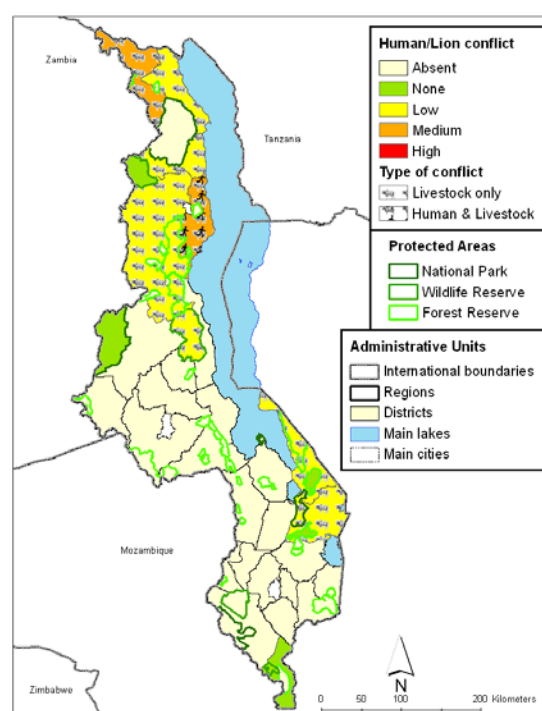
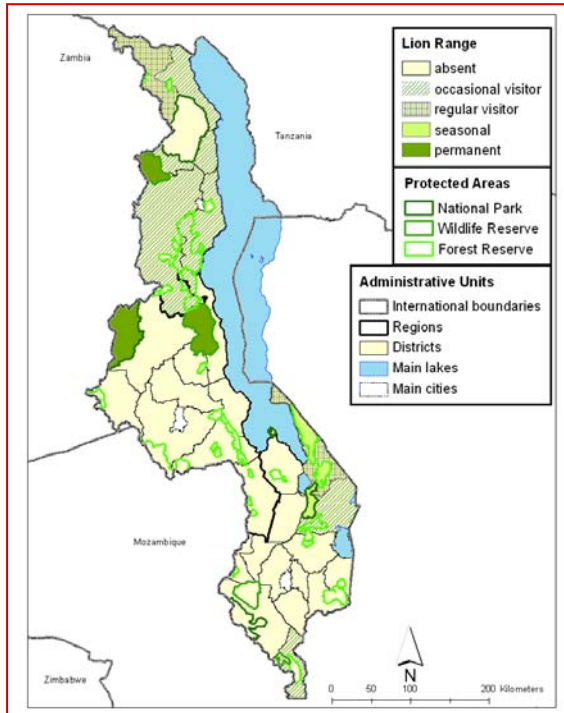


CONSERVATION STATUS OF THE LION (*Panthera leo* Linnaeus, 1758) IN MALAWI



DECEMBER 2010



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

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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. Malawi authorities, together with local stakeholders, took part in the regional exercise for establishing the Regional Lion Conservation Strategy in Eastern and Southern Africa. The Malawi authorities expressed their will to update the lion profile in the country and to hold a national workshop for establishing a Lion National Action Plan.

The present survey proposed an update of the conservation status of the lion in Malawi. 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 as well as the information generated by a specific inquiry among 175 informants. The resulting level of knowledge on lions was high in most Protected Areas and non-gazetted areas.

The lion range in Malawi, formerly covering most of the country, is now reduced to only 12,650 km², *i.e.* 13% of the terrestrial surface of the country, of which 6,950 km² (*i.e.* 55%) are located inside Protected Areas. Resident Malawi lions survive in isolated populations only found in a few Protected Areas. The resident population size of free-ranging lions has been estimated at about 34 free-ranging individuals for the whole country.

The lion is therefore highly threatened with extinction in Malawi. The country is characterized by a very high human density and concomitant severe degradation of natural habitat. Lion survival within the last lion strongholds (*i.e.* in a few Protected Areas) is threatened by intense poaching of lion's preys, mostly through indiscriminate snaring. Outside their strongholds, lions are harassed by local communities and often eliminated through official operations of Problematic Animal Control: an equivalent of 20% of the national resident lion population was eliminated by PAC operations between 2006 and 2010. If lion is to be conserved in Malawi, rapid actions must be undertaken to secure the relict populations. In a way, the Malawi situation may help to foresee what could happen next to other lion range states.

¹IGF Foundation; ²DNPW; ³FD; ⁴DAHLD

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ACRONYMS

CBO	Community-Based Organisations
CDV	Canine Distemper Virus
DNPW	Department of National Parks and Wildlife, Ministry of Tourism, Wildlife and Culture
FAO	Food and Agriculture Organization of the United Nations
FR	Forest Reserve(s)
FD	Forestry Department, Ministry of Natural Resources, Energy and Environment
DAHLD	Department of Animal Health and Livestock Development, Ministry of Agriculture and Food Security
GDP	Gross Domestic Product
HLC	Human/Lion Conflicts
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
MAFD	Ministry of Agriculture and Food Security
MNREE	Ministry of Natural Resources, Energy and Environment
NP	National Park(s)
PAC	Problem Animal Control
PA	Protected Area(s)
SCI Foundation	Safari Club International Foundation
WR	Wildlife Reserve(s)

I. INTRODUCTION

1. BACKGROUND

Until mid XXth 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. The 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 at this level that the strategy actions are implemented” (IUCN SSC Cat Specialist Group, 2006).

Malawi authorities, together with local stakeholders, took part in the regional exercise for establishing the regional strategy. Soon after, the Government of Malawi expressed the will to update the lion profile in the country. This survey is attempting to provide a forthcoming national workshop with comprehensive material on lion. This workshop will aim at finalizing 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 Malawi. The survey included three phases:

- **Phase 1: Preliminary survey**

Phase 1 gathered existing and available information on the lion conservation status in Malawi (August 2010).

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

Phase 2 focused on collecting as much information as possible from resource persons through a specific inquiry (September 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 Malawi (October 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 Malawi.

3. FOLLOW UP

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

This report 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). As a matter of fact, 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 maintained by Malawi authorities, mainly the Department of National Parks and Wildlife (DNPW), Ministry of Tourism, Wildlife and Culture.

- **Information generated**

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

- Direct inquiry: interviews with resource persons (Photo 1);
- Indirect inquiry: questionnaire forms sent to target networks through the DNPW Division managers.

The generated information was collected in Malawi between the 13th of September and the 15th of October 2010 by a team made of one DNPW expert and one IGF Foundation expert.

Only information about free-ranging lions was considered in the present survey, in other words enclosed lions were not included for assessing the lion distribution and abundance in Malawi.

Table I: Sources of information used in the present survey

Source of information		Information	Type of information
Existing information	DNPW	Lion PAC	Existing database
	Survey Dpt	Maps of Regions, Districts and main lakes	GIS tool
	FD	Maps of Protected Areas	GIS tool
	MAFS	Livestock census	Existing database
	Various	Historical data, scientific papers	Literature
Information generated	Survey team: the DNPW & IGF Foundation	DNPW	Inquiry
		FD	Inquiry
		MAFS	Inquiry
		Tourism sector	Inquiry
		NGOs, researchers	Inquiry
		Local communities	Inquiry



Photo 1: Interview with a Game Officer by Edson Sichali ©Pascal Mesochina/IGF Foundation

1.1. Existing information

• Literature

Information on lion issues in Malawi were found in peer-reviewed literature and technical reports. 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 Malawi has been used. By convention, any information dated more than 5 years ago (before 2006) has been considered as historical account and not as contribution to the present situation.

○ Continental scale

Information on lions in Malawi may be found in a recent survey conducted at continental scale (Chardonnet, 2002). This survey was based on published papers, unpublished reports and personal communications of informed persons (wildlife managers, experts, etc.). Chardonnet (2002) compiled estimates for 144 lion populations brought together into 36 isolated subpopulations (Map A, Appendix I).

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 B, Appendix I). More recently, a probabilistic model on continental lion distribution and abundance has been developed (Loveridge & Canney, 2009; Map C, 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

The Eastern and Southern African Lion Conservation Workshop, held in Johannesburg in January 2006, gives the best available source of information at regional level (IUCN SSC Cat

Specialist Group, 2006). During the workshop, participants refined the formerly proposed lion ranges, identified ecological units of importance for lion conservation through a Range Wide Priority Setting exercise (Lion Conservation Unit [LCU]; Map D, Appendix I).

A recent study has reviewed the status and distribution of carnivores in the Protected Areas (PAs) of the Zambezi Basin as well as levels of human/carnivore conflicts (Purchase *et al.*, 2007).

- **National scale**

Information about lion conservation status in Malawi has been published in National State of Environment Reports (MMNREA 1998, 2002). A review of the knowledge on the conservation status of lion in Malawi was presented at the 7th African Wildlife Consultative Forum, Windhoek, Namibia (DNPW, 2008).

Information about past human/lion conflicts were found in a review of historical human/wildlife conflicts throughout Malawi (Morris, 2000).

- **Local scale**

- **Protected Areas**

Apart from a two years survey in the mid 1980s in Wvaza Marsh Wildlife Reserve (McShane, 1985), monitoring of lion populations, based on individual recognition of known lions and/or radio-collaring, has not been conducted in Malawi. In a recent review of mammal conservation history in Malawi, Morris (2006) has compiled information about lion occurrence inside National Parks (NPs) and Wildlife Reserves (WRs) up to the early 1990s.

Three methods of ground survey have been used by the Research Unit of the DNPW to assess animal populations in NPs and WRs, namely: (i) roadside counts from a vehicle, (ii) transect counts by foot and (iii) sighting rates that are mostly derived from game patrol reports. Aerial censuses have also been carried out in several PAs. Aerial censuses of large mammals have been conducted yearly in Liwonde NP since 2006 (Wilderness Trust, 2010).

None of these methods is appropriate to properly monitor lion populations; however, the latest census reports were examined to assess trends in lion's prey abundance, using the National Mammal Inventory (Simons *et al.*, 1991) as a reference.

- **Others**

To our knowledge, information on lion status outside PAs is scarce in Malawi. During the second half of the XIXth century, information on lions in Malawi was provided by early explorers, hunters and missionaries (*e.g.* Laws, 1934; Debenham, 1955; Muldoon, 1955; Hayes, 1979). In a review of mammal conservation history in Malawi, Morris (2006) has collected a few accounts of past lion occurrence outside PAs.

- **Existing database**

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

- **Human/lion conflicts**

DNPW division managers keep records of human/wildlife conflicts in their respective areas of responsibility.

- **Digital maps**

The Survey Department has provided the survey team with the digital outlines (shapefiles) of Regions, Districts and main lakes (Map 1). The Forestry Department (FD) has given the digital outlines of Forest Reserves (FRs), as well as NPs and WRs (Map 2).

For information, the direct technical management of Malawi wildlife falls under the responsibility of two entities:

- The DNPW, Ministry of Tourism, Wildlife and Culture is in charge of NPs and WRs;
- The FD, Ministry of Natural Resources, Energy and Environment, is responsible for FRs.

1.2. Information generated

In preparation of the present survey, questionnaire forms (Appendix II) were designed in collaboration with the DNPW.

