent.

### **2.1. Perception of the major threats to lion conservation in Tanzania**

According to the Regional Conservation Strategy for the Lion in Eastern and Southern Africa, the top threats to lion conservation in the Tanzania LCUs included, by order of importance (Table XVII; IUCN SSC Cat Specialist Group, 2006):

- 1) Low prey availability;
- 2) Indiscriminate killing of lions (*e.g.* inadvertent snaring);
- 3) Diseases;
- 4) Low amount of wild habitat available and lion trophy hunting.

Participants to the first national workshop on lion and leopard conservation identified the following threats as relevant to both species (TAWIRI, 2007):

- 1) Retaliatory killing;
- 2) Loss of suitable habitat;
- 3) Inadequate management.

During the present survey, the informants were consulted on their perceptions of threats to lion survival. According to them, the top threats to the lion conservation in Tanzania included, by order of importance (Table XVIII, Appendix VII):

- 1) Livestock encroachment;
- 2) Indiscriminate killing of lions (mostly retaliation and intentional poaching);
- 3) Loss of suitable habitat;
- 4) Lack of prey and inefficacy of management for lion conservation;
- 5) Lion trophy hunting.

Livestock pastoralism was reported as the top ranking threat to lion conservation by the respondents of the present survey (Table XVIII; Appendix VII). This result matched well the Regional Strategy that mentioned livestock encroachment as a recurrent threat to the LCUs, with the exception of the Selous GR where livestock encroachment was not considered as important (Table XVII). However, respondents to the present inquiry have reported that Sukuma people were currently moving with their cattle from the north-western part of the country towards the south-east, more precisely towards the Selous GR.

Respondents to the present inquiry then identified retaliatory killing as a major threat. The high and close ranking scores of livestock encroachment and retaliatory killing illustrate their tight relationship, with retaliatory killing of lions being the principal response of local communities to livestock depredation and human casualties.

Loss of habitat was the third listed major threat perceived by the respondents of the present survey. In contrast, the habitat conservation appeared of second importance in the Regional Strategy.

Lack of prey was not often mentioned as a major threat in the present inquiry, while it came out as the top ranking threat perceived by the Regional Strategy. Similarly, the pathology was not regarded as a high threat by respondents to the present survey, while it was ranked as the third highest threat by the Regional Strategy. This difference might be due to the people involved in the respective studies: most of the respondents to the present survey were local stakeholders while participants to the Regional Strategy were mainly scientists.

Tourist hunting was not raised as a major threat by the participants (i) to the Regional Strategy, (ii) to the first national workshop as well as (iii) by informants contributing to the present survey.

Finally, in our survey threats to lion survival were more frequently reported outside Protected Areas, reflecting more challenging situations there. However, the relative high levels of perceived threats in PAs illustrate that lion conservation is not fully secured within PAs.

**Table XVII:** Assessment and ranking of threats to LCUs in Tanzania according to the Regional Strategy for Lion Conservation (adapted from IUCN SSC Cat Specialist Group, 2006)

Lion Conservation Unit	LCU Type	Population size	Disease	Indiscriminate killing of lions	PAC	Lion trophy hunting	Prey availability**	Livestock encroachment	Habitat conservation	Resource extraction
Selous	I	Large	Some <sup>3</sup>	None <sup>2</sup>	Some	Some <sup>4</sup>	High <sup>1</sup>	None	None	None
Ruaha-Rungwa	I	Large	Some <sup>4</sup>	Some <sup>1</sup>	Some	Lots <sup>3</sup>	High <sup>2</sup>	Some <sup>5</sup>	Some	None
Dar-Biharamulo	II	Large	Some <sup>5</sup>	Lots <sup>1</sup>	Some	None	Low <sup>2</sup>	Lots	Lots <sup>4</sup>	Lots <sup>3</sup>
Maasai Steppe	I	Large	None	Some <sup>1</sup>	Some	Some <sup>5</sup>	Medium <sup>2</sup>	Lots <sup>3</sup>	Some <sup>4</sup>	Some
Serengeti Mara	I	Large <sup>6***</sup>	Some <sup>2</sup>	Some <sup>4</sup>	None	Some <sup>7</sup>	High <sup>1</sup>	Some <sup>5</sup>	None <sup>3</sup>	None
<b>Threat ranking points</b>			<b>3</b>	<b>11</b>	<b>0</b>	<b>1</b>	<b>12</b>	<b>1</b>	<b>1</b>	<b>1</b>

<sup>3</sup>Numbers in superscript indicate the rank of this threat compared to the others

\*\*Threat ranking is for human hunting of lion prey

\*\*\*This threat ranking refers to lion population only in Ngorongoro Crater, a small part of the LCU

**Table XVIII:** Ranking of threats to lion conservation at national scale according to the present survey

Global

Threats	Percentage of informants (N=304)
Livestock occurrence	71
Retaliation	69
Loss of habitat	66
Intentional poaching	61
Inefficient management	54
Lack of prey	53
Unintentional snaring/trapping	52
Official hunting	49
Diseases	46
Human encroachment	10

Protected Areas

Threats	Percentage of informants (N=168)
Livestock occurrence	63
Intentional poaching	61
Retaliation	58
Loss of habitat	58
Inefficient management	52
Unintentional snaring/trapping	51
Official hunting	48
Diseases	46
Lack of prey	45
Human encroachment	12

Non-gazetted areas

Threats	Percentage of informants (N=132)
Livestock occurrence	82
Retaliation	82
Loss of habitat	78
Lack of prey	65
Intentional poaching	61
Inefficient management	58
Unintentional snaring/trapping	55
Official hunting	50
Diseases	46
Human encroachment	5

## 2.2. Major threats to lion conservation in Tanzania

Nearly all the threats mentioned by the informants of the present survey and the Regional Strategy are of anthropogenic origin and more or less interconnected. Their impacts are either direct (lion removed) or indirect (lion weakened by environment degradation).

- **Direct threats**
  - **Lion killing**

In Tanzania, lions are killed both illegally (retaliatory killing, cultural killing & poaching) and legally (PAC & tourist hunting). All these causes responsible for lion mortality are indiscriminate (any sex and age is killed) except tourist hunting which only targets adult males.

- **Retaliatory killing**

Retaliatory killing is considered as the most serious threat to lion conservation in Tanzania by many informants of the present survey (*e.g.* Obed Mbangwa, Bernard Kissui, *pers. com.*) as well as by many studies (*e.g.* Kissui, 2008a & 2009a; Lichtenfeld, 2005; Ikanda, 2006; Ikanda & Packer, 2008; Table XIX). Livestock predation by lions may be the major driver of retaliation but retaliation also responds to human casualties (Frank *et al.*, 2006b).

Retaliatory killing of lions likely occurs everywhere man and lion share land.

The phenomenon is considered as particularly prominent around Tarangire NP and in Ngorongoro Conservation Area (Maasailand) where specific studies have been conducted since a long time. For instance, more than 85 lions were killed around Tarangire NP in 2004-2005 in response to livestock depredation (Kissui, 2008a) and about 35 cases of lion killed were recorded in the NCA between 1998 and 2004 (Ikanda, 2006). Retaliatory killing of lions is a major concern for the survival of the species in Tarangire ecosystem, considering both the extent of lion losses to retaliation and the migration pattern of lions that spend four to six months per year outside the secured Tarangire NP (Kissui, 2008a & 2009a).

However, the present survey discovered that very similar situations were found in areas not formerly covered by studies (*e.g.* Singida District in central Tanzania). The Sukuma people, originating from Mwanza Region, have recently moved to new Regions and wildlife areas in western, central and southern Tanzania where they are known to kill lions in response to livestock depredation or even to prevent the risk (Abrahams, 1967; Paciotti *et al.*, 2005).

High level of retaliatory killing has been linked to high livestock depredation rates (Holmern, Nyahongo & Roskaft, 2007; Ikanda & Packer, 2008). However, when effective protection measures are implemented, local communities are less likely to kill lions (Lichtenfeld, 2005). A wide range of methods was recently reviewed by FAO (Chardonnet *et al.*, 2010) and compiled 4 sets of mitigation measures:

- Lion management;
- Human management;
- Livestock management;
- Environment management.

**Table XIX:** Some examples of lion killing in some areas of Tanzania - *continued*

Area	Period	Lion killed as PAC	Unofficial killing of lions	Comments	Reference
1-2 km from the southeastern end of Tarangire NP border in Kimotorok village / Maasai steppe	August 2009		5 lionesses from a large pride of Tarangire NP poisoned. More lions are presumed to have succumbed to poison.	Preventive killing for human safety and livestock protection	Kissui, 2009a
12 villages of the Maasai Steppe in Northern Tanzania (Emboreet, Engaruka chini, Engaruka juu, Esilalei, Kimotorok, Loboir sired, Loibor soit, Makuyuni, Mswakini chini, Mswakini juu, Oltukai, Selela)	From 2004 to 2005	85 (PAC or/and unofficial killings?)		Retaliatory killings of lions may be driven by traditional ritual hunting ( <i>Ala-mayo</i> ) by Maasai warriors.	Kissui, 2008a
3km inside Tarangire National Park's North-western border, adjacent Minjingu village, and 5km outside Tarangire National Park's North-western border, adjacent Minjingu village	December 2008		2		Kissui, 2009b
Agricultural land along the southern bank of the Rufiji River	In 2002 and part of 2003	9			Baldus, 2004
Area of 2000km <sup>2</sup> in southwestern Tanzania, Wangingombe area.	Between 1932 and 1946	30			Baldus, 2004
Central Tanzania	2000's	3-7 individuals per year			Ikanda, 2008
	2000's	73-77 individuals per year			Ikanda, 2008
Countrywide	From 1990 to 2005		89 killed, 13 injured		Wildlife Division records, unpublished
	Yearly	Less than 50	Rough estimates: between 20 and 400 lions are traditionally hunted by Maasai.		Baldus, 2004
Greater Tarangire-Manyara Ecosystem	Between 2000 and 2005	125 (PAC or/and unofficial killings?)			Kissui, in preparation <i>in Frank et al.</i> , 2006b
Kisaki, north of the Selous Game Reserve	2002		2 individuals	Killing by pastoralists	Baldus, 2004
Loiber Serrit	One yearlong study between 2002 and 2005		9 of the 11 lion depredations resulted in retaliation, 5 lions were killed.		Lichtenfeld, 2005
	2008		12		Kissui, 2009a
	2009		15		Kissui, 2009a
Maasai Steppe	Between January and August 2009		More than 11 lions poisoned, in addition to lions killed by spears, guns, etc. From January to August 2009, more than 23 lions died in human-lion conflicts, making a total of 170 lion deaths in 12 villages since 2004.	Unofficial lion killings. Carbofuran pesticide used to poison lion and other wildlife species. The use of poison is widespread across the Maasai Steppe from the fringes of Lake Natron in Angaruka to the south most end of the Ecosystem in Kotorok.	Kissui, 2009a
Mkongo Ward	Between August 2002 and April 2004	9			Baldus, 2006
Mswakini village / North of Tarangire National Park	November 2006		6		Kissui, 2009b
Near the airport near the coast	1999 and 2000	7			Baldus, 2004
Ngorongoro Conservation Area	Between 1965 and 2003		More than 69		Ikanda & Packer, 2008
	Between 1998 and 2004	35 (PAC or/and unofficial kills?)			Ikanda, 2006
Ngorongoro Crater	1962		Yes, but no figures	The weakened lions (because of the "plague") started taking cattle, and several were killed by angry Maasai.	Packer & Pusey, 1987
Northern Serengeti	From 1980 to 1987		Yes, but no figures		Sinclair, 1995 <i>in Sinclair et al.</i> , 2003
Outside Tarangire National Park	January to May 2005		21 individuals		Craig Packer, <i>pers. com.</i> <i>in</i> Baldus, 2004

**Table XIX:** Some examples of lion killing in some areas of Tanzania - *end*

Area	Period	Lion killed as PAC	Unofficial killing of lions	Comments	Reference
Pawaga-Idodi Wildlife Management Area / southern border of Ruaha National Park	From February 2007 to January 2008		7 interviewees admitted they had killed lions + 2 respondents (Maasai) admitted having been on traditional lion hunts, killing an average of one lion on each hunt.		Dickman, 2008
Rufiji District	Between 1980 and 1990	94 killed and 34 injured		Occurrence of retaliatory killings of lions	Frank <i>et al.</i> , 2006
Serengeti Ecosystem	1992-1993			Snaring	Hofer <i>et al.</i> , 1996
	Dates?		Dozens of individuals per year (caught in snares)		Tanzania National Parks, unpub. data in Ikanda & Packer, 2008
Southern part of the Lunda-Mkwambi Game Controlled Area / Eastern boundary of Ruaha National Park	Recent years		At least 2		Dickman, 2005
Tarangire Ecosystem	From 2002 to 2005		The Maasai induced an annual lion mortality rate between 6.4 and 8.8%, while sport hunting leads to 7.4% to 10.1% in annual adult male mortality.		Lichtenfeld, 2005
Tarangire National Park	From 2003 to 2007		More than 133 individuals killed in villages around Tarangire National Park in retaliation to livestock predation from 2004 to July 2007.	Increase in retaliatory lion killing and offtake by trophy hunting	Kissui, 2008b
Tarangire-Manyara Maasai rangelands	2000's		At least 40 individuals per year to ritual killing, 10% of the lion population.		Maddox, 2003; Ikanda, 2006
Village of Loibor Serrit	March 2009		More than three lions killed by poison.		Kissui, 2009a
Villages in Loliondo Game Controlled Area and Ngorongoro Conservation Area (NCA)	Between April 1999 and May 2001		Use of poison or snares in response to attack. More than 70% of respondents have participated in at least one traditional Maasai lion hunting, removing an estimated 30-40 lions from the entire Tanzanian and Kenyan Maasailand.		Maddox, 2003
Villages of Endulen, Kakesio, Oloirobi, Nainokanoka, Naiyobi, Olduvai, and Laitoli / Ngorongoro Conservation Area	From 1965 to 2002		69 killed over a 38 year period (87% of males)		Ikanda, 2006
Villages of Esilalei, Selela, Loiborsoit, Emboret, Engaruka chini and juu, Oltukai, Minjingu, Makuyuni, Loibo-serit, Lolkisale and Mswakini / Tarangire Ecosystem.	From 2004 to 2009		More than 149		Kissui, 2009b
Villages of Lolkisale, Narakauo, Loiber Serrit along the eastern boundary of Tarangire National Park	From July to December 2002		Around 17 lion deaths/year		Lichtenfeld, 2005
Tunduru district	Since 1980	At least 83 lions; almost half of these were killed after a major man-eating outbreak in the late 1980s			Frank <i>et al.</i> , 2006



### ▪ Cultural killing

Traditional cultural practices, including spearing of lions, remain widespread in East Africa.

Traditionally, the Maasai engage in ritual lion hunts called *Ala-mayo* to express bravery and rite of passage to adulthood (Spencer, 1988). When a particularly large-manned lion is killed, the mane is taken and used at ceremonies or hung upon the warrior's village flag pole. When a lion is killed, the tail is cut off and becomes the property of the warrior who put the first spear in. After the initial celebrations, this tail is discarded. Paws are also cut off and used in the celebrations and then also discarded. Paws and teeth appear not to be kept. In case of lion poisoning, nothing is taken (Bernard Kissui, *pers. com.*).

However, in Tarangire ecosystem, *Ala-mayo* was considered as rare compared to retaliatory killing (Kissui, 2008a).

The Sukuma and Datoga peoples were also said to conduct ritual killings of lions, but to our knowledge the extent is not much documented.

### ▪ Poaching

Besides retaliatory killing and cultural killing, lions may be intentionally poached for commercial or traditional purposes, *e.g.* for its fat which when eaten is believed to boost courage (Haule *et al.*, 2002).