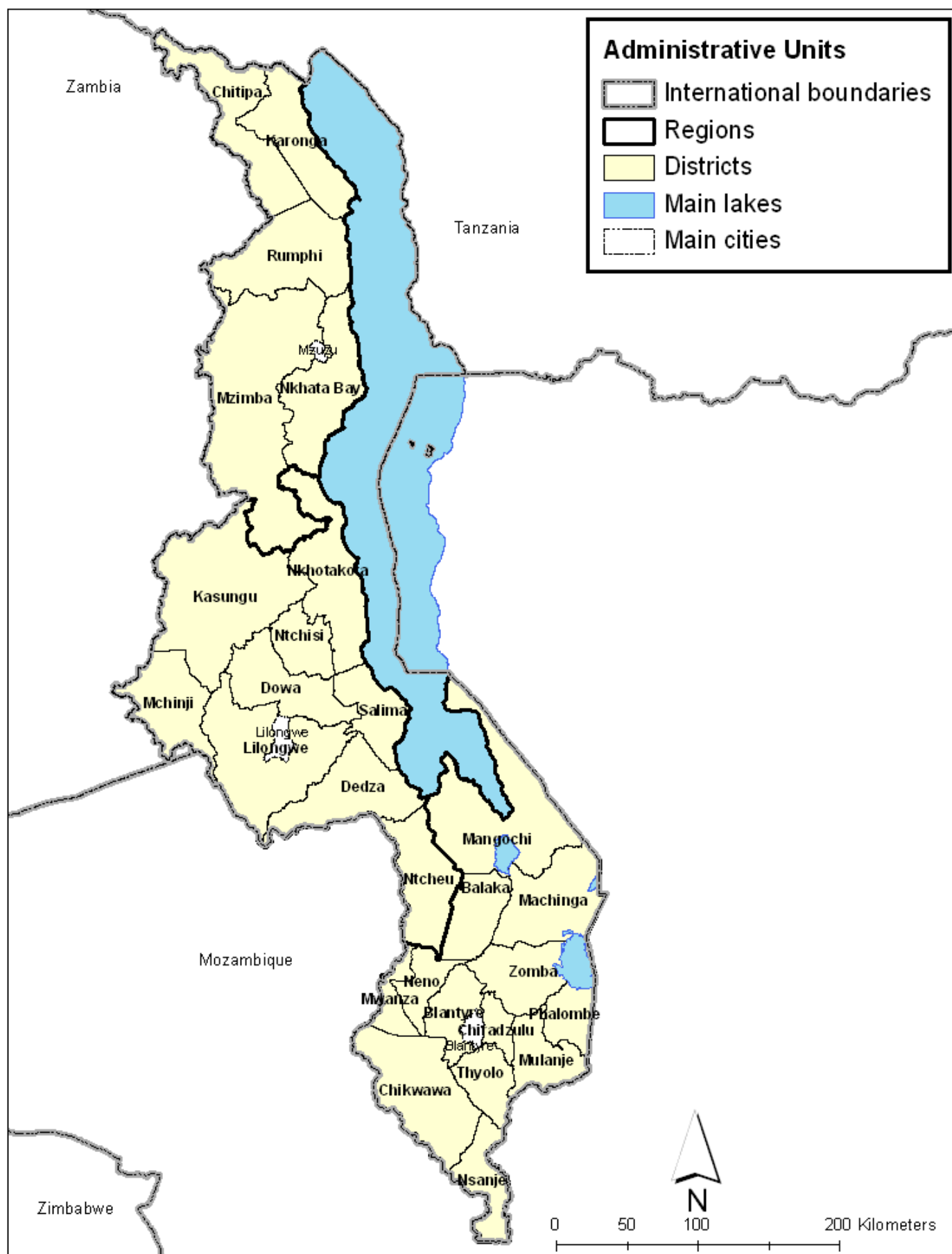
Respondents were asked to give information on:

- 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;
- Lion population trends over the last 5 years and before;
- Threats to lion survival;
- Most conflicting wildlife species with human population.

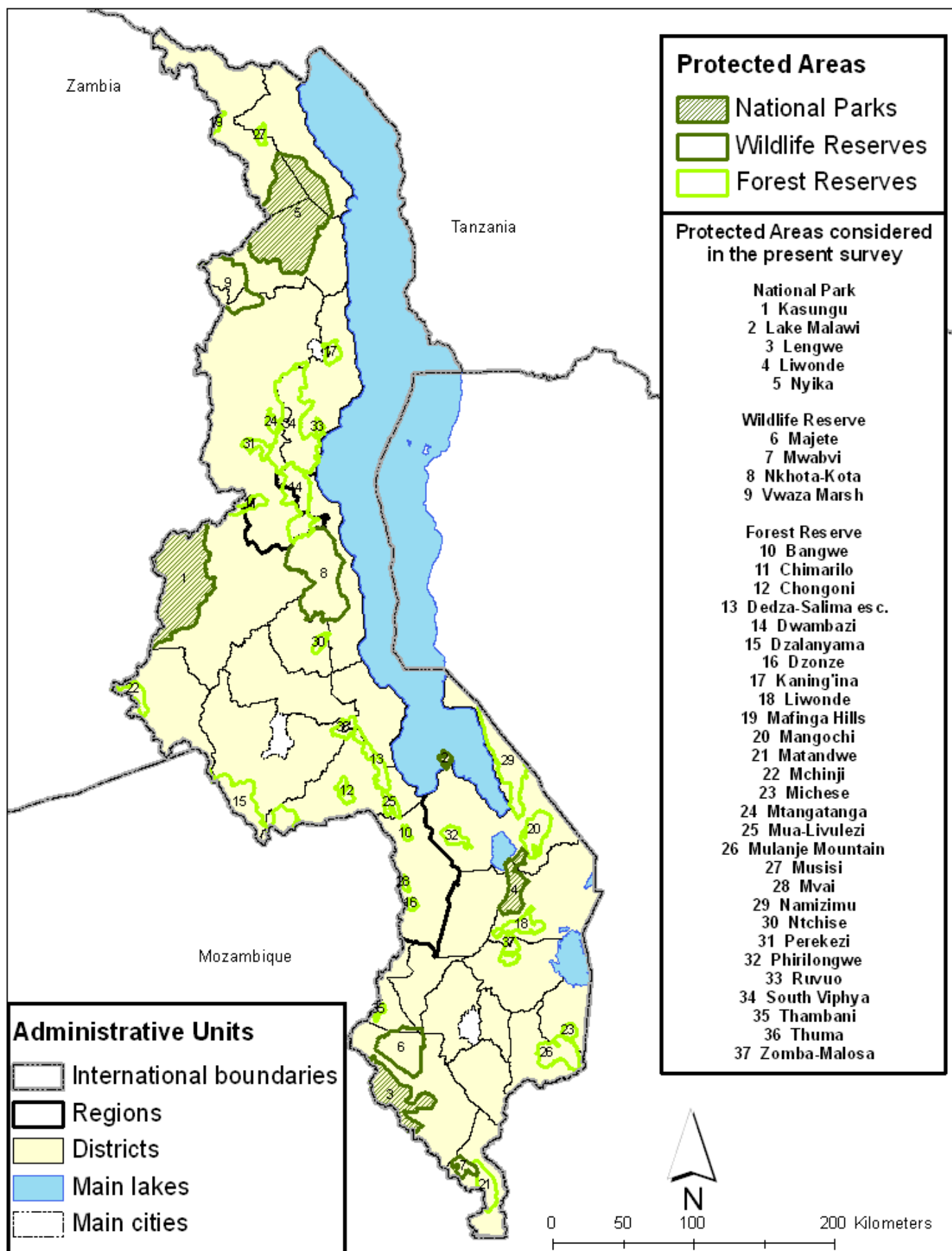
The resource persons (N=175, Appendix III) who contributed to the generated information belong to the following networks:

- Public sector:
 - Natural resources network: DNPW, FD;
 - Livestock resources network: Ministry of Agriculture and Food Security (MAFS).
- Private sector:
 - The tourist sector;
 - Local communities: farmers, villagers, etc.
- NGOs/Researchers.

Responses to the inquiry generated close to 250 sets of information (Table II) by either direct interviews or indirect inquiries.



Map 1: Administrative network of Districts (source: the Survey Department)



Map 2: Network of Protected Areas considered in this survey (source: the Survey and Forestry Departments)

Table II: Number of questionnaires filled in during the survey

Network of informants		Number of questionnaires
Public sector	Department of National Parks and Wildlife	78
	Animal Health and Livestock Development (+ Agriculture)	58
	Forestry Department	82
	Local Administration	1
Private sector	Local Community	3
	Tourism Company	7
NGO	NGO / Researcher	10
TOTAL NUMBER OF QUESTIONNAIRES		239

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 two tables which have been combined and consolidated. Being georeferenced, the consolidated database has been used to draw synthetic thematic maps (see §II.2.3.):

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

Table A [28 lines & 91 columns (25.10.10)] gathered information from all the terrestrial Districts (N=27), excluding PAs, about lion presence, frequency of lion observations, frequency and type of conflicts and level of knowledge.

Because the status of the lion differed in the Western and Eastern parts of the Mangochi District, the District has been split into two parts; therefore, the resulting number of non-gazetted area units considered in the survey was 28.

- **Table at the level of Protected Areas**

Table B [37 lines & 135 columns (25.10.10)] gathered information on lions at the level of the PAs, namely the NPs (N=5), WRs (N=4) and FRs (N=28).

Each one of the NPs and WRs was investigated. Malawi has about 75 FRs, of which only the gazetted Reserves larger than 4,000 ha were considered in the survey (N=28).

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 Malawi is around 118,000 km². 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

94,543 km². Using the GIS platform, the surface of the PAs (18,658 km²) was excluded from the District surfaces in order to estimate the range of non-gazetted areas (75,885 km²).

2.2. Lion abundance

The abundance of lion populations (*i.e.* population size) was assessed for resident lion populations only. Most knowledgeable persons were asked to provide this survey with an estimated range for the lion populations in their areas of responsibility. Mean values and confidence intervals were consequently derived.

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**

The level of knowledge on lion distribution has been assessed in each area 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 III). Each area has been classified accordingly.

Table III: 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)
High	≥ 8	≥ 8 (10)
Medium	4 to 7	4 to 7 (6)
Poor	2 to 3	2 to 3 (4)
Questionable	1	0 or 1 (2)

- **Lion range**

The estimate of lion range originated from a classification of lion records by (i) permanent presence, (ii) temporary presence or (iii) absence.

Two categories of lion populations were considered:

- **Resident populations:** where lions have permanent range (*i.e.* lions were observed all year long or seasonally);
- **Vagrant populations:** where lions have temporary range (*i.e.* lions were known to be visitors only). Two categories of vagrant populations were considered:
 - **Regular visitors:** visiting lions were regularly observed in the past 5 years.
 - **Occasional visitors:** visiting lions were observed once or twice in the past 5 years.

Considering occasional visitors within the range of the lion in Malawi would over-estimate the lion range in the country. In order to exclude occasional visitors from the range of the lion in Malawi:

- A given area was included in the lion range when at least 3 direct (lion sighting) or indirect (spoor, roaring, prey carcass, etc.) observations had been recorded during the past 5 years;
- A given area was excluded from the lion range when less than 3 observations had been made during the past 5 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 5 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 almost every month;
- **Weekly:** lions were noticed on a regular basis throughout the year.

- **Level of human/lion conflicts**

The level of human/lion conflicts was assessed with the frequency of conflicts reported since 2006 (5 years of data recording) and the impact of conflict (number of human casualties and/or livestock losses). It was categorized into 5 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 casualty;
- **Medium:** conflicts were reported every year and/or involved at least one human casualty;
- **High:** conflicts were reported several times a year and involved human casualties and/or high number of livestock losses.

- **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^o) for each of the two criteria, and then 2^o) 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 IVa & b).

Table IVa: 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	0.5
	Yearly	0.5
	Monthly	1
	Weekly	1

Table IVb: 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

- **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 Malawi exists within local communities and this knowledge can possibly be accessed through interviews. Written information on local presence of lions in Malawi is provided by many early explorers, hunters, missionaries and writers such as Robert Laws, David Livingstone, Henry Hamilton Johnston, Frank Debenham, Alexander White, Daniel J. Rankin, Donald Munro, William McEwan, Frederick Selous, etc. Most historical accounts tend to show a widespread distribution to the point that, anciently, very few locations in Malawi did not have lions (Ansell & Dowsett, 1988).

In a review of PAs in Malawi, the lion was considered as (i) present in Kasungu NP, Liwonde NP, Nyika NP, Vwaza Marsh WR and Nkhota-Kota WR and (ii) absent in Lengwe NP, Lake Malawi NP, Majete WR and Mwabvi WR (IUCN/UNEP, 1987). At the end of the XXth century, lion populations in Malawi were considered as mostly restricted to PAs (IUCN, 1996).

The Chardonnet's survey (2002) estimated that the lion range in Malawi (i) encompassed both PAs and non-gazetted areas, (ii) occupied a surface of about 8,400 km² and considered that two subpopulations of lions were ranging in the country (Map A, Appendix I):

- **Subpopulation n° 25:** in Liwonde NP and surrounding non-gazetted areas;
- **Subpopulation n° 27:** in Kasungu NP, Nyika NP, Vwaza Marsh WR, Nkhota-Kota WR and surrounding non-gazetted areas.

In 2002, Malawi wildlife authorities considered that the lion was present in Liwonde NP, Kasungu NP, Nkhota-Kota WR and Vwaza Marsh WR (MMNREA, 2002).

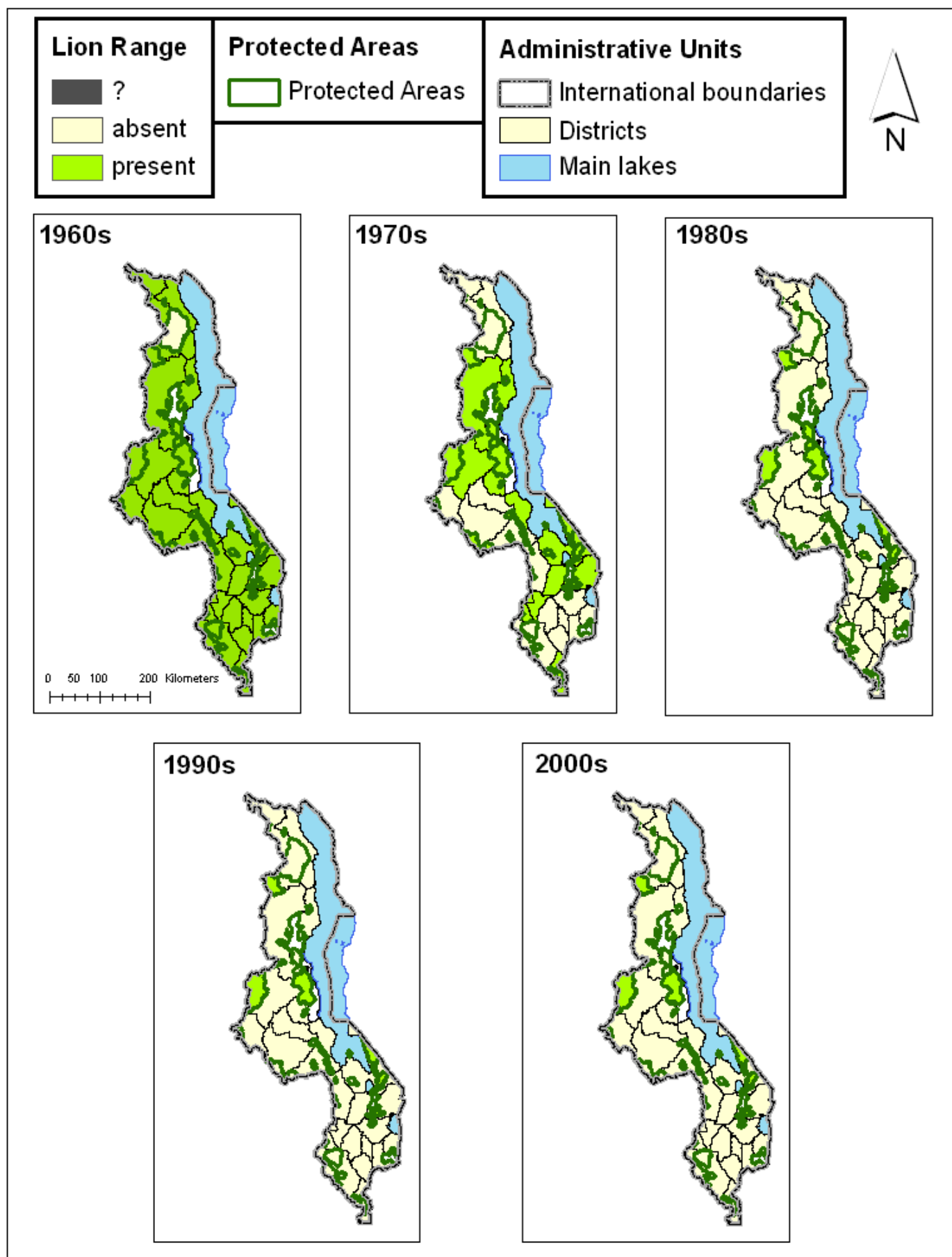
During the present survey, informants were asked to specify the decade of lion extirpation when known. According to the information received, the lion's range in Malawi has been particularly shrunk during the 1970s and the 1980s (Map 3).

1.2. Current range

- **Between 2006 and 2009**

The regional Eastern and Southern Africa Lion Workshop (Johannesburg, 8-13 January 2006) assessed the lion range in Malawi with a surface of about 8,400 km² (Map D, Appendix I; IUCN SSC Cat Specialist Group, 2006). This range was restricted to PAs and included Liwonde NP, Kasungu NP, Nyika NP, Nkhota-Kota WR, Vwaza Marsh WR, Mangochi FR and Namizimu FR (IUCN SSC Cat Specialist Group, 2006).

According to the review by Purchase *et al.* (2007) on PAs of the Zambezi Basin, the lion had been recently extirpated from Liwonde NP, Lengwe NP and Majete WR and was regarded as transient in Nyika NP, Kasungu NP, Vwaza Marsh WR, Nkhota-Kota WR and Mwabvi WR.



Map 3: Lion range reduction of resident lion populations in Malawi between the 1960s and the 2000s

According to the Malawi wildlife authorities, the lion national range in 2008 was restricted to Liwonde NP, Kasungu NP, Nyika NP, Nkhota-Kota WR, Vwaza Marsh WR, Mwabvi WR, Mangochi FR, Namizimu FR, Mafinga Hills FR and South Viphya FR (DNPW, 2008). A recent model of the African lion distribution considered lions in Malawi as (i) present in Nkhota-Kota WR and Vwaza Marsh WR, and (ii) absent in Kasungu NP, Lengwe NP, Liwonde NP, Nyika NP, Majete WR, Kalulu Hills FR, Mangochi FR, Michiru FR, Uzuma FR and Zomba FR (Loveridge & Canney, 2009).

- **The present survey**

The current lion range (or distribution area) in Malawi has been estimated by using the database of information on lion records collected during the past 5 years (after 2005). Information on lion presence was available in each of the 65 geographical units considered in this survey. As a result, the lion range in Malawi has been assessed within an area of 94,543 km², *i.e.* 100% of the terrestrial land in Malawi.

The general lion range, without distinction between resident and vagrant populations, encompassed (Map 4; Appendix IV):

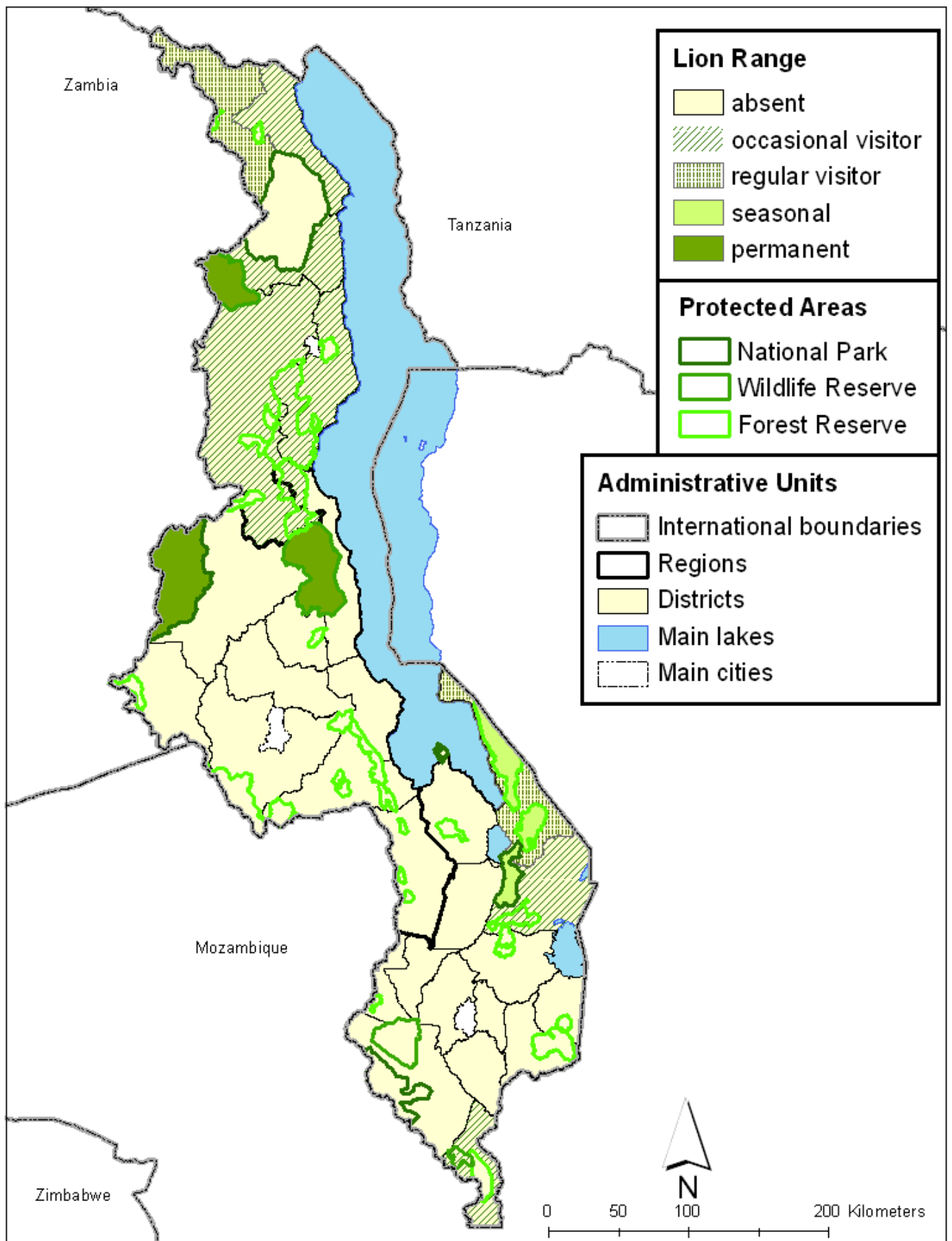
- A global surface of about 12,652 km², *i.e.* 13% of the total terrestrial surface of Malawi (excluding lakes and islands);
- 2 out of the 28 District units, *i.e.* 7% of the District units; Lions were regular visitors in Chitipa District and in the Eastern part of Mangochi District;
- 7 out of the 37 PAs, *i.e.* 19% of the PAs;
- A surface of 5,697 km² in non-gazetted areas, *i.e.* 45% of the lion range and of 6,955 km² within PAs, *i.e.* 55% of the lion range.

If we make a distinction between resident populations and regular visitors, the lion range was composed of (Map 4; Appendix IV):

- A permanent presence range of 6,903 km², *i.e.* 55% of the lion range and a temporary presence range of 5,749 km², *i.e.* 45% of the lion range;
- No District unit with permanent lion populations and 2 District units with temporary lion populations, *i.e.* lions were regular visitors in Chitipa District and in the Eastern part of Mangochi District;
- 6 PAs with permanent lion populations, *i.e.* 86% of the PAs hosting lions and a single PA with a vagrant lion population (Mafinga Hills FR);
- A temporary presence range of 5,697 km² in non-gazetted areas, *i.e.* 45% of the lion range;
- A permanent presence range of 6,903 km² and a temporary presence range of 52 km² in PAs, *i.e.* 55% and 0.4% of the lion range respectively and 99% and 1% of the lion range in PAs respectively.

- **Lion Conservation Units**

The two subpopulations identified by Chardonnet (2002) were regarded as transfrontier ones (Map A, Appendix I). The regional Eastern and Southern Africa Lion Workshop (Johannesburg, 8-13 January 2006) refined the subpopulations formerly proposed by Chardonnet (2002) by identifying seven LCUs in Malawi (IUCN SSC Cat Specialist Group, 2006; Map 5 & Map D, Appendix I):



Map 4: Lion range in Malawi (by October 2010) during the last 5 years only

- **LCU 59:** Nyika NP;
- **LCU 60:** Vwaza Marsh WR;
- **LCU 61:** Kasungu NP;
- **LCU 62:** Nkhota-Kota WR;
- **LCU 63:** Namizimu FR;
- **LCU 64:** Mangochi FR;
- **LCU 65:** Liwonde NP.