More often, lions are unintentionally caught in wire snares set for ungulates (Photo 2; Turner, 1987; Arcese *et al.*, 1995). Illegal game hunting for bushmeat is largely carried out by using snares in the south-western, western and north-western regions of the country. A wire snare may cause serious even lethal injuries to a lion caught (Hofer *et al.*, 1996). Dozens of lions are inadvertently killed in poachers' snares each year throughout the Serengeti ecosystem (TANAPA, unpublished data, *in* Ikanda & Packer, 2008).



**Photo 2:** Lion snared by bushmeat poachers in a Hunting Area, Tanzania, 2009, ©*Jérôme Latrive*

- **Problem Animal Control**

The number of lions reported as killed by PAC operations is already quite high and is likely below the real figure because of unreported PAC cases. As already mentioned in the PAC section, although PAC is an important legal measure of conflict mitigation, the progress margin is big in view of the indiscriminate and poorly controlled mechanism in place.

- **Tourist hunting**

On one hand, tourist hunting has been considered by some scientists as having a negative impact on lion demography when unsustainably practiced (*e.g.* Loveridge & Macdonald, 2002; Packer *et al.*, 2006; Withman *et al.*, 2007; Songorwa & Du Toit, 2008; Caro *et al.*, 2009). In a recent study, Packer *et al.* (2009) reported that the steepest declines in lion populations were observed in areas with the highest harvest intensities, which suggests that trophy hunting potentially contributes to declining lion numbers in these particular areas. The underlying mechanism highlighted by their population dynamic models is the removal of pride holding males, which results in loss of recruitment because incoming males are prone to kill cubs fathered by other males (Greene *et al.*, 1988; Whitman *et al.*, 2004 & 2007). However, a comprehensive and objective analysis, based on a new specific study to collect accurate quantified data, still needs to be conducted for properly quantifying the balance between positive and negative impacts of tourist hunting compared to the many other sources of lion mortality.

On the other hand, tourist hunting is known to set aside extensive areas for nature conservation. In Tanzania, proclaimed Protected Areas gazetted as Hunting Areas (*i.e.* 295,662 km<sup>2</sup>) are 5.1 times larger than Protected Areas without tourist hunting activity (*i.e.* 57,838 km<sup>2</sup>). The presence of a regulated hunting industry contributes significantly to reducing the illegal activities of poachers and provides an economic incentive to protect vast areas (Baldus & Cauldwell, 2004). Lions take advantage of such a safe environment with a secure prey basis and less poaching pressure than in non-gazetted areas. Without this industry, the Hunting Areas would be converted into agricultural and pastoral land with very little chance for biodiversity conservation. Tourist hunting therefore substantially contributes to protection of habitat (Loveridge *et al.*, 2007). Also, because most of the Hunting Areas are located around National Parks, they act as buffer zones and wildlife corridors.

As already mentioned, tourist hunting is the only cause of lion mortality which is well controlled both in quantity (numbers harvested) and quality (strictly targeted to adult males by protecting all females and youngsters).

- **Lion pathology**

Pathology as a whole is a direct threat, when responsible for lion mortality, and an indirect threat, when affecting the lion prey base.

Tanzania lions are exposed to various pathogens such as endoparasites (*e.g.* babesiosis), ectoparasites (*e.g.* stable flies), bacterial diseases (*e.g.* bovine tuberculosis) and viral diseases (*e.g.* Canine Distemper Virus/CDV, rabies) (Table XX).

In Tanzania, CDV is one of the most threatening pathogens for lion. Lion populations of Serengeti and Ngorongoro Crater have undergone several severe outbreaks of CDV during the last 40 years (Packer *et al.*, 1999; Kissui & Packer, 2004). The high number of domestic dogs, the alleged reservoir and vector of CDV in northern Tanzania, has been pointed out as the

main source of CDV outbreaks in lion populations (Cleaveland *et al.*, 2001). The lower impacts of CDV outbreaks on the Serengeti lion population compared to the Ngorongoro Crater population illustrates that larger populations can more readily sustain infectious diseases. Moreover, the high inbreeding level of the Ngorongoro Crater population (O'Brien *et al.*, 1987; Wildt *et al.*, 1987; Packer *et al.*, 1991) may partly explain its lower resistance. Indeed, low genetic diversity in small and isolated populations is sometimes considered as a possible factor responsible for the decline of carnivores.

Environmental perturbations may influence the prevalence of *Babesia sp.*, a tick-borne pathogen, in lion populations. Combined with the immunosuppressive nature of CDV, *Babesia sp.* was responsible for lion mass mortalities recorded in 1994 and 2001 (Munson *et al.*, 2008).

Bovine tuberculosis in buffalo especially and other mammal species in general is well-known to be transmitted to lions and to increase mortality and morbidity in infected lions (*e.g.* Keet *et al.*, 1998; Michel *et al.*, 2006). Bovine tuberculosis is known to occur in the Ruaha ecosystem in Tanzania (Clifford *et al.*, 2009) while more studies are needed to verify if its impact on lions may be as tough as for instance in Kruger National Park, South Africa (Keet *et al.*, 1998).

Free-ranging lions are exposed to other pathogens (Table XX). So far, only a few consistent signs of clinical disease, excess mortality or decrease in lion fecundity have been noticed for these pathogens.

- **Indirect threats**

- **Population growth and human needs**

As human population increases, so do human needs. Agriculture and livestock expand for attempting to meet the growing needs and the stress of wildlife becomes more acute accordingly with land-use conversion, habitat degradation and human settlement in natural ecosystems (Table XXI).

The Tanzania human population size was 34.3 million people in 2002 (NBS, 2007; Figure 2.a) and reached 42.5 million in 2008 (IFAD, 2009). While urbanization has been increasing by 38% for the last three decades, most of Tanzania's human population remains rural with more than 30 million people (IFAD, 2009).

90% of Tanzanians live with less than US\$2 a day and almost 60% with less than a dollar a day (UNDP, 2007). Poverty affects particularly the rural communities, and is especially high in families relying exclusively on livestock and food crop production (FAO, 2006, *in* Dickman, 2008). Living conditions in rural areas are often harsh and food security is a major challenge with more than 40% of households suffering of inadequate food: the rate of malnutrition remains high across the country (Mariki, 2002).

Agriculture is essential in Tanzania's economy, accounting for 45% of the gross domestic product (GDP) and being the main source of livelihood for more than three-quarters of the population (FAO, 2010). Forty million hectares are farmable, *i.e.* 42% of the total land area. In 2002, 13% of the farmable land was actually cultivated, comprising 4 million hectares of arable land and 1.1 million ha under permanent crops (FAO, 2005b; Figure 2.b).

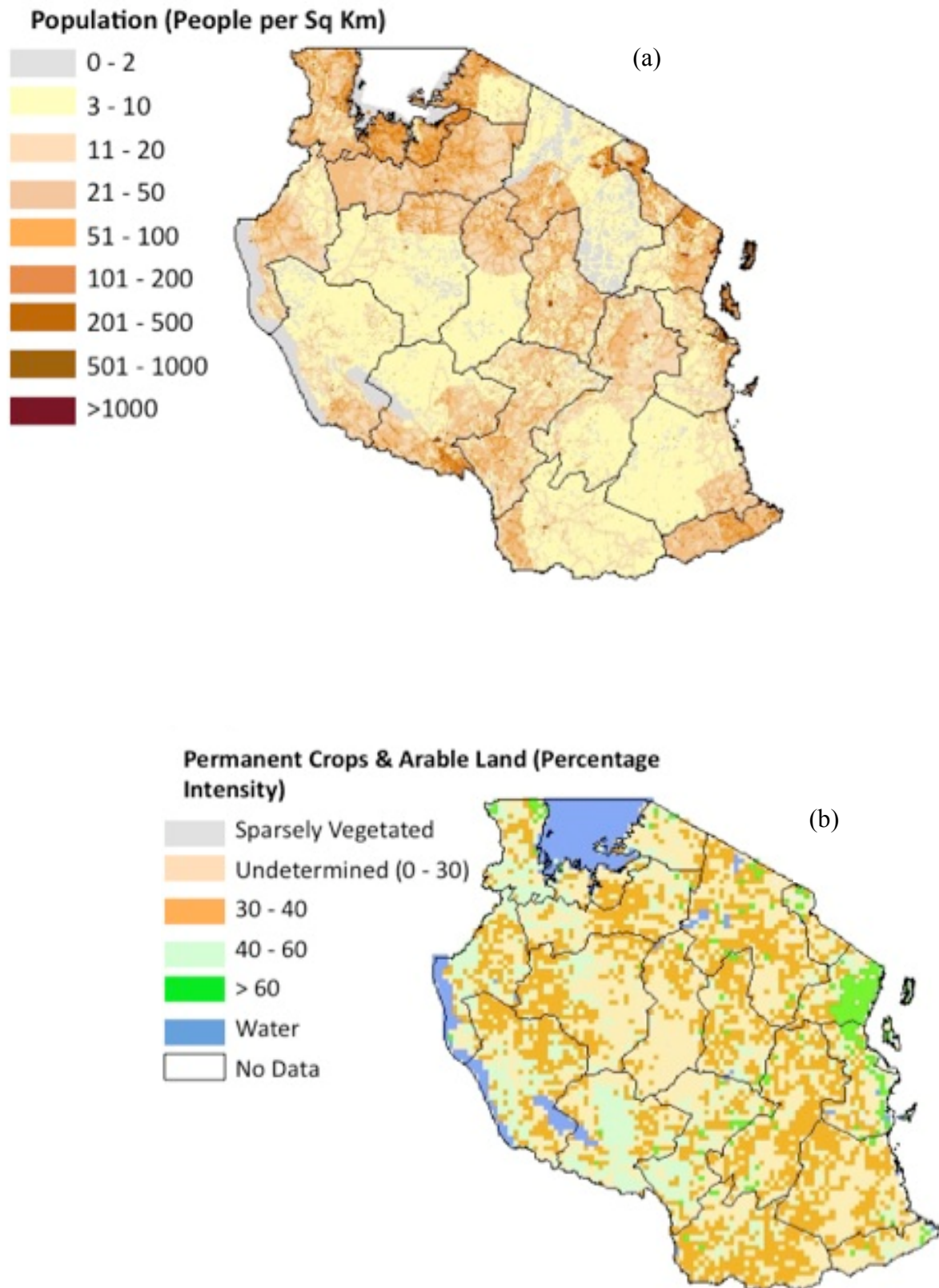
The livestock industry accounted for almost 6% of GDP in 2006, representing a major contribution to national food supply (meat, milk and eggs). Livestock is also a significant source of cash income and employment. Forty percents of Tanzania surface is used as rangeland for grazing 18.5 million cattle, 13.1 million goats and 3.6 million sheep (Figure 2.c; Campher *et al.*, 2008). These figures are projections based on the 2002/2003 National Sample Census. The previous census, carried out in 1984, revealed that there were 12.5 million cattle,

**Table XX:** Some examples of diseases and pathogens in lion populations in Tanzania

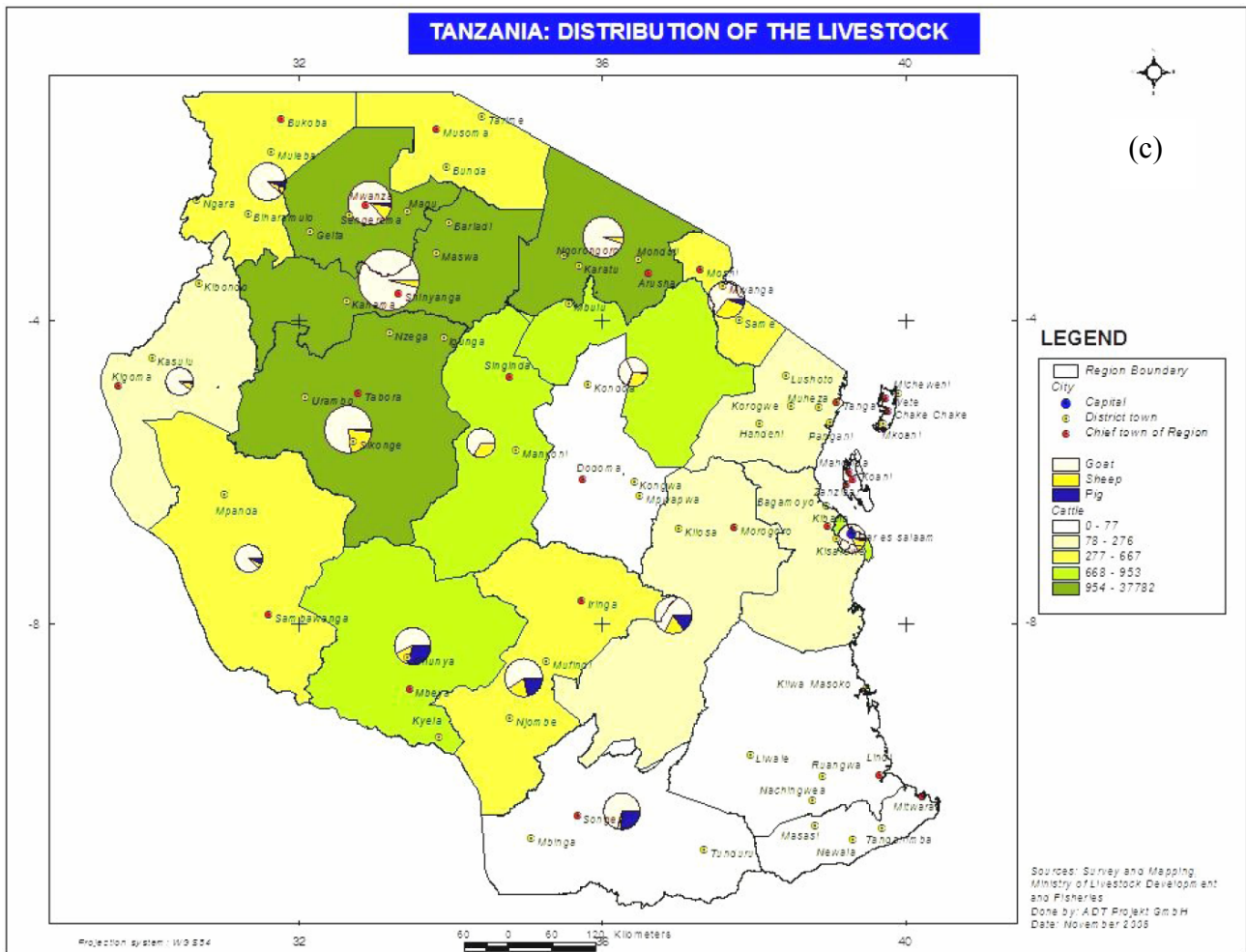
Ngorongoro Crater	Despite a high per capita food-intake rate, the lion population is still below its carrying capacity probably because of successive severe disease outbreaks undergone between 1994 and 2001.	The Crater lion population may have become unusually vulnerable to infectious disease in recent years owing to its close proximity to a growing human population and a history of close inbreeding.	Packer <i>et al.</i> , 1991; Kissui & Packer, 2004
	In 1962, the CDV outbreak coincided with an outbreak of blood-sucking stable flies ( <i>Stomoxys calcitrans</i> ).	The Crater lion population crashed from 75–100 to 12 individuals.	Fosbrooke, 1963; Packer <i>et al.</i> , 1991
	Bovine tuberculosis	Between 1985 and 2000, 4% of the lions sampled in the Serengeti and none of the 19 lions sampled in the Ngorongoro Crater were seropositive for bovine tuberculosis. Pathogenicity of bTB in these populations is still to be investigated.	Cleaveland <i>et al.</i> , 2005
Serengeti	CDV	Reservoir and transmission via domestic dogs and other carnivores. Outbreak in 1994 induced severe die-off in the lion population.	Craft, 2008 Roelke-Parker <i>et al.</i> , 1996
	Prevalence of coronavirus, parvovirus and calicivirus.	No consistent signs of clinical disease, excess mortality or decrease in lion fecundity.	Spencer, 1991; Spencer & Morkel, 1993; Hofmann-Lehmann <i>et al.</i> , 1996; Packer <i>et al.</i> , 1999; Driciru <i>et al.</i> , 2006
	Very high prevalence of Feline Herpes Virus (FIV)	No signs of clinical disease have been attributed to FHV in the Serengeti lions or in other wild felid populations. However since 100% of the population is infected, it is difficult to assess the potential impact of the infection on fecundity or survival.	Spencer & Morkel, 1993; Packer <i>et al.</i> , 1999; Driciru <i>et al.</i> , 2006; Ramsauer <i>et al.</i> , 2007
	Trypanosomes	Highest prevalence in the woodlands compared with the plains.	Averbeck <i>et al.</i> , 1990
	Presence of 19 parasites in free ranging lions.	No link with possible clinical effect mentioned.	Bjork, 2000
Serengeti and Ngorongoro Crater	Lion populations are infected with gastrointestinal endoparasites.	No evidence of lion population regulation due to parasites load.	Muller-Graf, 1995; Bjork, Averbeck & Stromberg, 2000; Muller-Graf, Woolhouse & Packer, 1999
	Lions are consistently infected with low levels of <i>Babesia</i> , a tick-borne parasite.	When conjugated to CDV outbreaks, may lead to severe die-offs.	Munson <i>et al.</i> , 2008