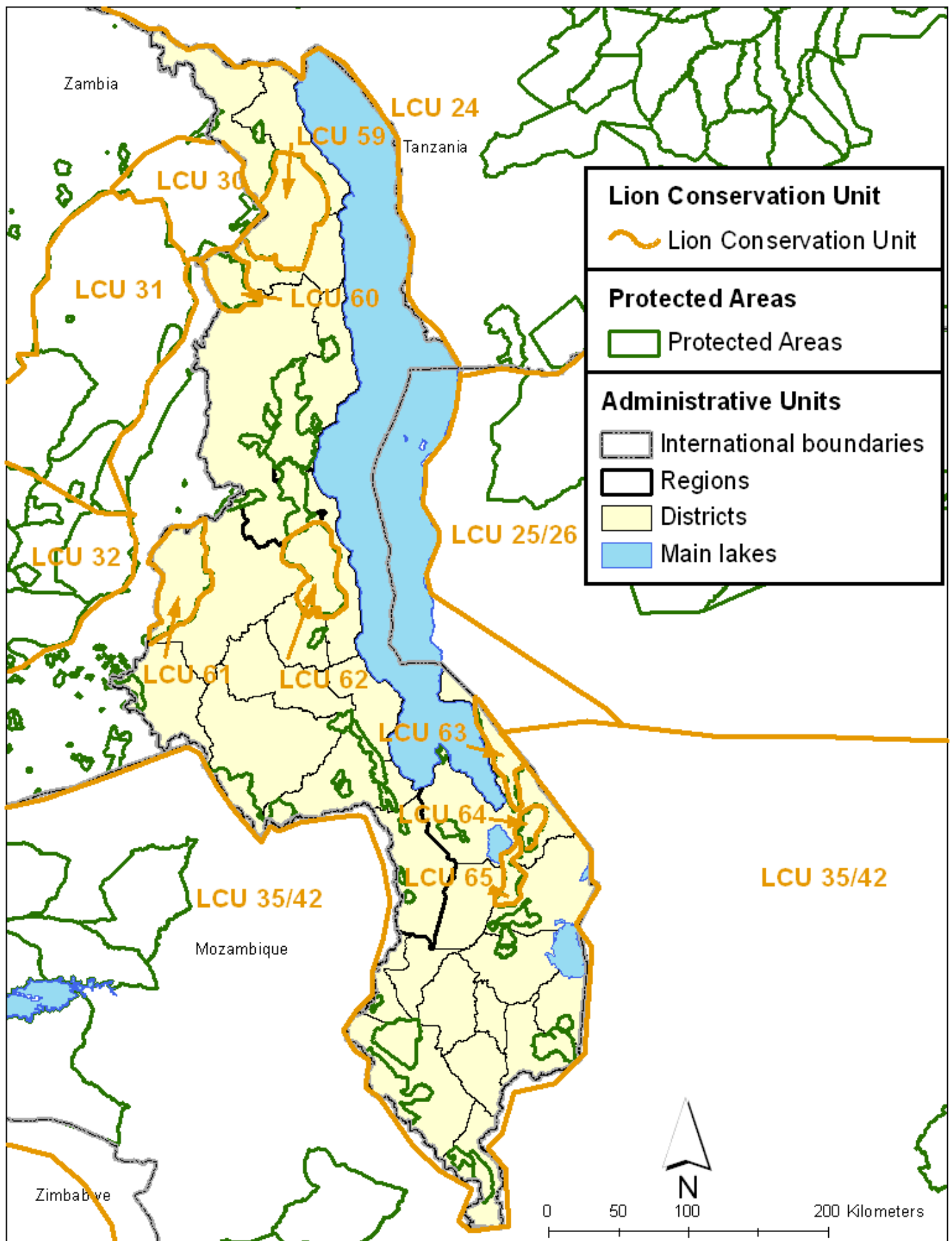
However, these LCUs do not completely match the lion range derived from the present survey (Map 4). We suggest removing regional LCU 59 (Map 6) because lions have not been observed in Nyika NP since 2003 and informants working in the National Park considered that it never hosted a resident lion population (Timothy Maseko-Chana, Hetherwick Msiska, Mutheto Ndhlamini, Ian Luhanga, Amos Chipzalo, Benard Kumwenda, *pers. com.*).

The LCUs proposed during the regional Eastern and Southern Africa Lion Workshop were neither interconnected, nor considered as transfrontier ones. Informants from Malawi and bordering countries helped localizing main corridors used by lion populations within Malawi and transfrontier lion populations crossing Malawi borders:

- **Connections within Malawi:** While all connections between North and Central Region' LCUs seem to be lost, a lot of informants confirmed that lions were moving between Liwonde NP, Mangochi FR and Namizimu FR (N=16 *pers. com.*). We consequently suggest that LCUs 63, 64 & 65 have to be considered as a single LCU also including the Eastern part of Mangochi District that lions use as corridor between the above-mentioned PAs (Map 6).
- **Connections beyond borders:**
 - Tanzania: in 2005, lions coming from Malawi killed people in Tunduru District (Peter Mtani, *pers. com. in Mésochina et al.*, 2010); in 2009, lions moved from Zambia to Tanzania through Chitipa and Karonga Districts (Fidelis Nthenda, William Kalua, Wysman Msiska, Gaston Macheka, Philip Munthali, *pers. com.*);
 - Zambia: Lions visiting Chitipa District were considered coming from Zambia (N=17 *pers. com.*, DNPW, 2008); lion movements between Kasungu NP and Zambia, as well as between Vwaza Marsh WR and Zambia, were considered as possible but could not be confirmed;
 - Mozambique: lions were known as moving between Liwonde NP, Namizimu FR and Mangochi FR in Malawi and Niassa Province in Mozambique (N=18 *pers. com.*). Occasional lions coming from Mozambique have been recorded in Nsanje District (N = 7 *pers. com.*).

As a result, we suggest (Map 6):

- including Chitipa District within LCU 30;
- pooling LCUs 63, 64 & 65 and including the resulting LCU within LCU 35/42.



Map 5: Regional Lion Conservation Units according to the regional Eastern and Southern Africa Lion Workshop (IUCN SSC Cat Specialist Group, 2006)



Map 6: Regional Lion Conservation Units as suggested by the present survey (sources for lion range in Tanzania: Mésochina *et al.*, 2010; for lion range in Mozambique: Chardonnet *et al.*, 2009; for lion range in Zambia: Zambia Wildlife Authority, 2009)

1.3. Lion status in Protected Areas

Only the main PAs or complexes of PAs were reviewed:

- **Nyika NP & Vwaza Marsh WR**

Around the turn of the XXth Century, larger mammals were plentiful in the Northern Region, particularly after having recovered from the rinderpest epidemic of 1893 and the expansion of the tsetse fly in the first decades of the Century (Morris, 2006).

The Nyika area has been gazetted as a Protected Area in 1952 and as a National Park in 1966; The Vwaza Marsh site has been declared as a Protected Area in 1956 and as a Wildlife Reserve in 1977.

Between 1959 and 1962, game patrols were observing 2 to 8 lions per 100 patrol days in Nyika and 3 lions per 100 patrol days in Vwaza Marsh in 1962 (Morris, 2006).

To our knowledge, estimates of the lion population size derived from specific surveys are not available in Nyika NP. In Vwaza Marsh, an ecological survey was carried out between 1982 and 1985 where 14 to 22 lions were annually recorded along transects (McShane, 1985); based on sightings of known individuals over 2 years, the resident lion population had been estimated to number 13 individuals (McShane, 1985).

Nowadays, DNPW staff considers that:

- 5 lions would survive in Vwaza Marsh WR (Leonard Sefu, Timothy Maseko-Chana, Hawela Kataya, *pers. com.*); in the past 5 years (2006-2010), game patrols rarely observed lions, *i.e.* once in 2007 and 3 times in 2008 (Vwaza Marsh Game Patrol reports);
- lions have stopped roaming in Nyika NP since 2003; these lions were considered as visitors and the possibility of a former resident lion population was regarded as doubtful (Alphius Lipiya, Timothy Maseko-Chana, Hetherwick Msiska, Mutheto Ndhlamini, Ian Luhanga, Amos Chipzalo, Benard Kumwenda, *pers. com.*).

- **Kasungu NP**

Although during the colonial period the Kasungu District supported a wealth of wildlife (Morris, 2006), the area occupied by Kasungu NP was already settled with a large human population since the early decades of the XXth Century. In 1922, the villagers were evacuated from the area following an outbreak of sleeping sickness in the Western part of Kasungu District. At the same time, the area was gazetted as a Protected Area and thereafter declared as a National Park in 1970.

Between 1959 and 1962, game patrols were observing 2 to 7 lions per 100 patrol days (Morris, 2006). The lion population was estimated between 20 and 40 individuals in the early 1980s (Bell, 1983) and around 40 individuals by late 1980s (Harry Munthali, *pers. com.*, in Morris, 2006). Nowadays, DNPW staff considers that about 5 lions would now survive in Kasungu NP. In the past 5 years (2006-2010), game patrols observed lions once to twice a year, except in 2008 where no lion's observation was reported (Kasungu Game Patrol reports).

- **Nkhota-Kota WR**

In the early colonial period, the Nkhota-Kota District was renowned for its wildlife and game animals were found in large numbers (Morris, 2006).

The Nkhota-Kota area was gazetted as a Protected Area in 1935 and as a Wildlife Reserve in 1938. The main tasks of the first Wildlife Reserve administrators were to destroy crop-raiding wildlife as well as man-eating lions and leopards that were abundant (Muldoon, 1955). Between 1959 and 1962, game patrols were observing 1 to 7 lions per 100 patrol days (Morris, 2006).

Nowadays, most informants to the present survey were considering that Nkhota-Kota WR was the last stronghold for lions in Malawi. DNPW staff thinks that around 20 lions would survive in Nkhota-Kota WR (Alex Chunga, Clement Chamanga, Dines Kabota, Samson Mkumbwa, Ponsiano Kwendanguwo, *pers. com.*). In the past 5 years (2006-2010), game patrols observed lions 6 times in 2006 and thereafter less than 3 times a year (Nkhota-Kota Game Patrol reports). Samson Mkumbwa, research officer in Nkhota-Kota WR, has confirmed the reduction in lion sightings by game patrols after 2006.

- **Lake Malawi NP**

A Southern Peninsula of Lake Malawi was gazetted as a National Park in 1980 in order to protect endemic fish species. The existence of large mammals in this area was considered as dubious when the Peninsula was declared as a National Park, and the only large predator mentioned was the leopard (*Panthera pardus*; DNPW, 1981).

- **Liwonde NP, Mangochi FR & Namizimu FR**

The Upper Shire Valley was renowned for the diversity and abundance of large mammals at the beginning of the XXth Century. In 1930, lions were still noted as common in the Region (Murray, 1932). The Liwonde area was gazetted as a Protected Area in 1962 and as a National Park in 1973.

At that time, lions were known to follow a migration route from Mulanje District to Namizimu FR through the Phalombe plain, the Zomba Mountain, Liwonde NP and Mangochi FR (Dudley & Stead, 1976; Hayes, 1979). 30 to 50 lions were believed to range in the area in the early 1990s (Simons & Chirambo, 1991; Chris Badger, Benjamin Chakhaza, Raphael Chiwindo, Samuel Nyanyale, *pers. com.*).

According to several informants, lions would have completely disappeared from Liwonde between the mid 1990s and the early 2000s when less than 5 lions were seasonally seen (Dudley, 2001; Taylor, 2002; Raphael Chiwindo, Chris Badger, Benjamin Chakhaza, *pers. com.*).

Nowadays, it is considered that around 5 lions would move between Liwonde NP, Mangochi FR and Namizimu FR (Kambani, 2005; Pheroce Pendame, Blessings Msikuwanga, Raphael Chiwindo, Vega Jackson, Samuel Nyanyale, *pers. com.*). In the past 5 years (2006-2010), game patrols did not report lion sightings but a lion footprint in May 2007 (Liwonde Game Patrol reports).

- **Lengwe NP, Majete WR & Mwabvi WR**

Lions used to be common in the Lower Shire Valley up to at least the late 1930s (Hayes, 1979). The Lengwe area was gazetted as a Protected Area in 1928 and as a National Park in 1970; The Majete site was gazetted as a Protected Area in 1953 and as a Wildlife Reserve in 1955; The Mwabvi area was gazetted as a Wildlife Reserve in 1953.

In the early 1960s, lions were already rare in the Lower Shire Valley. Between 1959 and 1962, game patrols were observing 1 lion per 100 patrol days in Majete WR while no lion was observed in Mwabvi WR and Lengwe NP (Morris, 2006). According to Anderson, game guard

at Mwabvi WR in the early 1960s, three lions only were ranging in the Reserve (*pers. com.*, in Morris, 2006).

Resident lions would have been extirpated from these areas between the 1970s and the 1980s. There has been no report of lions since at least the 1980s in Lengwe NP (Sherry & Ridgeway, 1984) and Majete WR (Bell, 1984; Dowsett & Dowsett-Lemaire, 2005) and the late 1970s in Mwabvi WR (Dowsett & Dowsett-Lemaire, 2005). However, Mwabvi WR has received the visit of a pair of lions coming from Mozambique in 2006 & 2007 ($N = 7$ *pers. com.*).

In 2003, African Parks Majete Ltd. concluded an agreement with the DNPW of Malawi to take on responsibility for the rehabilitation, development and management of Majete WR. Since that time, the WR has been completely fenced and already more than 3,000 animals have been reintroduced. These include black rhino, sable antelope, buffalo, waterbuck, eland, impala, nyala, warthog, zebra, hartebeest and elephant. One of the goals is to re-establish Majete WR as a Big 5 Game Reserve, which means that once there will be enough game, the large predators like lion, leopard and cheetah will also be brought back (Hogerheijde, Hall-Martin & Ndadzela, 2008).

2. LION ABUNDANCE

2.1. Historical abundance

No accurate figure of historical estimates of Malawi lion abundance was found before the continental survey carried out in 2002 (Chardonnet, 2002) that assessed the total lion number in Malawi at 25 [20 - 30].

2.2. Current abundance

- **Between 2006 and 2009**

According to the Eastern and Southern African Lion Conservation Workshop (IUCN SSC Cat Specialist Group, 2006), the cumulative estimate for all LCUs related to Malawi was less than 70 lions. According to Malawi wildlife authorities, the country hosted a population of 50 lions in 2008 (min: 35; max: 62) (DNPW, 2008).

- **Present survey**

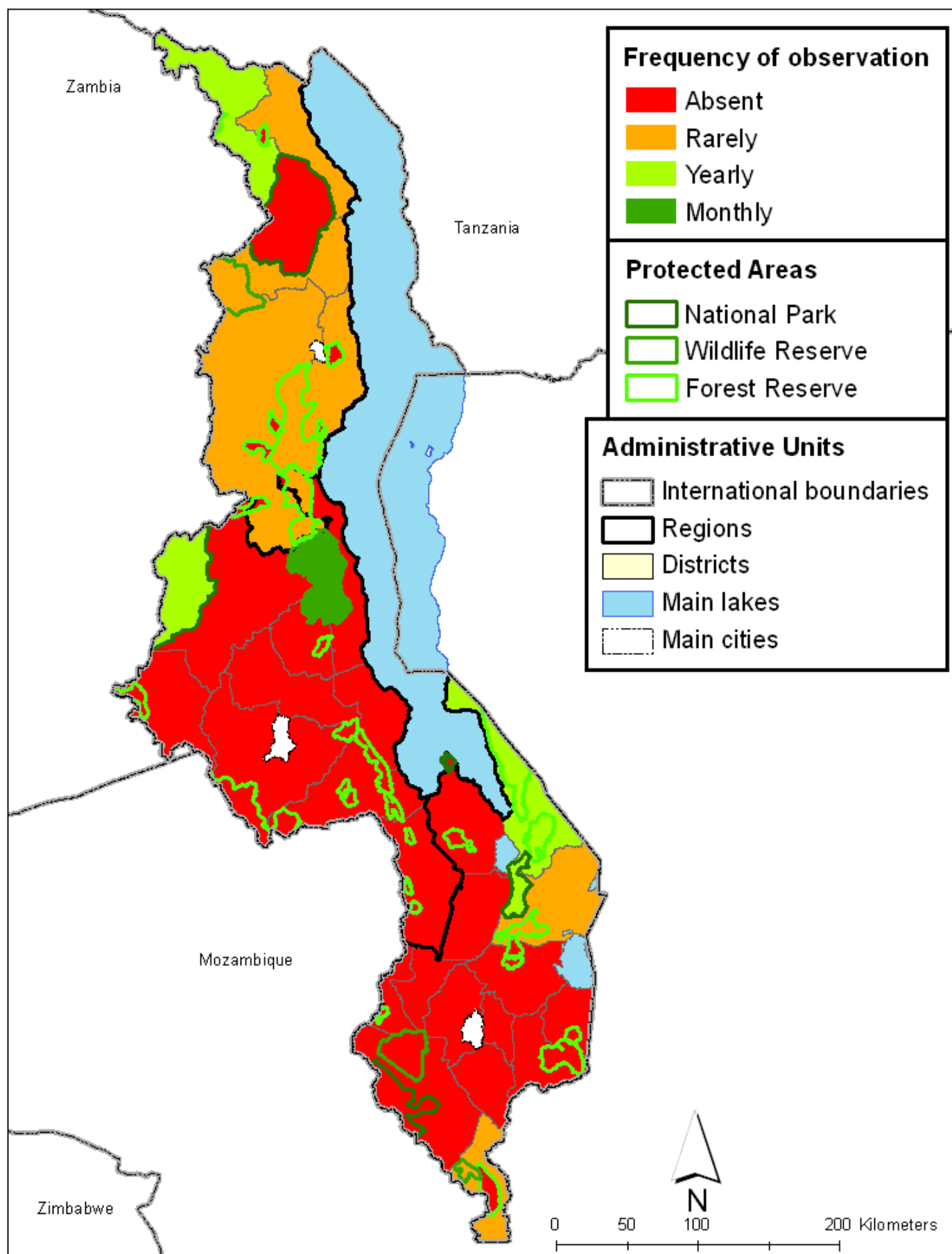
- **Lion population size**

Based on information given by knowledgeable persons, the tentative estimate of the total resident lion population size in Malawi was 34 free-ranging individuals (confidence interval: 23 - 47) (Table V).

All resident lions ranged in PAs and no resident lion population was found in non-gazetted areas.

- **Frequency of lion observations**

In non-gazetted areas hosting vagrant lions, the species was only observed yearly in two District units, namely Chitipa District and Eastern part of Mangochi District (Map 7; Appendix IV). Occasional visitors (with rare observations) were also recorded in 6 Districts (Karonga, Rumphi, Mzimba, Nkhata-Bay, Machinga and Nsanje).



Map 7: Frequency of lion observations in Malawi (by October 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 almost every month; Weekly: lions recorded regularly throughout the year.

In PAs with resident lions or regular visitors, lions were observed (Map 7; Appendix IV):

- Monthly in 1 PA, namely Nkhota-Kota WR (*i.e.* 14% of PA);
- Yearly in 4 PAs (*i.e.* 57% of PAs);
- Rarely in 2 PAs (*i.e.* 29% of PAs).

Table V: Estimates of lion population size in Protected Areas

Area	Population size estimate			
	Mean	Confidence interval	N	Sources
Vwaza Marsh WR	5	[4-6]	4	DNPW, 2008; Leonard Sefu, Timothy Maseko, Hawetha Kataya, <i>pers. com.</i>
Kasungu NP	6	[4-8]	5	DNPW, 2008; Jackwell Chibwe, Brave Madise, Alphius Lipiya, Joseph Chigamula, <i>pers. com.</i>
Nkhota Kota WR	18	[12-24]	6	DNPW, 2008; Alex Chunga, Clement Chamanga, Dines Kabota, Samson Mkumbwa, Ponsiano Kwendanguwo, <i>pers. com.</i>
Liwonde Ecosystem*	6	[3-9]	6	DNPW, 2008; Pheroce Pendame, Blessings Msikuwanga, Raphael Chiwindo, Vega Jackson, Samuel Nyanyale, <i>pers. com.</i>
Total	34	[23-47]		

*: Liwonde NP, Mangochi FR & Namizimu FR

Occasional visitors were also recorded in 4 PAs, namely Mwabvi WR, Dwambazi FR, South Viphya FR and Liwonde FR.

Based on lion population size estimates and reported frequency of lion observations, it seemed that the last lion stronghold in Malawi was located in Nkhota-Kota WR (Map 7).

2.3. Population trends

Historical global estimates of lion abundance in Malawi are lacking, which prevents performing documented population trend analysis. However, informants to the present survey have given information on historical and recent trends of lion populations at the scale of 8 PAs (Kasungu NP, Liwonde NP, Nyika NP, Nkhota-Kota WR, Mwabvi WR, Vwaza Marsh WR, Mangochi FR and Namizimu FR).

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

The lion abundance has been perceived as decreasing by the end of the XXth century by all the informants (Table VI).

- **Contemporary trends (last 5 years)**

The lion abundance has been perceived as stable or increasing by 15% of the informants only (Table VI).

Table VI: Historical and contemporary trends of lion abundance in Protected Areas of Malawi: perception by informants (source: present inquiry)

Lion population trends	Contemporary		Historical	
	(5 years)		(10 years+)	
	N	%	N	%
Increasing	1	5	0	0
Stability	2	10	0	0
Decreasing	17	85	26	100

3. HUMAN/LION CONFLICTS

3.1. Magnitude of the conflicts

“Human/lion conflicts occur 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**

“In the past, Malawi had a reputation for its man-eating lions”, Brian Morris (2000)

Incidents and accidents between lions and people living side by side have a long history in Malawi.

The memoirs of early missionaries and administrators invariably contain a section on attacks of people by lions (Morris, 2000). During the first half of the XXth century, it has been estimated that in some Districts, an average of fifty people was killed annually by lions (Morris, 2000).

Robert Laws, an early missionary at Livingstonia, noted that eight people were killed by lions in his first year at the mission (Laws, 1934). Between 1929 and 1930, a lion was responsible for at least 36 deaths in 24 villages of the Mchinji District (Morris, 2000). In the 1940s, one notorious lion killed 14 people in one month near Mzimba (Muldoon, 1955).

Recounting all the historic reports of man-eating lions in Malawi is out of the scope of the present survey. However, several outbreaks of man-eating lions in Malawi are particularly impressive and worth mentioning.

During the 1940s, lions coming from Mozambique frequently roamed in the Namwera Hills, District of Mangochi. Because the area was already well-populated and game was scarce, outbreaks of man-eating lions used to occur from time to time in the area (Carr, 1969). One notorious case involved two lions in prime condition known as the Namwera lions: it has been suggested that a conservative estimate of human deaths attributed to them was around 50 in a period of little over three months (Hayes, 1979). During the 1950s, a lion known as ‘the man eater of Kasungu’ killed at least 60 persons before being shot by an administrative officer of Kasungu District (Debenham, 1955).

According to the present survey, lions killed at least 21 persons and injured a minimum of 8 persons in Malawi between 1970 and 2005 (Table VII). Most of these incidents were recorded in the Central Region with 14 human deaths and 5 injuries attributed to lions (Table VII).

The lion had also historically been responsible for livestock depredation (Morris, 2000). However, accurate figures have rarely been reported. Only a few cases have been documented: (i) in 1926, 102 goats, 22 sheep, 12 pigs and 20 heads of cattle were taken by large carnivores from 14 villages in the Ntcheu District, and 21 pigs were killed by lions from only 3 villages in 2 days (Morris, 2000); (ii) in the same year, 12 villages in the Neno District lost 6 pigs and 14 heads of cattle to lions (Morris, 2000); (iii) more recently, in 2002, a lion visiting the Chitipa District killed 18 heads of cattle before being shot in a Problematic Animal Control operation (PAC; Table VII).