**Table XXI:** Some examples of human population and agro-pastoralist expansion in some areas of Tanzania

Area	Human population pressure	Food security	Agro-pastoral activity		References
			Agriculture	Livestock	
Arusha, Kilimanjaro, Tanga, Manyara, Mara, Pwani		The cropping season failed because of inadequate rains in 2009. The Government supplied with food the northern regions to face the food shortage.			FAO, 2010
In the periphery of Ruaha National Park	Gradual immigration of farmers, agro-pastoralists and pastoralists of various ethnic groups, particularly Barabaig and Sukuma, into the Usangu Game Reserve.			Livestock numbers have doubled between 1990 and 1995, while wildlife densities have halved due to uncontrolled hunting and human population growth.	IRG, 2000 in Dickman, 2008; Arnold, 2001
Kigoma, Kibondo, Nakijura Village	A lot of people have migrated to the forest, and this is perceived as a major threat to wildlife.				Regina Migarambo, <i>pers. com.</i>
Maasai Steppe	As the human population increases in the Maasai Steppe, migratory lions are forced to navigate through an increasingly complex maze of human settlements and livestock grazing areas.				Kissui, 2008b
Morogoro	Immigrants are a threat to wildlife as they bring livestock. Poison used in Kilombero area. Most immigrants come from Arusha, Rukwa and Tabora.				Joseph Chiwa, <i>pers. com.</i>
Ngorongoro Conservation Area	35,000 people in 1992 and 60,000 in 2002 (growth of 3.5% per year).	Rapid decline in Tropical Livestock Units/person.	Increase in cultivation to respond to the decreasing livestock-based diet.		Kijazi <i>et al.</i> , 1997; Boone <i>et al.</i> , 2006
Selous-Niassa Wildlife Corridor	High population growth.		The agricultural expansion ( <i>e.g.</i> tobacco farming) will increasingly convert this still biologically intact corridor to cultivation.		Baldus <i>et al.</i> , 2003a
Shinyanga, Meatu	In 2008, 45 families illegally settled in Makao Open Area PA.			There are great numbers of cattle in the District.	Elias Ngwenga, <i>pers. com.</i>
Tabora, Urambo, Nsongolo Village	Vast immigration of Sukuma cattle-herders perceived as a threat to wildlife.				Amosi Msongo, <i>pers. com.</i>
Udzungwa Mountains National Park	Increased pressure on natural resources due to the immigration and internal human population growth.				De Luca & Mpunga, 2005
Western Serengeti	Human population size of 1.37 million in the Mara Region in 2002. Growth of 2.5-2.9% between 1988 and 2002. High population density (70 people/km <sup>2</sup> ).			Small-scale farmers with livestock as a major source of income and meat: 73% earn their income from the sale of animals or meat.	URT, 2002; Kilahama, 2003



**Figure 2:** **a** - Human population density, **b** - Intensity of permanent crops and arable lands, from the Oak Ridge National Laboratory, LandScan Global Population 1998 and 2000 Database (FAO, 2009)



**Figure 2c:** Density of livestock in Tanzania, projection for 2006/2007 (Campher *et al.*, 2008).

6.4 million goats and 3.1 million sheep (Campher *et al.*, 2008). There is a general consensus on a rapid growth of the livestock population size in the country. More than 90% of the livestock population in the country is bred by the traditional sector (Njombe & Msanga, 2009). Cattle holdings do not increase in accordance with the rapid human population growth, which results in fewer livestock per capita and hence leads to a lower tolerance to depredation, *e.g.* in Maasai pastoralists (Homewood & Rodgers, 1991; Coast, 2002; McCabe, 2003; Ikanda & Packer, 2008).

#### ○ Tolerance of human populations towards lion conservation

The perception of the “king of beasts” in rural African communities living close to lions is often very different from those who do not cohabit with wildlife. The interface between people and large predators always carries a risk in terms of predation on livestock and humans. Lions are considered by many rural communities as pests or vermines.

The wealth of human population greatly determines attitudes and perceptions of local communities in respect to the lion (Table XXII). Traditional pastoralists, probably more than agro-pastoralists, particularly suffer from the conflict because of their high dependency upon livestock and their lack of alternative income sources. The amount of losses partly drives the

level of hostility of local communities towards lion (Stander, 1997). The loss of grazing land to PAs, and the lack of tangible benefits or revenue from conservation greatly undermine the support of local communities to carnivore conservation (Woodroffe, 2001; Ogada *et al.*, 2003; Patterson *et al.*, 2004; Packer *et al.*, 2005; Homewood *et al.*, 2004; Kideghesho, 2006; Sachedina, 2008).

#### ○ **Habitat loss**

The widespread destruction of wildlife habitat and human encroachment in wildlife corridors constitute major threats to lion conservation (Table XXIII). “Lion populations can be incredibly resilient to perturbation, provided the social structure of the populations remains relatively intact and particularly if immigration is possible from nearby populations” (Loveridge, Packer & Dutton, 2009). In other words, loss of suitable habitat is considered as a top threat to lion survival in Tanzania. In the present survey, human encroachment and habitat loss through land conversion of wilderness areas into farm land were mentioned as the most serious threat to lion conservation in Tanzania by many informants (*e.g.* Derek Hurt, *pers. com.*).

Between 1990 and 2005, Tanzania lost more than 61,000 km<sup>2</sup> of forest cover, with an annual rate of around 1% loss, which is twice the average for low human development countries and five times the mean global rate (UNDP, 2007). The rapid agricultural expansion, unplanned land use strategies, unmanaged natural resource extraction and the building of roads are seriously threatening the viability of wild habitats. As an example, logging activity and concomitant poaching of wildlife in PA<sub>h</sub> between Lake Rukwa and Rungwa GRs were considered as major threats to wildlife survival (Danny McCallum, *pers. com.*).

Jones, Caro & Davenport (2009) estimated that, based on current rates of habitat change, wildlife corridors would last less than 5 years before disappearing, which would isolate Tanzania’s PAs and fragment wilderness areas. Human expansion and subsequent harassment by people increasingly restricts the lion to Protected Areas (Mills, 2000). Because lions live in vast home ranges, most PAs may be too small to adequately conserve large lion populations in the long-term (Woodroffe & Ginsberg, 1998). Consequently, lions partly rely on adjacent non-gazetted areas for supplementary habitat and food (Woodroffe & Frank, 2005; Kissui, 2008a). Because of the higher magnitude of the human/lion conflict outside PAs, and the persecution of lions by local communities, lion mortality on PA borders may become a major threat, with adjacent non-gazetted areas acting as population ‘sinks’ (Woodroffe & Ginsberg, 1998; Kissui, 2008a).

#### ○ **Drought**

Although rarely mentioned as a potential threat to lion survival, drought might have cumulative detrimental effects on lions.

First of all, droughts induce a reduction in wild prey basis and a modification of lions’ diet (*e.g.* Funston & Mills, 2006). Secondly, droughts negatively impact livestock husbandry making livestock herders less tolerant to cattle raiding lions. Noah Wekesa, the Minister of Forestry and Wildlife in Kenya, recently reported that “*the communities had lost over 80% of their livestock to the drought; when the lions and hyenas turned to the remaining livestock, the communities were distressed and attacked them in turn*” (Daily Nation, 2010). In other words, one of the consequences of the drought was an increase in human/wildlife conflict. Furthermore, surplus killing by lions of cows weakened by droughts is likely to occur.



**Table XXII:** Attitudes of local communities towards wildlife and lion conservation in some areas of Tanzania

Area	Local perception of wildlife and conservation	References
Around Ruaha National Park	People clearly regard wildlife as causing significant problems. Pastoralists and agro-pastoralists experience a high magnitude of conflict with wildlife, and are particularly hostile towards large carnivores because of livestock depredation. People strongly demand reduction or extirpation of carnivores.	Dickman, 2008
	Too few people actually receive income from the nearby Ruaha National Park. This probably exacerbates the hostility towards lion.	
Along the Northern boundary of the Selous Game Reserve	Allowed game meat harvesting positively influenced local perception of conservation programs and of the Game Reserve.	Gillingham & Lee, 1999
Villages next to the Selous Game Reserve along the Mgeta River buffer-zone	People from Bwakira Chini, Mvuha and Ngerengere expressed some mistrust and resentment towards the state wildlife management authorities.	Gillingham, 1998
Loliondo and Ngorongoro areas	High level of human-carnivore conflict perceived by the communities, with carnivores like lion subject to particular hostility.	Maddox, 2003
Villages of Lolkisale, Narakauo, Loiber Serrit along the eastern boundary of Tarangire National Park	Local populations consider lion as the most fearful and potentially harmful predator both for livestock and human. 96% of the interviewed people believed that lions involved in livestock depredation should be killed, and 51% favored the use of poison.	Lichtenfeld, 2005
Tarangire National Park	Hostility towards lion is exacerbated by Maasai's perception of governmental failures to mitigate human-lion conflicts and the inability of local communities to manage wildlife in their lands.	
Udzungwa Mountains	Communities' attitudes towards conservation eroded because of the greater needs of the increasing human population.	De Luca & Mpunga, 2005

**Table XXIII:** Some examples of habitat loss and threats to wildlife corridors in some areas in Tanzania

Area	Habitat loss/alteration/Resource extraction	Reference
Ikoma Open Area and the Mara Group Ranches	Currently receiving limited protection and threatened with poaching and agriculture.	Thirgood <i>et al.</i> , 2004
Kilombero Game Controlled Area	Potential threats to the future of wildlife in Kilombero include agricultural expansion, unsustainable cutting of trees and poaching.	
Kitenden corridor between Mount Kilimanjaro and Amboseli National Park in Kenya	Conversion of rangelands to agriculture resulting in a reduction of wildlife habitat.	Kidegesho, 2000
Kwakuchinja corridor linking Tarangire and Lake Manyara National Park	The proportion of cultivated lands has doubled since 1987, from 8% to approximately 16% of the land area.	Kidegesho, 2000
Ruahha National Park	Drying up of the Great Ruaha River that runs through the park, caused by upstream projects.	Stolberger, 2005
Selous-Niassa wildlife corridor	Illegal over-utilization of natural resources, in particular poaching of wild animals and poisoning of fish, destructive wildfires and unplanned farming leading to habitat degradation and loss in biodiversity. The obstruction of the movements of large herbivores will ultimately result in increased human-wildlife conflicts.	Baldus <i>et al.</i> , 2003a
Simanjiro plains to the east of Tarangire National Park	Cultivation increased from 1% to 4% of the total land area, due to both large scale land and smallholder conversions.	TMCP, 2002 <i>in</i> Rodgers, Melamari & Nelson, 2003
The Igando-Igawa corridor	General threat for wildlife: loss of habitat (clearance for agriculture, charcoal manufacture, burning).	Jones, Caro & Davenport, 2009
The Loazi-Kalambo corridor	General threat for wildlife: charcoal manufacture, timber and agriculture.	Jones, Caro & Davenport, 2009
The Selous-Niassa corridor	General threat for wildlife: loss of habitat (agriculture), poaching, mining, human-wildlife conflict.	Jones, Caro & Davenport, 2009
The Tarangire-Manyara (Kwakuchinja) corridor	General threat for wildlife: growth in settlements and agriculture, poaching and human disturbance.	Jones, Caro & Davenport, 2009
The Udzungwa-Selous corridor: the Nyanganje route	General threat for wildlife: likelihood of intensified cultivation and human settlement.	Jones, Caro & Davenport, 2009
The Udzungwa-Selous corridor: the Ruipa route	General threat for wildlife: rapid destruction of habitat (timber cutting and burning, charcoaling, human settlements, agriculture).	Jones, Caro & Davenport, 2009
Udzungwa Montains	Habitat degrading activities such as illegal logging, excessive firewood collection, uncontrolled fire, uncontrolled medicinal plant collection, hunting and trapping of prey species. The demand for arable land and infrastructure development has created barriers for wildlife dispersal, by interrupting the habitat matrix that connects different habitat patches (for example the road along the eastern side of the park and the case of Magombera forest).	Bakarr, 2000 <i>in</i> De Luca & Mpunga, 2005
Urumwa Forest Reserve	Timber exploitation threatening the local miombo woodland.	Solon <i>et al.</i> , 1996

- **Decrease in wild prey availability**

Decrease of wild prey is a major driver of human/lion conflict. In areas where natural prey availability becomes low, lion may switch to a livestock-biased diet. This contributes to amplify the antagonism of local communities and associated retaliation or pre-emptive killings of lions. Lion wild prey basis is influenced by natural events such as seasonal migrations and by anthropogenic factors such as poaching and habitat loss to agriculture and human settlements (Table XXIV).

- **Migration**

Some of the large herbivore populations in Tanzania, as wildebeest and zebra, migrate throughout the year. These populations may temporarily leave PAs and disperse in adjacent areas, with lion prides following them, which contributes to multiply human/lion encounters. When the availability of wild prey seasonally decreases because of migration, livestock predation increases, *e.g.* in Ngorongoro Conservation Area (Ikanda, 2006) and in the Maasai Steppe (Kissui, 2008a). While some lions follow the migration, some others remain resident in the area left by migratory species, turn their diet to livestock and eventually become usual livestock raiders.

- **Poaching**

With human population growth and poverty, illegal bushmeat tends to become a primary source of proteins and income. H.E. President Jakaya Mrisho Kikwete declared in December 2008 that Tanzania was losing 50,000 animals annually to poaching (*in* Caro & Andimile, 2009). Caro & Andimile (2009) considered this figure as rather optimistic and reported that 52,000 to 60,000 people participate in illegal hunting for bushmeat within PAs around Serengeti NP, and mentioned an educated guess of 5,000 to 10,000 animals extracted from the Katavi-Rukwa complex yearly.

In their comprehensive survey of the Tanzania wildlife sector, Chardonnet *et al.* (1995) calculated that 480,000 wild animals were harvested annually for a production of more than 46,000 tonnes, a value of US\$ 27 million and a per capita bushmeat consumption of 2.3 kg. Holmern *et al.* (2004) showed that 83% of the households regularly buy illegal meat in western Serengeti. Up to 94% of people regularly consume bushmeat from illegal poaching in northern Tanzania (Barnett, 2000). In a nationwide study, Stoner *et al.* (2006) collated aerial census data collected from the late 1980s to early 2000s for large herbivore populations over various PAs (Burigi-Biharamulo GRs, Greater Ruaha complex, Tarangire NP, Katavi NP, Serengeti NP, Ugalla GR, Moyowosi-Kigosi GRs, and Selous-Mikumi complex) and showed that most populations of all herbivores declined in many portions of the country. The major causes of wildlife declines, particularly in the northern part of the country, were over-exploitation of wild animals and the conversion of rangeland habitats to other land uses, such as agriculture and human settlements.

**Table XXIV:** Some examples of decrease in prey availability in some areas of Tanzania

Area	Availability of prey	Cause	Reference
Burigi-Biharamulo	Large herbivores fared particularly badly over the time span of 1990–2000, due to a combination of heavy burning, large groups of organized poachers, and a lack of rangers patrolling during the 1980s.	Poaching	WCMC, 1984; Stoner <i>et al.</i> , 2007
Greater Ruaha	Decline of large herbivores population during the dry season because of the Ruaha River being diverted for cultivation in the Usangu plains	Seasonal migration	WWF, 2002; Sokile, Van Koppen & Lankford, 2003 in Stoner <i>et al.</i> , 2006
In the corridors between Lake Manyara and Tarangire	Unsustainable harvest of wildlife and other pressures from human activities has depleted the area's large mammals.	Poaching and agricultural expansion	Rodgers, Melamari & Nelson, 2003
Isunkaviula Plateau, in Ruaha National Park		Evidences of poaching	Stolberger, 2005
Katavi Rukwa ecosystem	Populations of several large ungulate species declined between 1988 and 2002 probably because of illegal hunting.	Poaching	Caro, 1999; Stoner <i>et al.</i> , 2006; Caro, 2008
Kilombero Game Controlled Area	Local government officials indicated that poaching increased dramatically since 1994, which threatens the sustainability of the area.	Poaching and agricultural expansion	Haule <i>et al.</i> , 2002
Maasai Steppe	Seasonal migration of ungulates may influence livestock predation patterns: livestock predation by lions and hyenas is higher in the wet season when these predators follow the migratory herbivores into dispersal areas in communal lands.	Seasonal migration	Kissui, 2008b
	When lions leave Tarangire National Park at the onset of the wet season, they spend up to six months in the villages where they are subject to retaliatory killing by livestock keepers in reaction to livestock predation.	Seasonal migration	
	Overall decline in abundance and diversity of wildlife due to unsustainable harvests and deteriorating habitat.	Poaching	Rodgers, Melamari & Nelson, 2003; Nelson, 2005
Ngorongoro Conservation Area	Migration of wild prey which seasonally decreases lion prey (especially zebra and wildebeest) basis. As wild prey move to other areas, livestock predation increases.	Seasonal migration	Ikanda, 2006
Selous Game Reserve		Evidences of poaching	Baldus, 2002
Selous-Niassa Wildlife Corridor	Bushmeat poaching for the local market threatens wildlife populations in the corridor.	Poaching	Baldus <i>et al.</i> , 2003a
Tanzania portion of the Amboseli-Longido ecosystem	Heavy impact of bushmeat exploitation leading to a drastic loss of wildlife.	Poaching	Rodgers, Melamari & Nelson, 2003
Tarangire	Declines of large herbivores population during the wet season maybe exacerbated by migratory roads severed by crop cultivation and settlements.	Seasonal migration	Shemwetta & Kideghesho, 2000 in Stoner <i>et al.</i> , 2006
Tarangire ecosystem	Population crash of species such as wildebeest, zebra, hartebeest and oryx.		Rodgers, Melamari & Nelson, 2003
Udzungwa Mountains		Evidences of poaching	De Luca & Mpunga; 2005
Unprotected northern Tanzanian rangelands, West Kilimanjaro	Local declines or extinctions of species such as giraffe, buffalo, eland, oryx and hartebeest.	Poaching and agricultural expansion	Nelson, 2000
Usangu Game Reserve	Wildlife densities are estimated to have halved in this region between 1990 and 1995.	Poaching and human population growth, with doubling of livestock numbers.	Arnold, 2001
Western Serengeti	Illegal hunting is extensively practiced and is responsible for the decline of populations of resident herbivores.	Poaching	Arcese <i>et al.</i> , 1995; Campbell & Hofer, 1995; Holmern <i>et al.</i> , 2002; Loibooki <i>et al.</i> , 2002
	Bushmeat meals in all villages within 30 km of the Park boundary increased with the seasonal influx of migratory herbivores.	Poaching	Nyahongo <i>et al.</i> , 2009

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## **APPENDICES**

### **APPENDIX I: Lion range maps published in literature**

- **Map A:** African lion range according to Bauer & Van Der Merwe (2004);
- **Map B:** African lion range according to Chardonnet (2002);
- **Map C:** African lion range according to African mammal databank (1999);
- **Map D:** Probability of lion presence across Africa according to Loveridge & Canney (2009);
- **Map E:** Kenya, Uganda and Tanzania lion range according to Kingdon (1989);
- **Map F:** Eastern and Southern African lion range and Lion Conservation Units according to IUCN SSC Cat Specialist Group (2006).

### **APPENDIX II: Authorized activities in the various categories of Protected Areas**

### **APPENDIX III: Inquiry forms**

- Non-gazetted area questionnaire;
- Protected Area questionnaire.

### **APPENDIX IV:**

- List of informants who have contributed to the information generated through inquiries