Table VII: Human/Lion conflicts reported during the present survey for the 1970-2005 period

Region	District	Protected Area	Livestock killed				Human casualties [killed (injured)]				Lion killed [PAC (unofficial)]				Source
			1970-1979	1980-1989	1990-1999	2000-2005	1970-1979	1980-1989	1990-1999	2000-2005	1970-1979	1980-1989	1990-1999	2000-2005	
Northern	Chitipa					18 - 2002							1 - 2002		PAC files
	Chitipa					2 - 2003				1(2) - 2003			(1) - 2003		PAC files
	Karonga														
	Mzimba				5 - 1992				1 - 1990						Ezlon Jere, <i>pers. com.</i>
	Mzimba				x - 1998							1 - 1998			Julio Chiwalo, <i>pers. com.</i>
	Mzimba					4-2004								2 - 2004	Bonface Phiri, <i>pers. com.</i>
	Mzimba									1 - 2003				1 - 2003	PAC files
	Mzimba	Perekezi					1				1				Mozes Chirongo, <i>pers. com.</i>
Central	Nkhata Bay													1 - 2005	PAC files
	Rumphi														
	Dedza														
	Dowa														
	Kasungu								1 - 1991				2 - 1991		PAC files
	Kasungu					2 - 2003				5(2) - 2003				1 - 2003	PAC files, Alphius Lipiya, Henry Mvula, Joseph Chigamula, Harrison Phula, <i>pers. com.</i>
	Kasungu					1-2004									Joseph Chigamula, <i>pers. com.</i>
	Kasungu	Kasungu							(1) - 1991				1 - 1991		Clifford Mwale, <i>pers. com.</i>
	Lilongwe	Dzalanyama	x	x	x										Felix Chirombo, Chrispine Phiri, Leman Levi, <i>pers. com.</i>
	Lilongwe	Dzalanyama				8 - 2001				(1) - 2001				(1) - 2001	Thomas Chimbaza, <i>pers. com.</i>
	Mchinji			> 5 - 1989											Erick Nsisamla, <i>pers. com.</i>
	Nkhota Kota	Nkhota Kota				3 - 2002	1 - 1979	1 - 1982	1 - 1995	1(1) - 2002		1 - 1982			Clifford Mwale, Ponsiano Kwendanguwo, <i>pers. com.</i>
	Ntcheu														Dines Kabota, <i>pers. com.</i>
	Ntchisi					2 - 2003									Ponsiano Kwendanguwo, <i>pers. com.</i>
	Ntchisi					1 - 2005				3 - 2005					Denison Mnkondya, <i>pers. com.</i>
Southern	Ntchisi	Ntchisi							1 - 1996						Douglas Makombe, <i>pers. com.</i>
	Salima									2 - 1976					
	Balaka														
	Blantyre														
	Chiradzulu														
	Machinga				x - 1995								1 - 1995		Benjamin Chakhaza, <i>pers. com.</i>
	Mangochi			3 - 1980									1 - 1980		Driano Zeno, <i>pers. com.</i>
	Mangochi			3 - 1988											Leimos Mlaviwa, <i>pers. com.</i>
	Mangochi												1 - 1991		Greenfell, 1993
	Mangochi				1 - 1998								5 - 1998		PAC files
	Mangochi	Phirilongwe			x - 1994				2(1) - 1994				(2) - 1994		Elesani Zakochera, <i>pers. com.</i>
	Mangochi	Mangochi				x - 2003									Mighty Felemu, <i>pers. com.</i>
	Mulanje														
	Mwanza														
	Neno	Thambani			x - 1999				1 - 1999						Alick Mitawa, <i>pers. com.</i>
	Nsanje	Mwabvi				1 - 2005									PAC files
	Phalombe														
	Thyolo														
	Zomba														

x: number unknown

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

Today, human/lion conflicts have become anecdotic in Malawi. This section presents the results of an inquiry on human/lion conflicts (HLC) conducted during the current survey and covering the period between 2006 and 2010.

- **Distribution of human/lion conflicts**

The distribution of human/lion conflicts (Map 8, Appendix IV) is presented inside and outside PAs.

- **In Protected Areas**

The HLC inquiry covered 37 PAs (sample, Table VIII):

- 5 PAs (14% of the sample and 45% of PAs where lion presence has been recorded) were affected by HLC;
- Every PA with HLC faced livestock depredation only.

- **Outside Protected Areas [in District units]**

The HLC inquiry was carried out in 28 District units (sample, Table IX):

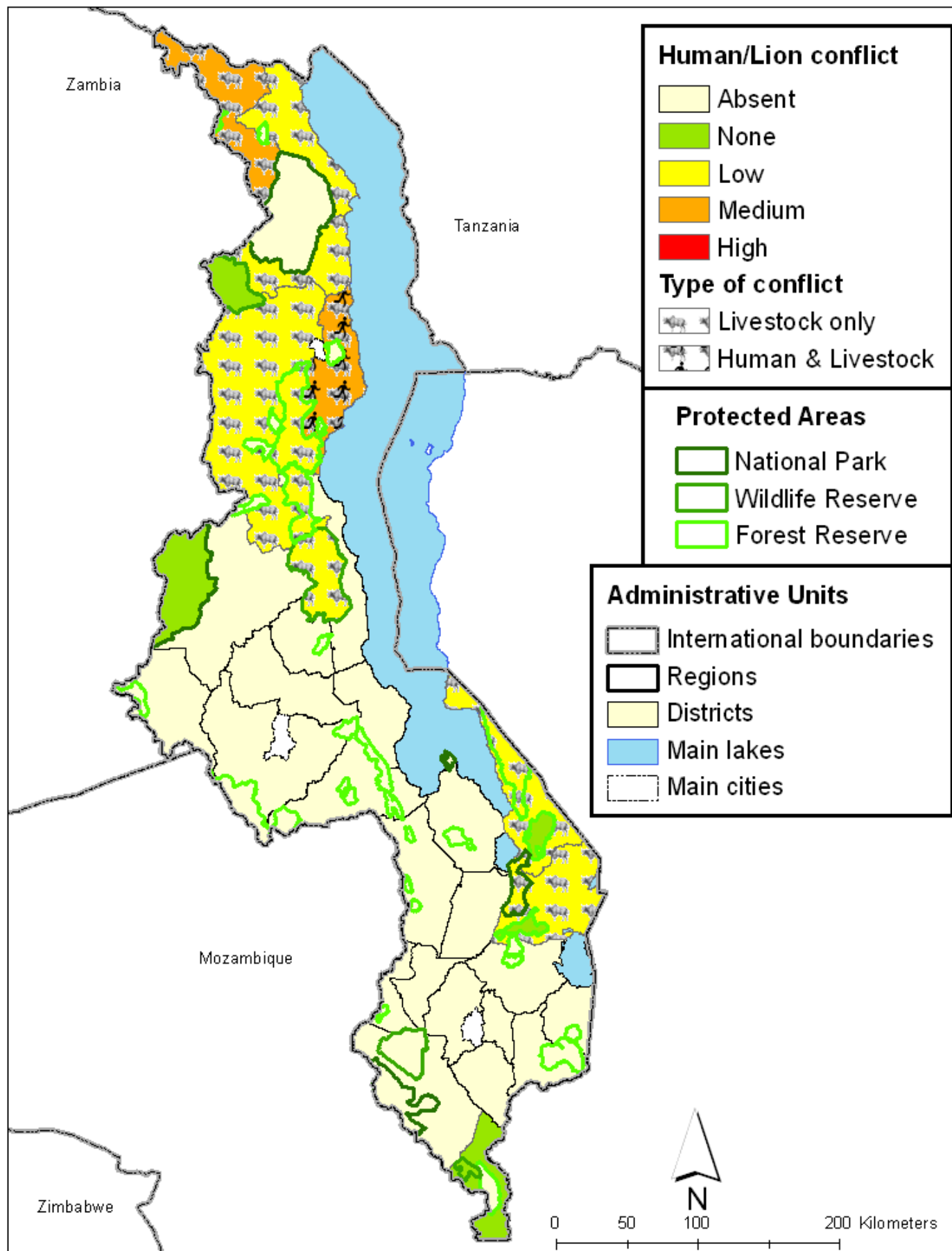
- 7 District units (25% of the sample and 88% of District units where lion presence has been recorded) reported HLC;
- 100% of the District units with HLC met with livestock depredation difficulties and 14% with human casualty problems.

Table VIII: Coverage and results of the inquiry on human/lion conflicts inside Protected Areas during the present survey in Malawi for the 2006-2010 period

Protected Area (N=37)					
Lion range	present			absent	
	11			26	
Human/Lion conflict	existing		none		
	5		6		
Nature of the conflict	human	human & livestock			livestock
	0	0			5

Table IX: Coverage and results of the inquiry on human/lion conflicts outside Protected Areas (*i.e.* in District units) during the present survey in Malawi for the 2006-2010 period

District units (N=28)					
Lion range	present			absent	
	8				
Human/Lion conflict	existing		none	20	
	7		1		
Nature of the conflict	human	human & livestock			livestock
	0	1			6



Map 8: Frequency and type of human/lion conflicts in Malawi (by October 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 casualty; Medium: conflicts reported every year and/or with at least one human casualty; High: conflicts reported several times a year and with human casualties and/or a high number of livestock losses.

- **Ranking of the lion as problem animal**

In the present inquiry, the lion was considered as the most conflicting predator by only 3% of the informants (N=111), while spotted hyena (*Crocuta crocuta*) and crocodile (*Crocodylus niloticus*) were mentioned as the most conflicting predators by respectively 49% and 12% of the informants. Moreover the predators do not come first in the list of problem animal: the elephant (*Loxodonta africana*) was mentioned as the most conflicting animal by 35% of the informants (N=111). Baboon (*Papio cynocephalus*), other primates, buffalo (*Syncerus caffer*), antelopes, and hippopotamus (*Hippopotamus amphibius*) 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 (5 PAs): only conflicts of low intensity were recorded.

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

The frequency of HLC was assessed in all District units where HLC were recorded (7 Districts). The frequency of HLC was reported as medium in 2 District units (29%) and as low in 5 District units (71%).

- **Nature of the conflicts**

- **Overall**

The global picture inside and outside PAs is given by consolidating both sampling units (*i.e.* PAs and District units) with reports of HLC (N=12):

- Livestock losses occurred in 12 units (100%);
 - Human casualties in 1 unit (8%);
 - Both kinds of damages in 1 unit (8%).

- **Human casualties**

In the past 5 years, only one human casualty was recorded in Nkhata-Bay District (January 2006; a person had been injured by a lion; Table X).

- **Livestock losses**

According to the present survey, 29 heads of cattle, 13 goats and 3 pigs were lost to lions throughout Malawi over the past 5 years (Table X).

Within PAs, livestock damages occurred in 5 PAs (14% of the PAs sample). Livestock attacks occurred in all the PAs with HLC.

Outside PAs, 7 District units out of the 28 sampled (25%) experienced livestock depredation; only livestock attacks occurred in 6 of these District units.

Table X: Human/Lion conflicts reported during the present survey for the 2006-2010 period

Region	District	Protected Area	Livestock killed					Human casualties - [killed (injured)]					Lion killed in PAC					Source
			2006	2007	2008	2009	2010	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010	
Northern	Chitipa			1 cattle 6 goats										6				PAC files
	Chitipa					9 cattle 6 goats												PAC files
	Karonga					4 cattle												Philip Munthali, <i>pers. com.</i>
	Mzimba	Dwambazi					1 cattle											James Banda, <i>pers. com.</i>
	Mzimba	South Viphya		3 cattle										1				Wellington Nyondo, <i>pers. com.</i>
	Nkhata Bay		3 pigs 1 goat					(1)					1					PAC files, Martin Nuka, <i>pers. com.</i>
	Rumphi					4 cattle												Hawekha Kataya, Ian Luhanga, <i>pers. com.</i>
Central	Dedza																	
	Dowa																	
	Kasungu																	
	Lilongwe																	
	Mchinji																	
	Nkhota Kota																	
	Ntcheu																	
Southern	Salima																	
	Balaka																	
	Blantyre																	
	Chikwawa																	
	Chiradzulu																	
	Machinga					3 cattle												Osborn Ngwira, <i>pers. com.</i>
	Mangochi				3 cattle													Samuel Nyanyale, Benjamin Chakhaza, <i>pers. com.</i>
	Mangochi			1 cattle														Sydney Bandawe, <i>pers. com.</i>
	Mulanje																	
	Mwanza																	
	Neno																	
	Nsanje																	
	Phalombe																	
	Thyolo																	
	Zomba																	

- **Predation on endangered species**

The predation by lion on endangered species is often a neglected aspect of the potential conflict between lions and humans. Although this is part of a natural process, it may happen that rare species stuck in a 'predator pit' require intervention by 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 (*Acinonyx jubatus*) which have only 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) or even certain antelopes such as the Roan antelope (*Hippotragus equinus*) as it is the case in Kruger NP, 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 conflicts originate from different sides: man, lion, prey and habitat.

- **The human factor**

The African lion has a tendency to attack humans only opportunistically and victims are usually easy targets, such as a lone individuals. While engaged in hunting-related activities, isolated men are more often taken by lions than men in groups. In Tanzania for example, 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 an increased risk of lion attacks:

- Protection of crops: in some regions, farmers stay in their fields to prevent problem animals during the day [birds such as the dioch (*Quelea quelea*), primates such as the baboon] and during the night [bushpig (*Potamochoerus larvatus*), elephant] from damaging standing crops. In Southern Tanzania, 39% of lion attacks occurred during the harvest season 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 NP, Tanzania, human victims were mainly taken at night, *i.e.* 76% of the casualties (Skuja, 2002), which is consistent with the lion predatory behaviour, ambush and escape being easier in the dark.
- Also, the absence of proper latrines in villages has been 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 (IUCN, 1996). At the end of XIXth century, an outbreak of rinderpest disease killed millions of buffalo, antelopes and other wildlife throughout Africa. 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 region of south-eastern Tanzania and north-eastern Mozambique where livestock is scarce 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, 2000; 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 potential “surplus killing”: a lion breaking into a fenced enclosure may kill more, sometimes many more, domestic animals than it can eat (IUCN, 1996).