### **APPENDIX V:**

- Survey's synthetic database

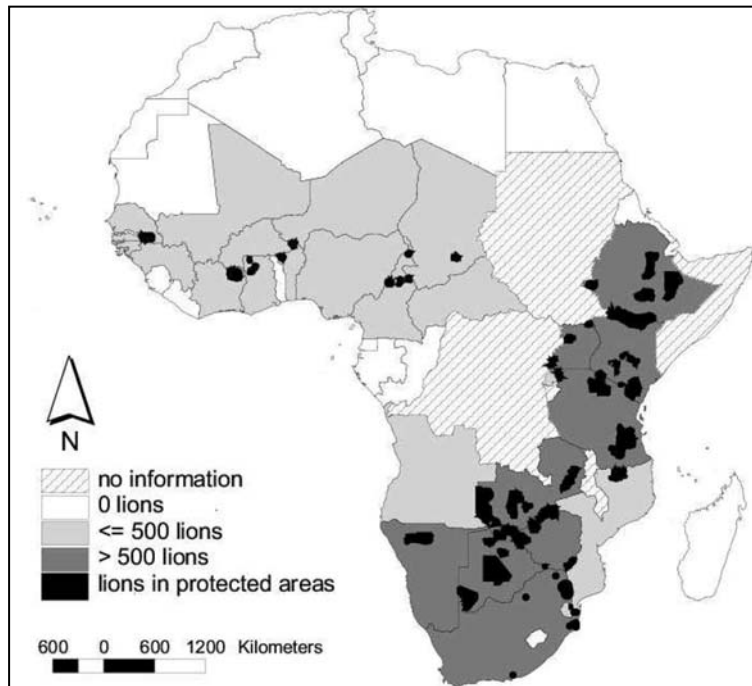
### **APPENDIX VI:**

- Some legal aspects of people's defence against wildlife damage

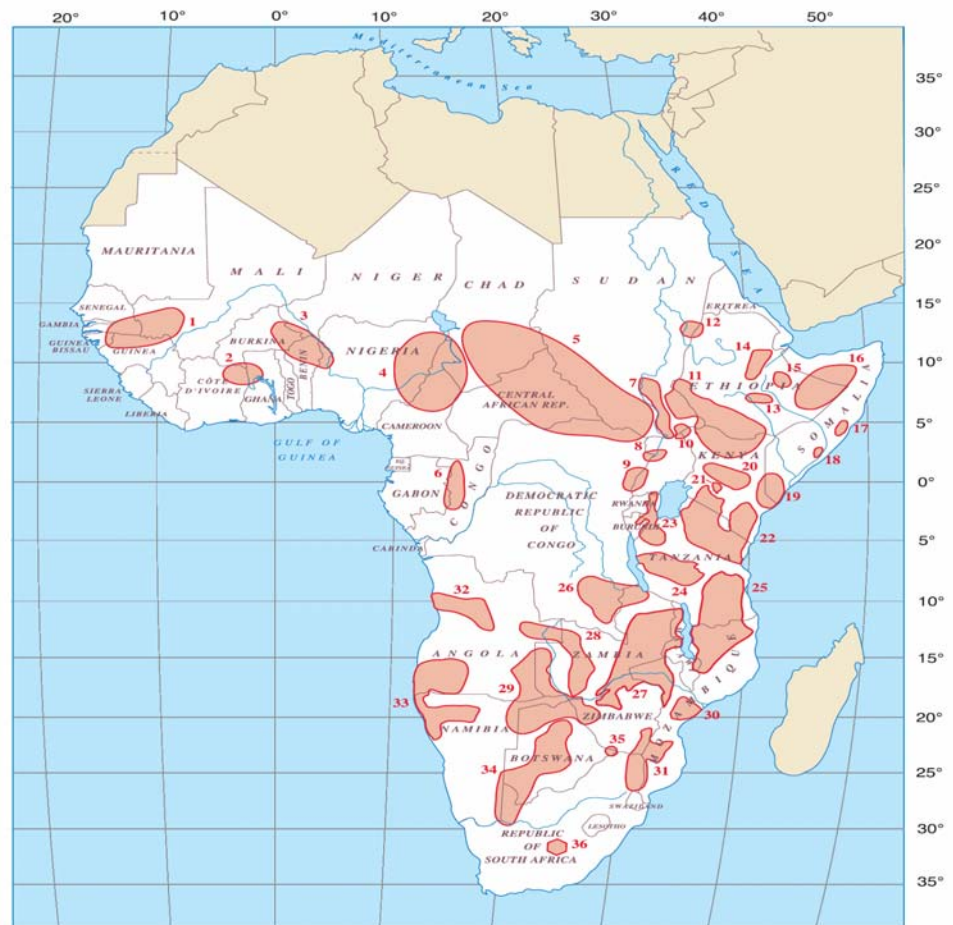
### **APPENDIX VII:**

- Perception of threats to lion survival per Lion Conservation Unit

**APPENDIX I: Lion range maps published in literature**

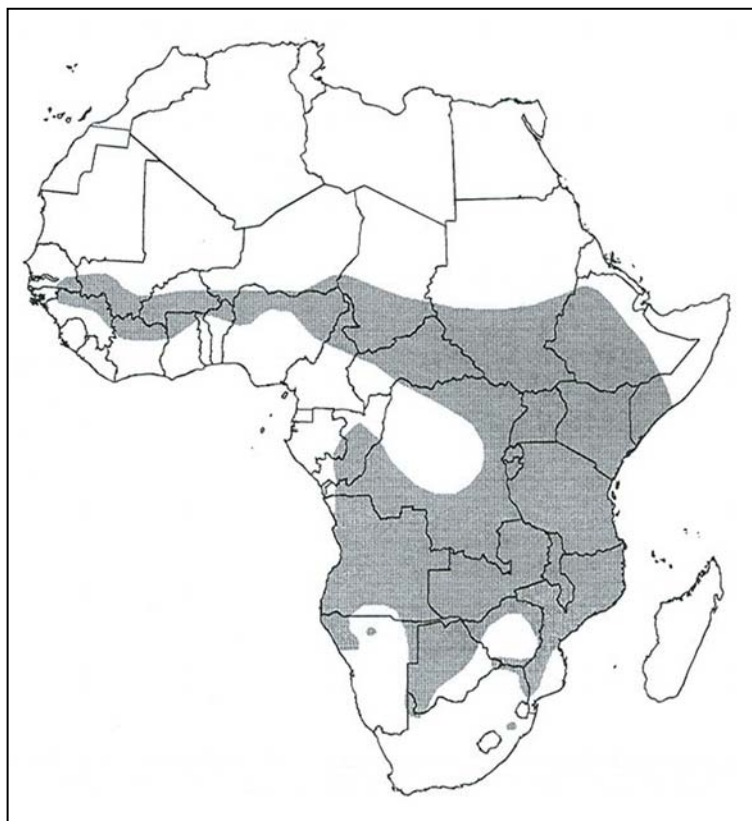


**Map A:** African lion range according to Bauer & Van Der Merwe (2004)

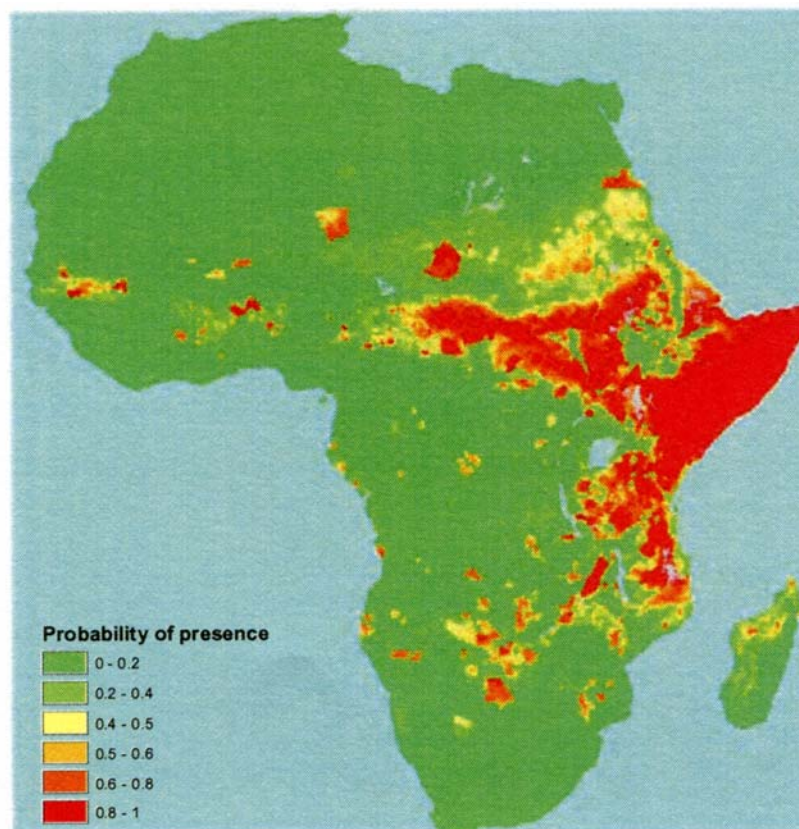


**Map B:** African lion range according to Chardonnet (2002)

**APPENDIX I:** Lion range maps published in literature

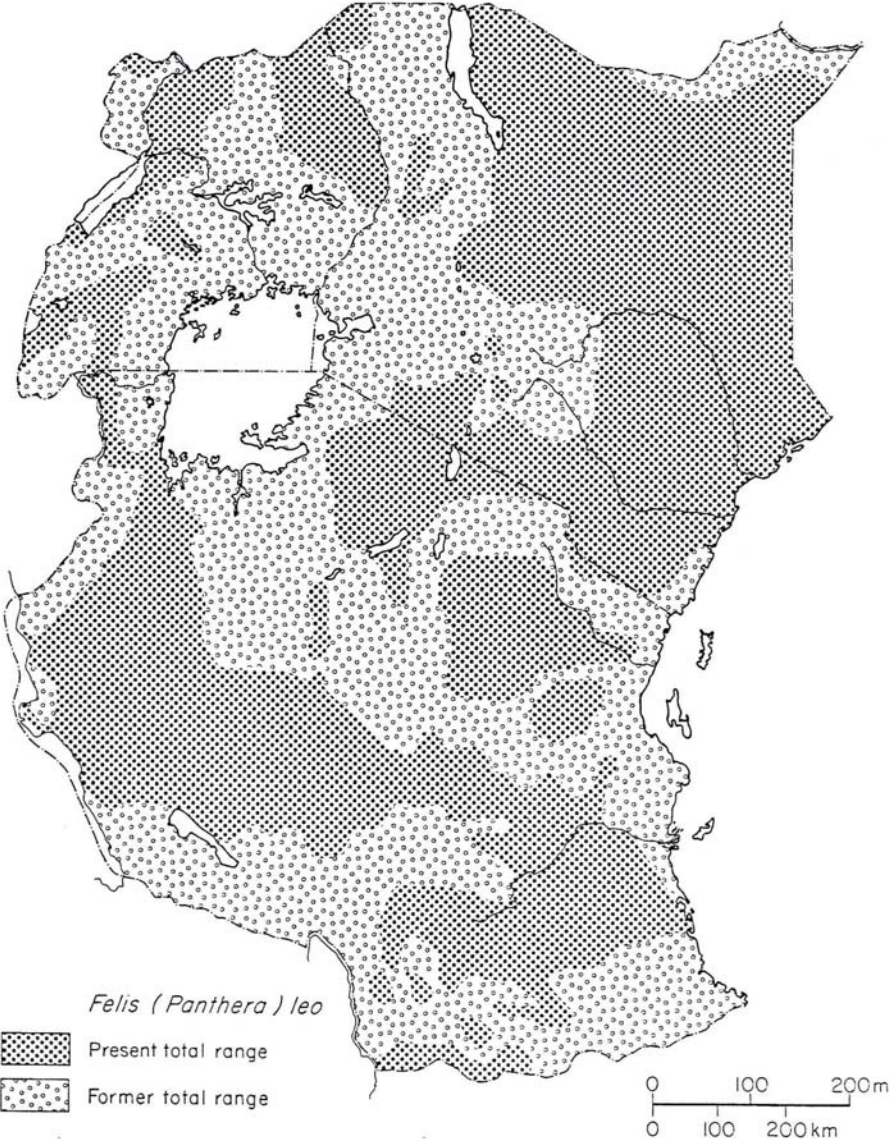


**Map C:** African lion range according to African mammal databank (1999)



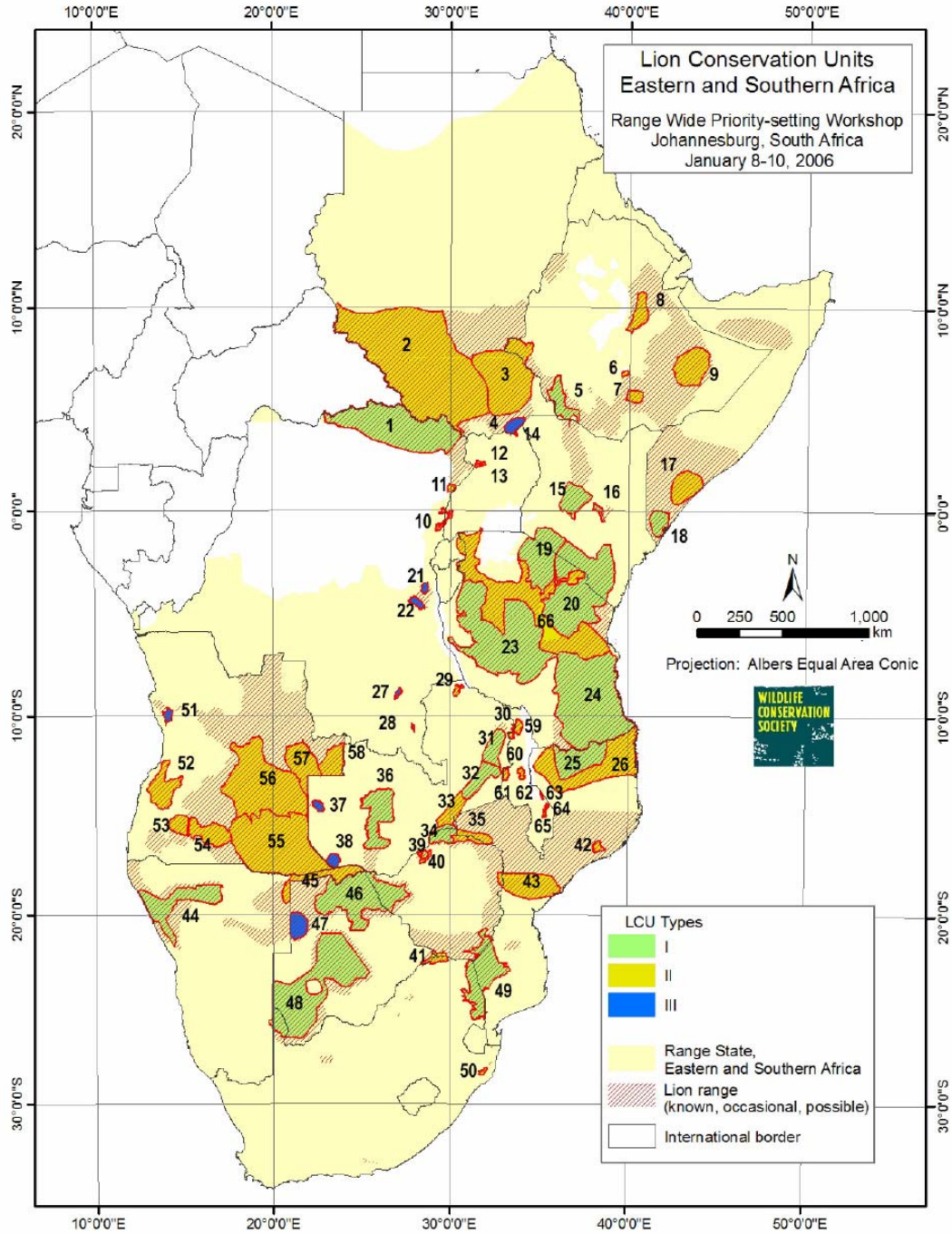
**Map D:** Probability of lion presence across Africa according to Loveridge & Canney (2009)

**APPENDIX I:** Lion range maps published in literature



**Map E:** Kenya, Uganda and Tanzania lion range according to Kingdon (1989)

**APPENDIX I:** Lion range maps published in literature



**Map F:** Eastern and Southern African lion range and Lion Conservation Units according to IUCN SSC Cat Specialist Group (2006)

## APPENDIX II: Authorized activities in the various categories of Protected Areas

Category		Administration	Human Settlement	Legal Uses of Wildlife					
				Wildlife viewing	Livestock grazing	Fishing	Live capture	Tourist hunting	Resident hunting
Protected Area*	National Park	TANAPA	No						
	Conservation Area	Ngorongoro Conservation Area	Yes						
	Game Reserve	WD	No						
	Game Controlled Area	WD	Yes						
	Wildlife Management Area	WD & Local Authorities	Yes	Currently under revision by WD					
Non-gazetted Area	Open Area	Regional Authorities	Yes						

\* Forest Reserves were not considered in the present survey.

**APPENDIX III: Non-gazetted area questionnaire (Swahili version)**

**DODOSO KUHUSU SIMBA – MAENEO YASİYOTANGAZWA KWENYE GAZETI LA SERIKALI**

**TAFADHALI, JAZA DODOSO MOJA KWA KILA ENEO LILILO CHINI YA USIMAMIZI WAKO**

Tarehe : \_\_\_\_\_

**MAELEZO YA KINA YA ENEO AMBALO BADO HALIJATANGAZWA KWENYE GAZETI LA SERIKALI**

Mkoa : \_\_\_\_\_ Wilaya : \_\_\_\_\_ Mji : \_\_\_\_\_

Vitu vinavyotambulisha eneo: Kaskazini : \_\_\_\_\_

Kusini: \_\_\_\_\_

Magharibi : \_\_\_\_\_

Mashariki : \_\_\_\_\_

**MAELEZO YA KINA YA MTOA TAARIFA**

1. Jina : \_\_\_\_\_ 2. Kazi : \_\_\_\_\_

3. Umekuwepo katika eneo hili kwa muda gani : \_\_\_\_\_

4. Namba ya simu : \_\_\_\_\_ Anuani ya barua pepe : \_\_\_\_\_

**KUONEKANA KWA SIMBA**

1. Je Simba wapo katika eneo lililotajwa katika fomu hii? \_\_\_\_\_ Ndiyo/Hapana/Sijui

Kama siyo, walitoweka lini (mwaka au karne)? \_\_\_\_\_

2. Ni mara ngapi uliwaona simba katika kipindi cha mwaka 2008? \_\_\_\_\_ Kwa mwaka 2009 \_\_\_\_\_

Uliwaona simba wangapi katika kipindi cha mwaka 2008? \_\_\_\_\_ Kwa mwaka 2009 \_\_\_\_\_

Wastani wa idadi ya Simba walioonekana kwa msimu katika kipindi cha misimu ya miaka mitano iliyopita? \_\_\_\_\_

3. Kiwango cha kuonekana kwa simba (s = Simba kuonekana; I = Dalili za kuwepo kwa simba(mungurumo, nyayo, mabaki ya chakula chake)?

S	Kwa Wiki	Kwa mwezi	Kwa mwaka	Mara chache	I	Kwa Wiki	Kwa mwezi	Kwa mwaka	Mara chache

4. Maelezo ya kina kuhusu kuonekana kwa simba kwa mara ya mwisho:

Tarehe	Ukubwa wa kundi	Muundo wa kundi			Mahali
		Dume	Jike	Watoto	

5. Je, unafahamu ni familia ngapi za simba zinaonekana katika eneo lako? (kwa kudumu/kwa muda): \_\_\_\_\_ / \_\_\_\_\_

6. Je, una ufahamu kuhusu jumla ya simba waliopo katika eneo lako? (kudumu/kwa muda) \_\_\_\_\_ / \_\_\_\_\_

7. Kadiria ukubwa wa eneo wanaloishi simba (Kilomita za mraba): \_\_\_\_\_

8. Kiwango cha juu cha idadi ya simba walioonekana kwa pamoja (mwaka na mahali) \_\_\_\_\_

9. Je, simba unaowaona mara kwa mara ni wale uliowahi kuwaona? Ndiyo/Hapana/Sijui

10. Je umewahi kusikia muungumo wa simba ? \_\_\_\_\_ Ndiyo/Hapana

Ni mara ngapi umesikia muungumo wa simba? \_\_\_\_\_

11. Je, idadi ya simba imepungua au imeongezeka kwa kipindi cha miaka mitano? mepungua/imeongezeka/haijapungua wala kuongezeka/sijui \_\_\_\_\_



12. Je, idadi ya simba imepungua au imeongezeka kwa kipindi cha miaka hamsini?

Imepungua/imeongezeka/haijapungua wala kuongezeka/sijui \_\_\_\_\_

13. Je, wenzako wanawaona simba? \_\_\_\_\_ Ndiyo/Hapana/Sijui

14. Mawasiliano ya mtu anayeweza kutupa taarifa kuhusu simba : \_\_\_\_\_ Ndiyo/Hapana/Sijui

**WANYAMA WALIWAO NA SIMBA – TANO BORA**

**MGAWO WA UWINDAJI NA UHAKIKI (KAMA UPO)**

Aina ya mnyama	Wachache	Wengi kiasi	Wengi sana

	Mgawo uliotengwa	Mgawo Uliotumika
2009		
2008		
2007		
2006		
2005		

**MIGOGORO BAINA YA BINADAMU NA SIMBA**

1. Je, umewahi kuona simba waliouwawa na majangili? \_\_\_\_\_ Ndiyo/Hapana/Sijui

Maelezo ya kina kuhusu matukio yaliyowahi kutokea

Mwaka/Mwezi	Idadi ya Simba	Mahali	Hali ya tukio

2. Je, simba hushambulia binadamu au mifugo katika eneo husika? \_\_\_\_\_ Ndiyo/Hapana/Sijui

3. Idadi ya majeruhi (Idadi ya matukio)

Migogoro baina ya binadamu na simba	Watu waliouawa	Watu waliojeruhiwa	Mifugo iliyopotea	Uwindaji wa simba kiofisi kama njia ya kupunguza wanyama waharibifu	Uwindaji ulio wa kiofisi wa simba waharibifu
2009					
2008					
2007					
2006					
2005					

4. Mnyama yupi wa porini ni mharibifu zaidi? \_\_\_\_\_

5. Ni mnyama yupi wa porini alaye nyama husababisha uharibifu zaidi? \_\_\_\_\_

**VIHATARISHI VYA MAISHA YA SIMBA**

Taja vihatarishi vikuu vya maisha ya simba (+++: kihatarishi kikuu; ++: kihatarishi cha kati ; + kihatarishi kidogo)?

Kukosekana kwa chakula	Uwindaji ulioruhusiwa	Ujangili wa makusudi	Ukamataji usiokusudiwa	Kupotea kwa makazi stahili	Usimamizi usiomadhubuti wa simba	Kuwepo kwa mifugo	Magonjwa

Taja vihatarishi vingine : \_\_\_\_\_

Asante sana! !

**APPENDIX III: Protected Area questionnaire (English version)**

**PLEASE, FILL ONE QUESTIONNAIRE FOR EACH PROTECTED AREA UNDER YOUR MANAGEMENT**

Date : \_\_\_\_\_

**DETAILS OF THE PROTECTED AREA**

Region: \_\_\_\_\_ District: \_\_\_\_\_

Name of the Protected Area: \_\_\_\_\_

Name of the company managing the Protected Area (if any): \_\_\_\_\_

Area (km<sup>2</sup>): \_\_\_\_\_

**DETAILS OF THE INFORMANT**

1. Name: \_\_\_\_\_ 2. Function: \_\_\_\_\_

3. How long have you been in this area? \_\_\_\_\_

4. Telephone number: \_\_\_\_\_ E.mail: \_\_\_\_\_

5. Mean time spent in the field per year (in month): \_\_\_\_\_

**OBSERVATIONS OF LIONS**

1. Are lions present in the area considered by this form? \_\_\_\_\_ Yes / No / Don't know  
 If not, when have they disappeared (year or decade)? \_\_\_\_\_

2. How many times have you seen lions in 2008? \_\_\_\_\_ in 2009: \_\_\_\_\_  
 How many lions have you seen in 2008? \_\_\_\_\_ in 2009: \_\_\_\_\_

Average number of lions seen per season over the last 5 seasons? \_\_\_\_\_

3. Frequency of observation of lions [S=lion seen ; I=Indirect observations (roaring, footprint, prey remains)]?

<b>S</b>	Weekly	Monthly	Yearly	Rarely	<b>I</b>	Weekly	Monthly	Yearly	Rarely
----------	--------	---------	--------	--------	----------	--------	---------	--------	--------

4. Details of the last observations of lions:

Date	Size of the group	Composition of the group			Location
		Male	Female	Young	

5. Do you know how many lion prides occur in your area (permanent / temporary)? \_\_\_\_\_/\_\_\_\_\_
6. Have you an idea of the total number of lions present in your area (permanent / temporary)? \_\_\_\_\_/\_\_\_\_\_
7. Approximate area occupied by lions (km<sup>2</sup>): \_\_\_\_\_
8. Maximum number of lions seen together (year and location): \_\_\_\_\_
9. Do you regularly see the same lion(s)? \_\_\_\_\_ Yes / No / Don't know
10. Do you hear lion roarings? \_\_\_\_\_ Yes / No
- How often do you hear lion roarings? \_\_\_\_\_

11. Do the number of lions has increased or decreased since 5 years? Increase / Decrease / Stable / Don't know  
 12. Do the number of lions has increased or decreased since 50 years? Increase / Decrease / Stable / Don't know  
 13. Do your colleagues see any lions? \_\_\_\_\_ Yes / No / Don't know  
 14. Contact of a person who can provide information on lions: \_\_\_\_\_

**LION PREY - TOP FIVE**

**HUNTING QUOTA AND REALISATION (IF ANY)**

Species	Low abundance	Medium Abundance	High Abundance

	Quota allocated	Quota utilized
2009		
2008		
2007		
2006		
2005		

**HUMAN/LION CONFLICTS**

1. Have you seen poached lions? \_\_\_\_\_ Yes / No

Details of the last seen cases:

Year/Month	Number of lion poached	location	circumstances

2. Do lions attack human or livestock in the considered area? \_\_\_\_\_ Yes / No / Don't know

3. Number of casualties (number of cases)

Human/lion conflict	Humans killed	Humans injured	Livestock losses	Official killings as Problematic Animal Control	Unofficial killings of problematic lions
2009					
2008					
2007					
2006					
2005					

4. Which wild animal causes the most problems? \_\_\_\_\_  
 5. Which predator causes the most problems? \_\_\_\_\_

**THREATS TO THE SURVIVAL OF LIONS**

What are the most severe threats to lion survival (+++: important threat; ++: medium threat; +: lower threat)?

Lack of prey	Official hunting	Intentional poaching	Retaliation	Unintentional trapping	Loss of suitable habitat	Unefficient management of lions	Presence of livestock	Diseases

Other threats: \_\_\_\_\_

Thank you... Asante Sana !!

**APPENDIX IV:** List of informants who have contributed to the present survey [HS: Tourist Hunting Sector, LC: Local Communities, LR: Livestock Resources, NGO: NGO/Researchers, NR: Natural Resources (WD, TANAPA, TAWIRI, NCCA)]

Name	Network	Name	Network	Name	Network	Name	Network	Name	Network	Name	Network
Abdulkadir Luta Mohamed	HS	Andrea Ndele	LC	Salum Kuga Salum	LC	Amedeus Makungu	NR	George Jidayi	NR	Omari Hamisi	NR
André Roux	HS	Antone Rachid	LC	Salum Malinga	LC	Amidu Aruli Liwanda	NR	Gilbert Ashem Bahyru	NR	Oscar Malima	NR
Andries Walt	HS	Athumani Kiwope	LC	Shabani Ludno	LC	Amiyo Amiyo	NR	Godfrey Mwari	NR	Pascal Mrina	NR
Arnaud Mermet	HS	B. Mpanjura	LC	Silvanus Getageta	LC	Aoweke Yangé	NR	Godian Anzelimu	NR	Paschal Mathew	NR
Bengt Kvitzau	HS	Bahati Joram, Farmer	LC	Sirina Kilenya	LC	August Kimolo	NR	Goodluck Emanueli	NR	Paskali Kika Kaleho	NR
Bernard Sehabiague	HS	Bahati Masoud	LC	Sophia Mkung'una	LC	August Martin	NR	Gradys Mgumbi	NR	Patrick Andrew	NR
Brian Van Blerk	HS	Bakari Mussa	LC	Victoria Raphael	LC	Baker Masureli	NR	Habib Wallace Mgeni	NR	Peter Isingo	NR
Christian Kamm	HS	Bernard Pyuza	LC	Walalasi Megrory	LC	Baldwin Muakamera	NR	Halima Mangi	NR	Peter Mtani	NR
Christophe Morio	HS	Busagala Saduka	LC	Ziara Sebastianas	LC	Beatrice Mtui	NR	Hindu Kahunda	NR	Peter Ottaru	NR
Christopher Trent	HS	Carl Voltaire	LC	Abel Babron	LR	Beatus Kisangija	NR	Honori Maliti	NR	Petro K.B. Ndege	NR
Craig Middleton	HS	Evans Jonathan	LC	Aminel Justo	LR	Beda Tembo	NR	Iddi Ndagenda	NR	R. Anatory	NR
Daniel Moore	HS	Fatima Mohameo	LC	Augustine Shayo	LR	Bruno Kawasange	NR	Imani Israel	NR	Rachid Mussa	NR
Danny McCallum	HS	Fatima Rashidi	LC	Bakari Hussemi	LR	Célestin Mafuru	NR	Inyasi Lejora	NR	Rajabu Hochi	NR
Dean Kendall	HS	Faushu Faistine	LC	Bomani C. Nwhoja	LR	Chande Ligibu	NR	Israel Naman	NR	Raymond Ndumbaro	NR
Derek Hurt	HS	Fideri Andrea	LC	Dr Walter Marandu	LR	Charles Gwera	NR	Jacob Elikana	NR	Rejab Makwiro	NR
Dominique Maartens	HS	Haji Issa Kainde	LC	Dr. Mleche	LR	Charles Masanja	NR	James Kabutta	NR	Richard Charles	NR
Eric Pasanisi	HS	Hassan Mataube	LC	Flora Assenge	LR	Charles Mvungi	NR	James Wakibara	NR	Richard Mbewa	NR
Ernst Scholz	HS	Husein Said Magaila	LC	Gabu Masalu	LR	Christoph Mwakyeja	NR	Joas Makwati	NR	Robert Hamza	NR
François de Grossouvre	HS	Hussein Luziga	LC	H.E.N. Kajhalankoro	LR	Clement Aroko	NR	John Honest	NR	Rose Bolrohe	NR
François Lyonnet	HS	Isack Mgwego	LC	Hayuma Yah	LR	Cosmasi Muungo	NR	John Kaaya	NR	Rose Ipande	NR
Frédéric Herbain	HS	Jamari Ndubeye	LC	Jeremiah Temu	LR	Cosmas Kireti	NR	John Masatu Masuka	NR	Rose Masha	NR
Frederico Muntades	HS	Joseph Gonebu Ginanari	LC	Kiraba Musoke	LR	David Kadomo	NR	John Mbwiliza	NR	Ruben Kassanda	NR
Gamshad Gamdust	HS	Joseph Hamza	LC	Laurensi Macha	LR	Dawson Balayangaki	NR	John Muya	NR	Rutharu Mbekwa	NR
Gérard Ambrose	HS	Julius Kaleb	LC	Longoviro Kipuyo	LR	Debu Ngadule	NR	Joseph Churva	NR	Samuel Bakari	NR
Gérard Pasanisi	HS	Juma Kabuta	LC	Mohamed Ali	LR	Dickson Xavery	NR	Joseph Halamaya	NR	Samuel Magoti	NR
Gordon Church	HS	Junna Diffa	LC	Mohamed Khatibu	LR	Dominick Bakari	NR	Joseph Halamga	NR	Samuel N. Mwita	NR
Harpreet Brar	HS	Kiaze Msangi	LC	Peter Njau	LR	Donald Matinga	NR	Joshua Lemorog	NR	Sandey Kitumi	NR
Jasper Perrett	HS	Lisha Saidi	LC	Slisa Ginamungu	LR	Dorcus Rumbali	NR	Julius Nganamuka	NR	Sebastian Paschazia	NR
Jean-Louis Masson	HS	Magreth Petro	LC	Stephania Mb?	LR	Edmund Kilapilo	NR	Julius Wandongo	NR	Sefu Ungele	NR
Jonathan Howells	HS	Mashani Mchee	LC	Thadeo Kavishe	LR	Edson Mgeni	NR	K.E. Mbwambo	NR	Shaddy Kyambile	NR
Leon Lamprecht	HS	Matei Philipo	LC	Yakobo Msanga	LR	Edward Idimael	NR	Kaburi Mzari	NR	Sikukuu Shauri	NR
Mauro Fabris	HS	Mauridi Makutwa	LC	Yohana Sagenge	LR	Edward Kileto	NR	Kazael Mrisha	NR	Simon Charles Kisinza	NR
Michel Mantheakis	HS	Michael Umru	LC	Alexander Piel	NGO	Edward Kuwungwa	NR	Kennedy Hinchu	NR	Simon Mduma	NR
Mike Angelides	HS	Mr Msiangi	LC	Alexander Songorwa	NGO	Edward Mlaponi	NR	Ladislas Kahane	NR	Tadeo Simon Kachenje	NR
Moshin Sheni Abdallah	HS	Mshamu Mohamed	LC	Andrew Perkin	NGO	Edward Svadala	NR	Laurent Sudi Monburi	NR	Terewa Ndeonansia	NR
Nicolas Dubich	HS	Mussa Bakari	LC	Anthony Collins	NGO	Egidius Rwebugaz	NR	Lawrance Kileo	NR	Thobias Menge	NR
Nicolas Gazelle	HS	Mzee Mbutuka	LC	Bernard Kissui	NGO	Eliamani Godwin	NR	Leonard Nathani	NR	Thomas Kasandiyo	NR
Paulo Shanalingigwa	HS	Namboni Nabaki	LC	Candida Mwingira	NGO	Elias Ngwenga	NR	Linus Chuwa	NR	Tito Towo	NR
Perdo de Sa Mello	HS	Nasoro Swedi	LC	Chediel Kazadi	NGO	Elison Johnstone	NR	Lucas Goroi	NR	Trevor Jones	NR
Peter Mkumbo	HS	Omar Seif Msumi	LC	Dennis Minja	NGO	Emanuel Sisya	NR	Lukius Musso	NR	Valentine Msusa	NR
Philippe Clero	HS	Omari Bakari Mzuzeri	LC	Emily Fitzherbert	NGO	Emmanuel Nyangaro	NR	M. Imapunda	NR	Victor Runyora	NR
Piet Fourie	HS	Omari Lugoma	LC	Goran Spang	NGO	Erasmus Tarimo	NR	Mabilibili Post	NR	Willness Minja	NR
René Warburg	HS	Omari Shabani Igiguru	LC	Henry Brink	NGO	Erenesi Makoni	NR	Martin Kauga	NR	Yussef Jilala	NR
Richard Ramoni	HS	Omary Maganga	LC	Ingela Jansson	NGO	Ernest Madanya	NR	Matata Mushi	NR	Yustina Kiwango	NR
Robin Voigt	HS	Patrick Masha	LC	Kija Hamza	NGO	Ernest Nambo	NR	Maurus Msuha	NR	Yusufu Mponda	NR
Roger Hurt	HS	Philip Antony	LC	Krissie Clark	NGO	Evelyn Izoba	NR	Mohamed Kimolo	NR	Zena Salum	NR
Sue Van Rensburg	HS	Rajachi Matinda	LC	Lota Melamari	NGO	Felix Ndebarika	NR	Mohamed Omari	NR		
Terry Calavrias	HS	Ramadhani Jonga	LC	Tim Davenport	NGO	Fidelis Bisigoro	NR	Moses Kyando	NR		
Thomas Dames	HS	Regina Migarambo	LC	Abassi A Luembe	NR	Francis Getera	NR	Mr Mwombeki	NR		
Walter Mmari	HS	Roman Thobias	LC	Adayo Karama	NR	Francis Kasambala	NR	Mussa Omary	NR		
Wayne Hendry	HS	Said Bongova	LC	Alen Mbaga	NR	Francis Sekwao	NR	Naphely Lulesu Sangaz	NR		
A.B. Maliwatu	LC	Said Yussugu	LC	Alex Choya	NR	Francisca Kimario	NR	Natashoo Msuya	NR		
Abdi Mponda	LC	Saidi Abasi Ambali	LC	Alex Kibwana	NR	Frederick Chokunegela	NR	Nuhu Ngoma	NR		
Agatoni August Mtemele	LC	Saidi Kinoumbo	LC	Alexander Lobora	NR	Frederick Mofulu	NR	Nyosivye Mwabukusi	NR		
Amosi Msongo	LC	Saidi Kipeneke	LC	Allen Shanny	NR	Fridon Di Kikasi	NR	Obed Mbangwa	NR		

APPENDIX V: Survey's synthetic database – District level - *continued*

Region	District	Surface (km <sup>2</sup> )*	Number of information	Presence	Frequency of observation	Frequency of conflict	Type of conflict	Level of knowledge	Gaps in knowledge
Arusha	Arumeru	1639.953	4	0	Absent	Absent	Absent	Medium	Minor
	Arusha	584.906	4	0	Absent	Absent	Absent	Medium	Minor
	Karatu	3961.88	1	10	Rarely	Medium	HL	Questionable	Major
	Longido	0	6	1	Monthly	High	HL	Medium	Mild
	Monduli	1713.023	3	1	Monthly	High	L	Poor	Major
Dar es salaam	Ngorongoro	0	1	10	Rarely	NA	NA	Questionable	Major
	Ilala	343.882	1	10	Rarely	Medium	HL	Questionable	Major
	Kinondoni	519.416	3	0	Absent	Absent	Absent	Poor	Minor
Dodoma	Temeke	726.61	2	10	Rarely	None	None	Poor	Minor
	Bahi	4629.62	2	1	NA	NA	NA	Poor	Major
	Chamwino	9054.512	4	1	Monthly	None	None	Medium	Mild
	Dodoma	3222.783	4	10	Rarely	Medium	H	Questionable	Mild
	Kondo	10374.253	7	1	Yearly	Medium	HL	Medium	Minor
	Kongwa	3966.113	4	0	Absent	Absent	Absent	Medium	Minor
	Mpwapwa	7768.604	6	0	Absent	Absent	Absent	Poor	Minor
Iringa	Iringa	7331.523	2	1	NA	High	L	Poor	Major
	Kilolo	7860.572	1	10	Rarely	NA	NA	Questionable	Major
	Ludewa	6045.575	2	0	Absent	Absent	Absent	Poor	Minor
	Makete	3669.29	3	10	Rarely	Low	L	Questionable	Mild
	Mufindi	9485.51	2	10	Rarely	None	None	Questionable	Mild
Kagera	Njombe	11389.372	2	10	Rarely	None	None	Questionable	Mild
	Biharamulo	4175.435	2	10	Rarely	NA	NA	Questionable	Mild
	Bukoba	2984.682	2	0	Absent	Absent	Absent	Poor	Minor
	Chato	2469.671	0	NA	NA	NA	NA	None	Major
	Karagwe	4447.446	1	10	Rarely	NA	NA	Questionable	Major
	Misenyi	2725.041	0	NA	NA	NA	NA	None	Major
Kigoma	Muleba	2719.377	0	NA	NA	NA	None	None	Major
	Ngara	3225.45	3	10	Rarely	None	None	Questionable	Mild
	Kasulu	6208.611	2	1	Yearly	NA	NA	Poor	Mild
	Kibondo	4335.994	3	1	Yearly	Medium	H	Poor	Mild
Kilimanjaro	Kigoma	8663.456	4	1	Yearly	NA	NA	Medium	Minor
	Hai	1126.032	2	10	Rarely	NA	NA	Questionable	Mild
	Siha (Moshi)	883.8	6	0	Absent	Absent	Absent	Medium	Minor
	Mwanga	1522.904	7	10	Rarely	Medium	HL	Medium	Minor
	Rombo	2325.859	6	10	Rarely	Medium	H	Poor	Minor
Lindi	Same	4436.349	5	10	Rarely	None	None	Questionable	Mild
	Kilwa	6693.099	10	1	Yearly	Medium	HL	Medium	Minor
	Lindi	6361.742	9	1	Yearly	High	HL	Medium	Minor
	Liwale	12868.006	7	1	Yearly	Medium	H	Medium	Minor
	Nachingwea	6536.57	5	10	Rarely	Low	L	Medium	Minor
Manyara	Ruangwa	2349.844	3	1	Yearly	Medium	HL	Poor	Mild
	Babati	3441.333	11	10	Rarely	Medium	HL	Poor	Minor
	Hanang	3814.805	4	1	Monthly	Medium	HL	Medium	Mild
	Kiteto	0	2	1	Yearly	NA	NA	Poor	Mild
	Mbulu	2054.617	2	1	Yearly	Medium	HL	Poor	Mild
Mara	Simanjiro	2863.395	11	1	Monthly	High	HL	High	None
	Bunda	2008.622	2	1	Monthly	Medium	L	Poor	Major
	Musoma	3885.219	0	NA	NA	NA	NA	None	Major
	Serengeti	3520.279	1	10	Rarely	Low	L	Questionable	Major
Mbeya	Tarime	3375.596	0	NA	NA	NA	NA	None	Major
	Chunva	6984.592	3	10	Rarely	Medium	HL	Questionable	Mild
	Ileja	2328.367	3	10	Rarely	Medium	HL	Questionable	Mild
	Kyela	1167.828	2	0	Absent	Absent	Absent	Poor	Mild
	Mbarali	8632.336	2	10	Rarely	NA	NA	Questionable	Mild
	Mbeya	3601.509	2	0	Absent	Absent	Absent	Poor	Mild
Rungwe	Mbozi	9476.254	2	10	Rarely	Low	L	Questionable	Mild
	Rungwe	1858.235	1	0	Absent	Absent	Absent	Questionable	Major