Lions usually prefer to distance themselves from developed areas. However, lions may occur close to human settlements where favourable habitat and available prey base are found. Lions' preference for dense habitat 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 may also be 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 habitat occurs, human/lion encounters and conflicts are bound to increase.

3.3. Biases in conflict assessment

Both under-reporting and overestimation of human/predator conflicts are common throughout the world because complaints of victims tend to be exaggerated, whereas reactions of non-stakeholders tend to minimize the damages. In a number of African countries, biases may also be increased by ancestral beliefs in “spirit-lions”. In Malawi, so-called “spirit-lions” are

named “*walenga*” and are locally regarded as former revengeful chiefs (Carr, 1969). As a result, on one side real human/lion conflicts might be perceived as magical; on the other side, real men might as well carry out disguised killings as if they had been done by lions. However, with lion disappearance in Malawi, this belief in “spirit-lions” has been gradually displaced to “spirit-hyenas” and “spirit-crocodiles” (Edson Sichali, *pers. com.*).

- **Under-reporting**

For many reasons, under-reporting of human/lion conflicts is huge in many countries such as it may be the case in Malawi. Generally, reporting is often discouraged by the little capacity available for monitoring, recording and compensating damages.

More specifically, illegal cattle herders grazing inside PAs 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, because the belief that a lion might be the reincarnation of a former chief was widely spread in Malawi (Debenham, 1955; Carr, 1969), some people might have been reluctant to report a casualty when reincarnation was suspected.

- **Overestimation**

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

Similar situations occur in neighbouring countries as well. 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 tend to overestimate the human/lion conflicts and to accuse the lion unfairly. In Mozambique, in the 1980s, some lion attacks were believed to be the work of witchcraft and “spirit-lions”, not bush lions; such cases appear to have declined within the Niassa National Reserve in the 1990s, following the death of the powerful traditional healer 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.*).

Interestingly, this phenomenon has been known for long. In the late XIXth 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 Malawi**

“*A lion’s roar in the vicinity of a village is enough for demanding a PAC operation*”, Samuel Nyanyale, *com. pers.*

In Malawi, the mitigation of human/wildlife conflicts remains a constant source of worries for all stakeholders not only the victims themselves but also the authorities at all levels. The management of human/lion conflicts is a matter of special concern in this particular country because of its psychological impact on local communities.

Like in many other countries, the control of problem animals in Malawi is addressed by the Law (National Parks and Wildlife Act, 1992). The legal framework also addresses the defence of people and people's assets against 'dangerous animals', *i.e.* hyena, lion, leopard, hippopotamus, elephant, rhinoceros (*Diceros bicornis*), buffalo and crocodile (National Parks and Wildlife Act, 1992; Appendix V). For the time being, there is no compensation scheme or insurance system for wildlife damages.

- **Problem Lion Control**

- **Historical accounts**

Wildlife control used to play a central role in the early development of wildlife management in Malawi. During the English colonial period, crop protection and the control of so-called marauding predators were the major tasks of the Department of Game, Fish and Tsetse Control. The Department was focussing upon control rather than conservation of game, to the point that eradication of large mammals outside PAs was considered as a target (Morris, 2006). Between 1948 and 1961, around 80,000 baboons were killed for crop protection and 560 marauding carnivores (lions & leopards) were shot as PAC (Morris, 2006).

The Department of Game, Fish and Tsetse Control was disbanded in 1963 and matters related to crop protection and game conservation fell under the jurisdiction of the new Department of Forestry. In 1973, the DNPW was established with a focus on game conservation although game control was still a central task that led to the creation of a crop protection unit in 1975 (Morris, 2006). Between 1977 and 1982, an average of 656 animals and 8 lions were killed yearly as PAC (Clarke, 1983; Table XI).

The latest PAC operations against lions were carried out in 1998 in the Southern Region (5 lions out of a pride of 11 were killed in Namwera Hills, Mangochi District, after having killed a cow; PAC files, DNPW), in 2003 in the Central Region (1 vagrant lion coming from Nkhota-Kota WR was killed in Kasungu District after having killed 5 persons and injured 2 others) and in 2007 in the Northern Region (refer to § current situation, page 36).

Table XI: Number of lions killed as PAC in each Region of Malawi between 1977 and 1982 (Source: Clarke, 1983)

Year	# Lions killed as PAC		
	Northern	Central	Southern
1977	3	3	1
1978	1	6	1
1979	1	5	2
1980	0	1	3
1981	0	5	9
1982	0	3	4
Total per Region	5	23	20
Total	48		

○ **Current situation**

Problem Animal Control (PAC) in Malawi is conducted through an administrative and technical mechanism falling under the authority of the DNPW. Records of attacks on people and livestock are kept at Division level then transferred to Lilongwe DNPW headquarters. While official records for man eating are reliable over most of the country, data monitoring for livestock attacks is seldom comprehensive. The reporting system could be improved by setting up a comprehensive database with standard protocols.

When a lion attack is reported to District authorities, the official procedure consists in dispatching wildlife officers for tackling the issue. 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.). The wildlife officers tend to chase away every single lion they succeed to find which may be keeping other more dangerous individuals out.

Problem lions are likely to be removed and eliminated. Since 2006, PAC operations against lions have been carried out in the Northern Region only. Twelve problem lion control cases (lion PAC) were reported in the Northern Region for the past 5 years, resulting in the destruction of 7 lions (2006-2010; Table XII). Although 6 out of the 7 lions killed as PAC were visitors from Zambia, the number of lions reported as killed by PAC operations is very high when compared to the lion population size in Malawi (*i.e.* an equivalent of 20% of the national resident lion population has been eliminated by PAC operations since 2006).

As mentioned earlier, problem lion control is difficult to carry out. Some PAC cases happen with lions ending injured (Table VII) or only chased away (Table XII). It is worth noting that, for some informants, PAC and other conflict mitigation programs should take into account the traditional believes in “spirit lions”. According to them, any preventive or deterrent measure fail when traditional believes are neglected.

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

The Malawi Government is constantly requested by local communities to solve wildlife related problems. As a global response, the Government has been encouraging long term integrated approaches for human/lion conflict mitigation, such as Community Based Natural Resources Management (Malawi Government, 2007).

With the establishment of NPs and WRs, a “fences and fines” approach denied access to wildlife resources for local communities. This policy was revised in 2000 (Wildlife Policy, 2000) to promote collaborative management with local stakeholders. The principle of collaborative management provides for sharing of roles and responsibilities with major stakeholders, among them Community-Based Organisations (CBO). Collaborative management allows for sustainable utilisation of harvestable resources from NPs and WRs such as thatch grass, fruit and honey (Malawi Government, 2007).

4. LION HUNTING

Lions are protected by legislation wherever they occur in Malawi (National Parks and Wildlife Act, 1992). Informal and formal harvesting of lion is not allowed in Malawi. If practised, it is treated as poaching and subject to fines and penalties as any illegal activity. However, in the mean time, the legal framework also allows people to defend themselves and

their assets against ‘dangerous animals’ (National Parks and Wildlife Act, 1992; Appendix V).

Table XII: Recent PAC operations against lion in the Northern Region (source: Timothy Maseko-Chana, DNPW)

Year	Month	District	# Lions chased	# Lions killed	Damages by lions	
					Livestock	Humans
2002	July	Chitipa	1	1	18	-
2003	January	Mzimba	4	1	-	1
2003	April	Chitipa	3	-	2	1
2005	December	Nkhata-Bay	-	1	-	-
2006	January	Nkhata-Bay	-	1	-	1
2006	July	Chitipa	1	-	-	-
2007	April	Chitipa	-	2	7	-
2007	August	Chitipa	2	-		
2007	October	Chitipa	-	1		
2007	October	Chitipa	2	1		
2007	November	Chitipa	-	2		
2008	January	Chitipa	1	-	-	-
2008	January	Mzimba	-	-	-	-
2009	August	Chitipa	2	-	-	-
2009	September	Mzimba	1	-	-	-
2009	September	Chitipa	2	-	-	-
Total			19	10	27	3

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

- **Level of knowledge**

- **In non-gazetted areas**

District units with more than 3 converging sources of information represented 14% of the District units for the medium level of knowledge category and 86% for the high level category (Map 9; Appendix IV; §II.2.3.). The level of knowledge was never considered as questionable or poor.

- **In Protected Areas**

The level of knowledge was considered as high in 46% of the PAs, medium in 30% of the PAs and poor in 24% of the PAs (Map 9; Appendix IV). Medium and poor levels of knowledge were recorded in FRs only.