Presence: 1 = Permanent presence; 10 = temporary presence; 0 = Absence; NA = No information

**APPENDIX V: Survey's synthetic database – District level - end**

Region	District	Surface (km <sup>2</sup> )*	Number of information	Presence	Frequency of observation	Frequency of conflict	Type of conflict	Level of knowledge	Gaps in knowledge
Morogoro	Kilombero	2721.407	8	1	Monthly	Medium	H	Medium	Major
	Kilosa	11797.136	5	1	Yearly	Low	L	Medium	Minor
	Morogoro	7312.59	7	10	Rarely	Medium	HL	Questionable	Mild
	Mvomero	5385.991	2	1	Yearly	Low	L	Poor	Mild
	Ulanga	4496.414	8	1	Yearly	None	None	Medium	Mild
Mtwara	Masasi	4871.653	1	10	Rarely	NA	NA	Questionable	Major
	Mtwara	4044.993	1	10	Rarely	Medium	H	Questionable	Major
	Nanyumbu	4934.384	0	NA	NA	NA	NA	None	Major
	Newala	1635.173	1	0	Absent	Absent	Absent	Questionable	Major
	Tandahimba	2176.913	1	10	Rarely	Medium	L	Questionable	Major
Mwanza	Geita	6815.276	1	0	Absent	Absent	Absent	Questionable	Major
	Kwimba	3998.938	1	0	Absent	Absent	Absent	Questionable	Major
	Ilemela	364.199	1	0	Absent	Absent	Absent	Questionable	Major
	Magu	3172.352	1	0	Absent	Absent	Absent	Questionable	Major
	Nyamagana	365.755	1	0	Absent	Absent	Absent	Questionable	Major
	Misungwi	2024.681	4	0	Absent	Absent	Absent	Medium	Minor
	Sengerema	2533.628	3	0	Absent	Absent	Absent	Poor	Minor
Pwani	Bagamoyo	7153.153	0	NA	NA	NA	NA	None	Major
	Kibaha	2280.623	1	0	Absent	Absent	Absent	Questionable	Major
	Kisarawe	3827.763	4	1	Yearly	Medium	HL	Medium	Minor
	Mkuranga	2870.347	19	1	Monthly	Medium	HL	High	None
	Rufiji	10229.398	10	1	Monthly	Medium	HL	High	None
Rukwa	Mpanda	15775.266	5	1	Yearly	Low	L	Medium	Mild
	Nkasi	7814.259	1	10	Rarely	NA	NA	Questionable	Major
	Sumbawanga	13594.051	3	10	Rarely	NA	NA	Questionable	Mild
Ruvuma	Mbinga	7175.177	2	1	Yearly	Medium	HL	Poor	Mild
	Namtumbo	8082.985	3	1	Yearly	Low	L	Poor	Mild
	Songea	9536.879	2	10	Rarely	NA	NA	Questionable	Mild
	Tunduru	11018.612	6	1	Monthly	Medium	HL	Medium	Mild
Shinyanga	Bariadi	4768.061	2	0	Absent	Absent	Absent	Poor	Minor
	Bukombe	4384.451	2	10	Rarely	Medium	L	Questionable	Mild
	Kahama	8281.067	2	1	Yearly	Low	L	Poor	Mild
	Kishapu	5152.637	0	NA	NA	NA	NA	None	Major
	Maswa	4105.538	1	10	Rarely	NA	NA	Questionable	Major
	Meatu	3402.719	4	1	Yearly	Medium	HL	Medium	Mild
Singida	Shinyanga	4094.989	0	NA	NA	NA	NA	None	Major
	Iramba	7298.728	0	NA	NA	NA	NA	None	Major
	Manyoni	7204.472	16	1	Yearly	High	HL	High	None
Tabora	Singida	13095.788	7	1	Yearly	High	HL	Poor	Mild
	Igunga	6765.385	9	10	Rarely	Medium	HL	Medium	Minor
	Nzega	6342.81	1	10	Rarely	NA	NA	Questionable	Major
	Sikonge	4953.707	5	1	Yearly	None	None	Medium	Minor
	Tabora	1811.027	1	0	Absent	Absent	Absent	Questionable	Major
	Urambo	7878.942	3	1	Yearly	Low	L	Poor	Mild
	Uyui	9627.264	3	10	Rarely	Medium	HL	Poor	Mild
Tanga	Handeni	7586.689	1	10	Rarely	None	None	Questionable	Major
	Kilindi	3973.014	0	NA	NA	NA	NA	None	Major
	Korogwe	3973.681	3	10	Rarely	None	None	Questionable	Mild
	Lushoto	2040.581	3	0	Absent	Absent	Absent	Poor	Minor
	Mkinga	1997.286	1	0	Absent	Absent	Absent	Questionable	Major
	Muheza	2107.48	2	0	Absent	Absent	Absent	Poor	Minor
	Pangani	1321.14	0	NA	NA	NA	NA	None	Major
Tanga	295.484	0	NA	NA	NA	NA	None	Major	

Presence: 1 = Permanent presence; 10 = temporary presence; 0 = Absence; NA = No information

## APPENDIX V: Survey's synthetic database – Protected Area without hunting level

Area name	Type	Surface (km <sup>2</sup> )*	Number of information	Presence	Frequency of observation	Frequency of conflict	Type of conflict	Level of knowledge	Gaps in knowledge
Ngorongoro	Cons. Area	8068	18	1	Weekly	Medium	HL	High	None
Arusha	National Park	112	12	0	Absent	Absent	Absent	Questionable	Mild
Gombe	National Park	34	7	0	Absent	Absent	Absent	Medium	Minor
Katavi	National Park	4279	13	1	Weekly	Medium	HL	High	None
Kilimanjaro	National Park	795	11	1	Yearly	None	None	Medium	Minor
Kitulo	National Park	426	4	10	Rarely	NA	NA	Medium	Minor
Lake Manyara	National Park	86	9	1	Weekly	Medium	H	High	None
Mahale Mts.	National Park	1450	11	1	Yearly	NA	NA	Medium	Minor
Mikumi	National Park	3234	10	1	Weekly	Medium	HL	High	None
Mkomazi	National Park	3446	10	1	Monthly	None	None	High	None
Ruaha	National Park	14507	15	1	Weekly	Medium	HL	High	None
Saadani	National Park	645	10	1	Weekly	NA	NA	Medium	Mild
Serengeti	National Park	13039	21	1	Weekly	None	None	High	None
Tarangire	National Park	2616	16	1	Weekly	None	None	High	None
Udzungwa Mountains	National Park	2089	6	1	Monthly	None	None	Medium	Mild
Selous Y1	Photo	867	2	1	NA	NA	NA	Poor	Major
Selous Z1	Photo	762	2	1	Weekly	None	None	Poor	Major
Selous KY1	Photo	539	2	1	Weekly	None	None	Poor	Major
Selous B1	Photo	845	2	1	Weekly	None	None	Poor	Major

Presence: 1 = Permanent presence; 10 = temporary presence; 0 = Absence

APPENDIX V: Survey's synthetic database – Protected Area with hunting level - *continued*

Area name	Type	Surface (km <sup>2</sup> )*	Number of information	Presence	Frequency of observation	Frequency of conflict	Type of conflict	Level of knowledge	Gaps in knowledge
Biharamulo GR	GR	723	18	1	Monthly	NA	NA	Poor	Major
Burigi West GR	GR	1112	8	1	Monthly	None	None	Medium	Mild
Burigi East GR	GR	1739	8	1	Monthly	None	None	Medium	Mild
Burko OA	OA	713	2	1	Monthly	Low	L	Poor	Major
Burunge GCA	GCA	355	3	10	Rarely	High	L	Poor	Minor
Chaya OA	OA	877	2	1	Monthly	High	HL	Poor	Major
Chunya East OA	OA	1551	3	1	Monthly	Medium	L	Poor	Major
Chunya West OA	OA	5673	4	1	Weekly	Low	L	Medium	Mild
Fort Ikoma OA	OA	253	2	1	Monthly	None	None	Poor	Major
Furua OA	OA	813	1	10	Rarely	NA	NA	Questionable	Major
Gombe GCA	GCA	2703	4	1	Weekly	NA	NA	Medium	Mild
Gonabisi Kidunda OA	OA	1092	1	1	NA	NA	NA	Questionable	Major
Grumeti GR	GR	434	6	1	Monthly	None	None	Medium	Mild
Handeni GCA	GCA	2860	1	1	NA	NA	NA	Questionable	Major
Ibanda GR	GR	307	11	10	Rarely	Low	L	Medium	Minor
Ibanda Rumanyika GR	GR	245	9	10	Rarely	Low	L	Medium	Minor
Irkishibor OA	OA	718	3	1	NA	Medium	HL	Poor	Major
Ikorongo GR	GR	558	6	1	Monthly	None	None	Medium	Mild
Inyonga East GCA	GCA	2321	3	1	Weekly	None	None	Poor	Major
Inyonga West GCA	GCA	2964	3	1	Weekly	None	None	Poor	Major
Ipole (not in GIS shapefile)**	WMA	NA	2	1	Yearly	Medium	HL	Poor	Major
Itete OA*	OA	889	0	NA	NA	NA	NA	None	Major
Ituru Forest OA	FR	2173	2	1	NA	NA	NA	Poor	Major
Kigosi Central GR	GR	3677	1	1	NA	NA	NA	Questionable	Major
Kigosi North GR*	GR	2412	0	NA	NA	NA	NA	None	Major
Kigosi South GR	GR	3181	1	1	NA	NA	NA	Questionable	Major
Kijeleshi GR*	GR	145	6	1	Monthly	None	None	Medium	Mild
Kilombero South Bomaulanga GCA	GCA	1134	2	1	NA	NA	NA	Poor	Major
Kilombero North Mgeta GCA*	GCA	1281	2	1	NA	NA	NA	Poor	Major
Kilombero South Malinyi GCA	OA	1358	2	1	NA	NA	NA	Poor	Major
Kilombero North Mlimba GCA	GCA	2021	3	1	Weekly	Medium	L	Poor	Major
Kilwa Central OA	OA	1418	2	1	NA	NA	NA	Poor	Major
Kilwa South Nakiu OA	OA	1845	2	1	NA	NA	NA	Poor	Major
Kilwa South Mbwem OA	OA	1160	2	1	NA	NA	NA	Poor	Major
Kilwa North OA	OA	2367	2	1	Weekly	NA	NA	Poor	Major
Kimisi GR	GR	966	8	1	Monthly	None	None	Medium	Mild
Kitwai South GCA	GCA	2618	4	1	Weekly	High	L	Medium	Mild
Kitwai North GCA	GCA	2476	4	1	Weekly	High	L	Medium	Mild
Kizigo Central GR	GR	1367	2	1	Weekly	NA	NA	Poor	Major
Kizigo East GR	GR	2470	2	1	Weekly	NA	NA	Poor	Major
Kizigo West GR	GR	1120	2	1	Weekly	NA	NA	Poor	Major
Lake Natron North GCA	GCA	3569	9	10	Rarely	Medium	L	Medium	Minor
Lake Natron South GCA	GCA	3117	7	10	Rarely	High	HL	Medium	Minor
Lake Rukwa GR	GR	1952	8	1	Monthly	NA	NA	Medium	Mild
Landanai GCA	GCA	1295	1	1	NA	NA	NA	Questionable	Major
Lihonja FR*	FR	242	0	NA	NA	NA	NA	None	Major
Liparamba GR*	GR	605	4	10	Rarely	Medium	HL	Medium	Minor
Litumbandoyosi / Gezamasua FR	OA	3141	0	NA	NA	NA	NA	None	Major
Liwale North OA	OA	3673	4	1	Monthly	NA	NA	Medium	Mild
Liwale South OA	OA	1109	3	1	Monthly	None	None	Poor	Major
Lokisale GCA	GCA	1318	6	1	Monthly	High	HL	Medium	Mild
Loliondo GCA	GCA	6038	5	10	Rarely	NA	NA	Medium	Minor
Longido GCA	GCA	1456	5	10	Rarely	NA	NA	Medium	Minor
Luafi	GR	2133	4	1	Weekly	None	None	Medium	Mild
Luganzo GCA	GCA	5118	5	1	Weekly	High	HL	Medium	Mild
Lukwati North GR	GR	1427	4	1	Weekly	None	None	Medium	Mild
Lukwati South GR	GR	2054	4	1	Weekly	None	None	Medium	Mild
Lukwika Lumesule GR	GR	424	7	1	Weekly	None	None	Medium	Mild
Lunda Mkwambi North GCA	GCA	1966	3	1	Weekly	Medium	L	Poor	Major
Magwamila OA*	OA	1349	1	10	Rarely	NA	NA	Questionable	Major
Mahenge South OA	OA	560	1	1	NA	NA	NA	Questionable	Major
Mahenge North OA*	OA	449	1	1	NA	NA	NA	Questionable	Major
Makere North FR	FR	797	5	1	Yearly	NA	NA	Medium	Minor
Makere South FR	FR	581	5	1	Yearly	NA	NA	Medium	Minor
Masai East OA	OA	2555	2	10	Rarely	NA	NA	Poor	Minor
Masai South OA	OA	7638	2	10	Rarely	NA	NA	Poor	Minor
Masai West OA	OA	985	7	1	Weekly	High	HL	Medium	Mild
Maswa Kimali GR	GR	1341	7	1	Weekly	Low	L	Medium	Mild
Maswa Makao OA	OA	1333	3	1	Weekly	Medium	L	Poor	Major
Maswa Mbono GR	GR	707	6	1	Weekly	None	None	Medium	Mild
Maswa North GR	GR	751	2	1	Weekly	None	None	Poor	Major
Matapwa OA*	OA	975	1	10	Rarely	NA	NA	Questionable	Major
Matundu FR*	FR	307	0	NA	NA	NA	NA	None	Major
Mbarang'andu OA	OA	3056	4	1	Monthly	High	HL	Medium	Mild
Misechela OA*	OA	1040	2	1	Monthly	None	None	Poor	Major
Mkungunero GR	GR	732	5	1	Monthly	High	HL	Medium	Mild
Mlele North GCA	GCA	2301	4	1	Weekly	NA	NA	Medium	Mild
Mlele South GCA	GR	1244	4	1	Weekly	None	None	Medium	Mild
Mnyera OA*	OA	1109	0	NA	NA	NA	NA	None	Major
Monduli Juu OA	OA	696	2	10	Rarely	NA	NA	Poor	Minor

Presence: 1 = Permanent presence; 10 = temporary presence; NA = No information



APPENDIX V: Survey's synthetic database – Protected Area with hunting level - *continued*

Area name	Type	Surface (km <sup>2</sup> )*	Number of information	Presence	Frequency of observation	Frequency of conflict	Type of conflict	Level of knowledge	Gaps in knowledge
Moyowosi Central GR	GR	2512	3	1	Monthly	NA	NA	Poor	Major
Moyowosi Njingwe North GR	GR	2695	2	1	Monthly	None	None	Poor	Major
Moyowosi Njingwe South GR	GR	3018	4	1	Weekly	Low	L	Medium	Mild
Moyowosi North GR	GR	3163	1	1	NA	NA	NA	Questionable	Major
Mpanga Kipengere GR	GR	957	4	1	Yearly	Low	L	Medium	Minor
Msanjesi GR*	GR	142	5	1	Monthly	NA	NA	Medium	Mild
Msima West GCA	GCA	6133	4	1	Weekly	Low	L	Medium	Mild
Msuluguda OA*	OA	886	0	NA	NA	NA	NA	None	Major
Mtimba OA*	OA	1256	0	NA	NA	NA	NA	None	Major
Mto wa Mbu GCA	GCA	1208	3	1	NA	NA	NA	Questionable	Major
Mtungwe Central OA	OA	1275	2	1	Monthly	NA	NA	Poor	Major
Mtungwe North OA	OA	1677	2	1	Monthly	NA	NA	Poor	Major
Mtungwe South OA	OA	1247	2	1	Monthly	NA	NA	Poor	Major
Muhesi GR	GR	4433	12	1	Weekly	None	None	High	None
Muhuwesi GCA	GCA	1812	5	1	Monthly	High	HL	Medium	Mild
Muhuwesi OA*	OA	233	1	10	Rarely	NA	NA	Questionable	Major
Mwambesi GCA	GCA	1021	2	1	Yearly	NA	NA	Poor	Mild
Mwatisi South OA	OA	1110	1	1	NA	NA	NA	Questionable	Major
Mwatisi North OA*	OA	1013	1	10	Rarely	NA	NA	Questionable	Major
Ngasera OA	OA	889	1	10	Rarely	NA	NA	Questionable	Major
Nkamba FR	FR	531	1	10	Rarely	NA	NA	Questionable	Major
Pande GR	GR	13	1	10	Rarely	None	None	Questionable	Major
Piti East OA	OA	2670	4	1	Weekly	None	None	Medium	Mild
Piti West OA	OA	1088	4	1	Weekly	None	None	Medium	Mild
Ruhudji / Ifinga OA	OA	2215	3	10	Rarely	None	None	Poor	Minor
Rungwa South OA	OA	3831	5	1	Weekly	Low	L	Medium	Mild
Rungwa Ikili GR	GR	2870	4	1	Weekly	None	None	Medium	Mild
Rungwa Inyonga GR	GR	1786	5	1	Weekly	Low	L	Medium	Mild
Rungwa Mpera GR	GR	1223	2	1	Weekly	NA	NA	Poor	Major
Rungwa Mwamagembe GR	GR	903	3	1	Weekly	None	None	Poor	Major
Rungwa North OA	OA	2593	2	1	NA	NA	NA	Poor	Major
Rungwa River FR	FR	3153	3	1	Weekly	None	None	Poor	Major
Rungwa Rungwa GR	GR	2193	2	1	Weekly	None	None	Poor	Major
Ruvu Masai GCA	GCA	2439	5	1	Weekly	High	L	Medium	Mild
Ruvuma OA	OA	1729	1	10	Rarely	NA	NA	Questionable	Major
Sasawara FR*	FR	563	1	10	Rarely	NA	NA	Questionable	Major
Selous IH1	GR	425	0	NA	NA	NA	NA	None	Major
Selous K1	GR	332	4	1	Weekly	None	None	Medium	Mild
Selous K2	GR	642	4	1	Weekly	None	None	Medium	Mild
Selous K3	GR	455	1	1	NA	NA	NA	Questionable	Major
Selous K4	GR	379	1	1	NA	NA	NA	Questionable	Major
Selous K5	GR	586	2	1	NA	NA	NA	Poor	Major
Selous L1	GR	464	1	1	NA	NA	NA	Questionable	Major
Selous LA1	GR	549	2	1	Weekly	None	None	Poor	Major
Selous LL1	GR	1709	6	1	Weekly	None	None	Medium	Mild
Selous LL2	GR	1745	8	1	Weekly	None	None	Medium	Mild
Selous LL3	GR	1709	3	1	Weekly	None	None	Poor	Major
Selous LU1	GR	2353	1	1	NA	NA	NA	Questionable	Major
Selous LU2	GR	1156	2	1	Monthly	None	None	Poor	Major
Selous LU3	GR	613	3	1	Monthly	NA	NA	Poor	Major
Selous LU4	GR	373	3	1	Weekly	None	None	Poor	Major
Selous LU5	GR	510	1	1	NA	NA	NA	Questionable	Major
Selous LU6	GR	883	4	1	Monthly	None	None	Medium	Mild
Selous LU7	GR	1459	4	1	Monthly	None	None	Medium	Mild
Selous LU8	GR	1623	4	1	Monthly	None	None	Medium	Mild
Selous M1	GR	530	2	1	Yearly	NA	NA	Poor	Mild
Selous M2	GR	395	2	1	Weekly	None	None	Poor	Major
Selous MA1	GR	1687	6	1	Weekly	None	None	Medium	Mild
Selous MB1	GR	2149	3	1	Monthly	None	None	Poor	Major
Selous MB2	GR	1054	5	1	Weekly	None	None	Medium	Mild
Selous MB3	GR	1686	3	1	Weekly	None	None	Poor	Major
Selous MH1	GR	1368	3	1	Weekly	None	None	Poor	Major
Selous MJ1	GR	1941	3	1	Weekly	None	None	Poor	Major
Selous MK1	GR	823	1	1	NA	NA	NA	Questionable	Major
Selous ML1	GR	792	3	1	Monthly	None	None	Poor	Major
Selous MS1	GR	1345	1	1	NA	NA	NA	Questionable	Major
Selous MT1	GR	873	3	1	Monthly	None	None	Poor	Major
Selous MT2	GR	2016	7	1	Weekly	None	None	Medium	Mild
Selous N1	GR	1803	4	1	Monthly	None	None	Medium	Mild
Selous N2	GR	1032	3	1	Monthly	None	None	Poor	Major
Selous R1	GR	455	2	1	Monthly	NA	NA	Poor	Major
Selous R2	GR	688	2	1	Yearly	NA	NA	Poor	Mild
Selous R3	GR	330	2	1	Weekly	None	None	Poor	Major
Selous R4	GR	582	2	1	Weekly	NA	NA	Poor	Major
Selous RU1	GR	1709	2	1	Weekly	None	None	Poor	Major
Selous U1	GR	589	1	1	NA	NA	NA	Questionable	Major
Selous U2	GR	520	1	1	NA	NA	NA	Questionable	Major
Selous U3	GR	777	5	1	Weekly	None	None	Medium	Mild
Selous U4	GR	785	2	1	Weekly	None	None	Poor	Major

Presence: 1 = Permanent presence; 10 = temporary presence; NA = No information

**APPENDIX V: Survey's synthetic database – Protected Area with hunting level - end**

Area name	Type	Surface (km <sup>2</sup> )*	Number of information	Presence	Frequency of observation	Frequency of conflict	Type of conflict	Level of knowledge	Gaps in knowledge
Simajaro West GCA	GCA	2936	2	1	NA	NA	NA	Poor	Major
Simanjiro Kitangare GCA	GCA	1750	4	1	Monthly	Low	L	Medium	Mild
Simanjiro Naberera GCA	GCA	2184	1	1	NA	NA	NA	Questionable	Major
Simbanguru / Igwemadete OA*	OA	371	0	NA	NA	NA	NA	None	Major
Swagaswaga GR*	GR	851	7	1	Monthly	Medium	HL	Medium	Mild
Talamai OA	OA	4433	2	1	Yearly	NA	NA	Poor	Mild
Tapika / Ngarambe OA	OA	316	3	1	Weekly	High	L	Poor	Major
Tunduru OA	OA	1018	3	1	Monthly	NA	NA	Poor	Major
Ugalla East GR	GR	2142	3	1	Weekly	None	None	Poor	Major
Ugalla West GR	GR	3050	3	1	Weekly	None	None	Poor	Major
Ugalla Niensi OA*	OA	4374	2	1	Yearly	NA	NA	Poor	Major
Ugalla North-West OA	OA	789	0	NA	NA	NA	NA	None	Major
Ugalla North-East OA	OA	700	0	NA	NA	NA	NA	None	Major
Ugunda GCA	GCA	4836	3	1	Monthly	NA	NA	Poor	Major
Uvinza OA	OA	2561	5	1	Yearly	Low	L	Medium	Minor
Uyumbu WMA*	WMA	837	2	1	Weekly	None	None	Poor	Major
Waga OA*	OA	525	0	NA	NA	NA	NA	None	Major
Wami Mbiki WMA	WMA	2361	3	1	Weekly	NA	NA	Poor	Major
Wembere South GCA	GCA	8434	2	1	Weekly	Medium	L	Poor	Major
Wembere Central 1 OA*	OA	1500	0	NA	NA	NA	NA	None	Major
Wembere North OA	OA	2086	0	NA	NA	NA	NA	None	Major
Wembere Central 2 OA	OA	1506	0	NA	NA	NA	NA	None	Major
Yaada Chini OA*	OA	500	1	10	Rarely	NA	NA	Questionable	Major

Presence: 1 = Permanent presence; 10 = temporary presence; NA = No information

## **APPENDIX VI: Some legal aspects of people's defence against wildlife damage**

### **Act to repeal and replace the Fauna Conservation Ordinance, to make provision for the protection, conservation, development, regulation and control of Fauna and Fauna products and for matters incidental thereto and connected therewith – 30th July, 1974**

Part IV - Hunting, capturing and photographing of animals

(d) Miscellaneous provisions relating to hunting

Killing animal in defence of life or property allowed

50 - (1) Nothing in this Act shall make it an offence to kill any animal in defence of human life or property or for the owner or occupier of such property or any person dependent on or employed by such owner or occupier to drive or kill by any means what-so-ever any animal found causing damage to such property...

### **The Wildlife Policy of Tanzania – March, 1998**

3.0 The Wildlife policy

3.3.12. Solving human-wildlife conflicts.....

Strategies for solving human-wildlife conflicts:

(ii) ... devolving progressively the responsibility for problem animal control to rural communities operating CBC programmes and continuing to give assistance where rural communities have not developed this capability.

Alternatives strategies: In the long term, alternative strategies to reduce the conflict between people and wildlife will be explored. Possibilities include incorporating numbers of animals that are not shot under problem animal control into hunting quotas that can provide greater economic benefits to rural communities.

## APPENDIX VII: Perception of threats to lion survival per Lion Conservation Unit (PA: Protected Areas; NGA: non-gazetted areas)

Global		PA Dar-Biharamulo		NGA		Global		PA Ruaha-Rungwa		NGA	
Threats	Percentage of informants (N=66)	Threats	Percentage of informants (N=31)	Threats	Percentage of informants (N=35)	Threats	Percentage of informants (N=44)	Threats	Percentage of informants (N=37)	Threats	Percentage of informants (N=7)
Intentional poaching	67	Intentional poaching	65	Loss of habitat	83	Unefficient management	80	Unefficient management	78	Loss of habitat	100
Retaliation	65	Unefficient management	58	Livestock occurrence	77	Intentional poaching	77	Intentional poaching	73	Intentional poaching	100
Livestock occurrence	64	Retaliation	52	Retaliation	77	Loss of habitat	75	Official hunting	70	Livestock occurrence	86
Loss of habitat	61	Livestock occurrence	48	Intentional poaching	69	Official hunting	73	Loss of habitat	70	Retaliation	86
Unefficient management	55	Official hunting	48	Lack of prey	63	Livestock occurrence	70	Livestock occurrence	68	Unintentional snaring/trapping	86
Official hunting	52	Unintentional snaring/trapping	45	Diseases	54	Unintentional snaring/trapping	66	Unintentional snaring/trapping	62	Official hunting	86
Unintentional snaring/trapping	50	Diseases	39	Official hunting	54	Retaliation	64	Retaliation	59	Unefficient management	86
Lack of prey	47	Loss of habitat	35	Unintentional snaring/trapping	54	Lack of prey	61	Lack of prey	59	Lack of prey	71
Diseases	47	Lack of prey	29	Unefficient management	51	Diseases	48	Diseases	46	Diseases	57
Human encroachment	11	Human encroachment	13	Human encroachment	9	Human encroachment	18	Human encroachment	19	Human encroachment	14

Global		PA Maasai Steppe		NGA		Global		PA Selous		NGA	
Threats	Percentage of informants (N=44)	Threats	Percentage of informants (N=22)	Threats	Percentage of informants (N=22)	Threats	Percentage of informants (N=89)	Threats	Percentage of informants (N=41)	Threats	Percentage of informants (N=48)
Livestock occurrence	89	Livestock occurrence	95	Livestock occurrence	82	Livestock occurrence	71	Diseases	51	Livestock occurrence	92
Retaliation	86	Retaliation	91	Retaliation	82	Loss of habitat	66	Unintentional snaring/trapping	49	Retaliation	92
Intentional poaching	70	Intentional poaching	86	Intentional poaching	55	Retaliation	65	Livestock occurrence	46	Loss of habitat	85
Loss of habitat	61	Loss of habitat	73	Lack of prey	50	Lack of prey	60	Loss of habitat	44	Lack of prey	79
Lack of prey	55	Lack of prey	59	Loss of habitat	50	Unintentional snaring/trapping	57	Official hunting	44	Unintentional snaring/trapping	65
Unefficient management	48	Unefficient management	45	Unefficient management	50	Diseases	52	Lack of prey	37	Unefficient management	60
Official hunting	36	Official hunting	41	Unintentional snaring/trapping	41	Unefficient management	49	Unefficient management	37	Intentional poaching	60
Unintentional snaring/trapping	36	Unintentional snaring/trapping	32	Diseases	32	Official hunting	48	Retaliation	34	Official hunting	52
Diseases	30	Diseases	27	Official hunting	32	Intentional poaching	46	Intentional poaching	29	Diseases	52
Human encroachment	10	Human encroachment	14	Human encroachment	5	Uncontrolled fire	3	Human encroachment	5	Old lion preying on human	4
								Uncontrolled fire	5		

Global		PA Serengeti-Mara*		Global		PA Non LCU		NGA	
Threats	Percentage of informants (N=27)	Threats	Percentage of informants (N=27)	Threats	Percentage of informants (N=25)	Threats	Percentage of informants (N=7)	Threats	Percentage of informants (N=18)
Livestock occurrence	74	Livestock occurrence	74	Loss of habitat	76	Loss of habitat	86	Loss of habitat	72
Retaliation	74	Retaliation	74	Livestock occurrence	60	Lack of prey	86	Livestock occurrence	61
Loss of habitat	74	Loss of habitat	74	Retaliation	60	Diseases	71	Retaliation	61
Intentional poaching	70	Intentional poaching	70	Lack of prey	56	Intentional poaching	71	Unefficient management	56
Unintentional snaring/trapping	70	Unintentional snaring/trapping	70	Unefficient management	52	Livestock occurrence	57	Lack of prey	44
Diseases	63	Diseases	63	Intentional poaching	44	Official hunting	57	Official hunting	39
Unefficient management	52	Unefficient management	52	Official hunting	44	Retaliation	57	Intentional poaching	33
Lack of prey	41	Lack of prey	41	Diseases	36	Unintentional snaring/trapping	43	Unintentional snaring/trapping	28
Official hunting	37	Official hunting	37	Unintentional snaring/trapping	32	Unefficient management	43	Diseases	22
Poor Husbandry techniques	4	Poor Husbandry techniques	4	Human encroachment	12	Human encroachment	29	Human encroachment	6
						Old lion preying on human	6		
						Lack of water	6		
						Sukuma	6		

\* only global results are presented as only 2 out of the 27 informants reported information in NGA