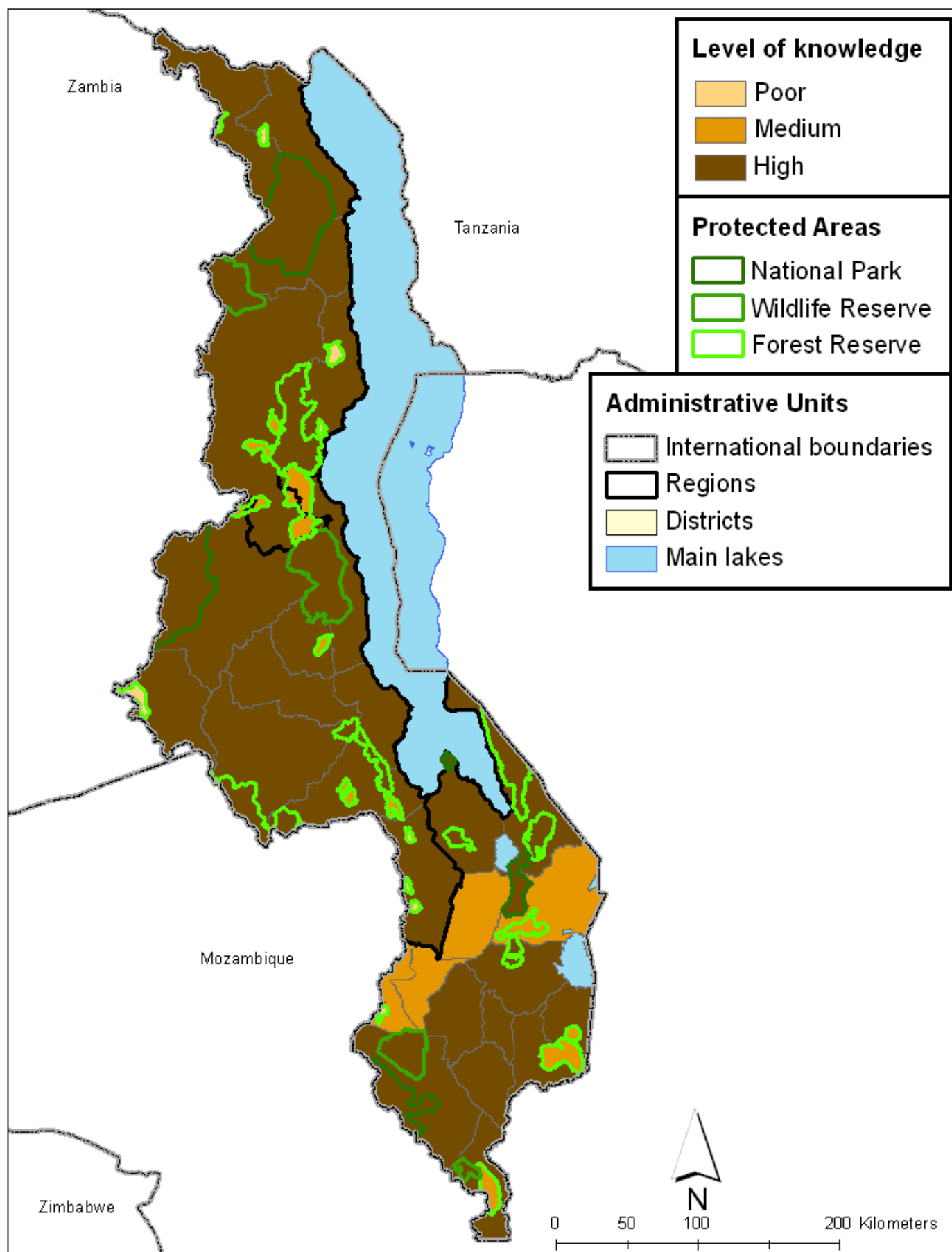
- **Gaps in knowledge**

- **In non-gazetted areas**

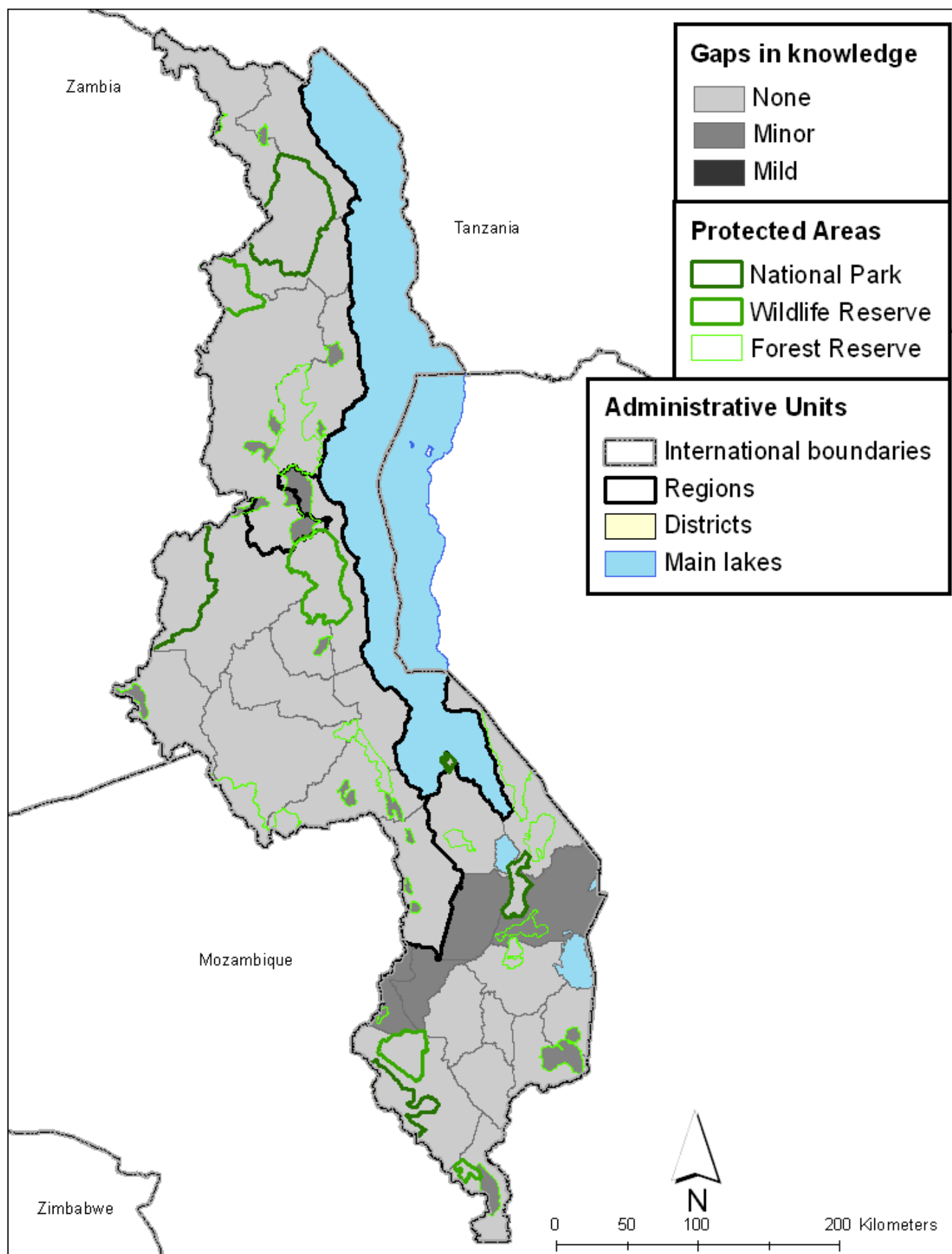
Gaps in knowledge were considered as non-existent in 86% of the District units and minor in 14% of the District units (Map 10; Appendix IV; §II.2.3.).

- **In Protected Areas**

Gaps in knowledge were considered as non-existent in 46% of the PAs, minor in 51% of the PAs and mild in 3% of the PAs (Map 10; Appendix IV).



Map 9: Level of knowledge of collated information (by October 2010). Questionable: only one information or two contradictory information; Poor: two or three information; Medium: four to seven information; High: more than eight information.



Map 10: Gaps in knowledge (by October 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**

The written knowledge on lion is quite limited in Malawi. The present survey came across very few peer-reviewed papers, books and reports addressing lion issues in Malawi.

The difficulty to collate data is clearly understandable and 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 was set up. The information feeding the database was collected through:

- Collection of existing information;
- Interviews with informed persons, involving 175 informants across various networks (Appendix III) and distributed as follows: 63% of informants belonged to natural resource networks (DNPW & FD), 25% to livestock and agriculture network (MAFS), 5% to the NGO/research community, 4% to the tourist sector, and 3% to local communities.

This approach offers a more cost-effective and less time-consuming alternative than 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.

Overall, according to the present survey, the general level of knowledge on lion in Malawi appeared medium to high (Map 9).

- **Data analysis**

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

The database and the maps were established at (i) the level of PAs and (ii) the level of Districts. The only exception was related to Mangochi District where the lion status markedly differed between the Eastern and Western part of the District. The District was consequently cut into an Eastern and a Western unit.

The entire surface of a given District unit or PA was included in the lion range as soon as lion observations were reported in that particular District unit or PA, even though it does not always imply that lions occur in the entire given District unit or PA. As a consequence, the proposed lion range might be slightly overestimated and can therefore still be refined.

- **Gaps in knowledge**

- **Gaps regarding the lion range**

For identifying major gaps in knowledge, Districts and PAs were ranked according to the method previously described (§II.2.3.). Because the general level of knowledge on lion was high in Malawi, most District units and PAs had no gaps in knowledge (Map 9; Appendix IV). The level of knowledge obtained in Malawi was far better than levels recorded in

neighbouring countries where the same survey has been conducted (Chardonnet *et al.*, 2009; Mésochina *et al.*, 2010).

Areas with poor information (N=9, *i.e.* 14% of the areas considered in the survey; Appendix IV) were not prioritized when lions were not 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 were 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.

- **Lion Conservation Status**

- **Historical account**

A few historical reports on lion presence in Malawi exist and, to our knowledge, little information is available on a precise historical distribution. However, most historical accounts tend to show a widespread distribution to the point that, anciently, very few locations in Malawi did not host lions.

No quantitative figure of historical estimates of Malawi lion population size was found before 2002, when a continental survey brought the first assessments of lion population sizes in Malawi (Chardonnet, 2002), with an estimate of 25 lions for the whole country.

- **Current Status**

- **Lion range**

According to the present survey, the lion range in Malawi, formerly covering most of the country, has been considerably reduced (Map 3): in 2010, the lion range covered 13% of the total terrestrial surface of the country only (Map 4; §III.1.2.). The contraction of the lion range was likely due to urbanization and human encroachment in rural areas (§IV.2.2.). In 2010, about half of the lion range lied in non-gazetted areas (*i.e.* ~45% of its national distribution; Map 4), but resident lion populations were confined into PAs.

The distinction between ranges of permanent and temporary presence remains difficult. When lions were frequently observed, their permanent presence was obvious. However, when lions were rarely seen, it does not readily mean that their presence was not permanent (absence of lion observation is not an evidence of absence of lion). It is especially the case outside PAs where lions could 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.

- **Lion Conservation Unit connectivity**

While connections between North and Central Region' LCU seemed to have been lost by 2010, many informants confirmed that the same pride of lions was moving between Liwonde NP, Mangochi FR and Namizimu FR (N=16 *pers. com.*; Map 6), and regularly crossed the Malawi border to Mozambique.

Moreover, lions from Zambia have regularly visited the Chitipa District in recent years (N=18 *pers. com.*; Map 6).

▪ **Lion population size**

Lion abundance was extrapolated to around 35 free-ranging resident individuals for the whole country in 2010, a value lying within the range of previous estimates recently published (Chardonnet, 2002; DNPW, 2008).

Lion populations are not specifically monitored in Malawi. Since no lion populations were documented yet in terms of abundance, the population size proposed in this survey is considered as tentative and subject to refinement.

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 during at least several years.

▪ **Abundance distribution**

According to the present survey, resident lion populations in 2010 were only found in a few PAs in Malawi, *i.e.* Vwaza Marsh WR, Nkhota-Kota WR, Kasungu NP and Liwonde ecosystem (Liwonde NP, Mangochi FR and Namizimu FR).

▪ **Population trend**

The absence of former estimates of lion abundance in Malawi prevented performing documented population trend analysis.

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

- All the informants (*i.e.* 100%) perceived the lion abundance as decreasing by the end of the XXth century;
- 85% of the informants perceived the lion abundance as decreasing in the past 5 years.

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

▪ **Conclusions**

Considering the restricted lion range still reducing, the lack of connection between the remaining lion populations, the very small national population size below 50 and the global down trend, the lion was considered as highly threatened with extinction in Malawi at the time of the present survey (2010).

• **Overall lion mortality**

Lion mortality results from both natural and anthropogenic origins.

- **Natural mortality**

Information on natural mortality in lions was not yet available in Malawi, although it is especially important considering in small size populations.

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, hyena and wild dog (Schaller, 1972).

- **Man-induced mortality**

- **Legal harvest**

Legal harvest in Malawi only included PAC operations. In the past 10 years, a mean number of 1.2 lions were yearly eliminated through PAC operations. Although it was far less than the level recorded in the early 1980s (8 lions were yearly killed as PAC; Clarke, 1983), the number of lions recently killed by PAC operations may well be considered as high when compared to the overall lion population size in Malawi: an equivalent of 20% of the national resident lion population was eliminated by PAC operations since 2006.

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 negative effect on lion population because it is most often indiscriminate, poorly controlled and eliminates all sexes and ages. 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 comprehensive review of alternative methods to PAC has been published by FAO (Chardonnet *et al.*, 2010).

- **Illegal killing**

Illegal killing of lion by people was mostly attributed to poaching, either unintentional in the quest of bushmeat (mostly through snaring) or intentional in retaliation and for ritual purposes. A few cases of illegal killing of lions were reported during the present survey (Table XIII); however accurate global figures were not available and the information collected certainly underestimated the extent of illegal killing of lions. Interestingly, 10 out of the 19 cases reported involved snaring (Table XIII).

2. THREATS TO LIONS

2.1. Perception of the major threats to lion conservation in Malawi

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

- 1) Habitat conservation;
- 2) Resource extraction;
- 3) Small population size;
- 4) Prey availability.

Table XIII: Information regarding illegal killing of lions in Malawi since the 1980s (source: present survey)

Region	District	Protected Area	Lion poaching								Source
			1980-1989	1990-1999	2000-2005	2006	2007	2008	2009	2010	
Northern	Chitipa										
	Karonga										
	Mzimba										
	Nkhata Bay										
	Rumphi	Vwaza Marsh WR	2 (sn)					1 (sn)			McShane, 1985; Godfrey Mhone, <i>pers. com.</i>
Central	Dedza										
	Dowa										
	Kasungu										
	Lilongwe	Dzalanyama FR	1 (gun) - 1989								Harrison Phula, <i>pers. com.</i>
	Lilongwe	Dzalanyama FR			1 (gun) - 2001						Thomas Chimbaza, <i>pers. com.</i>
	Mchinji		1 (gun) - 1989								Denison Mnkondya, <i>pers. com.</i>
	Nkhota Kota	Nkhota Kota WR			1 (sn) - 2004						Dines Kabota, <i>pers. com.</i>
	Nkhota Kota	Nkhota Kota WR			1 (sn) - 2005						Brighton Wadi, <i>pers. com.</i>
	Nkhota Kota	Nkhota Kota WR				1 (pit)	1 (sn)				Ponsiano Kwendanguwo, <i>pers. com.</i>
	Nkhota Kota	Nkhota Kota WR								1 (sn)	Alex Chunga, <i>pers. com.</i>
	Ntcheu										
Southern	Salima										
	Balaka										
	Blantyre										
	Chikwawa										
	Chiradzulu										
	Machinga	Liwonde NP		1 (psn) - 1996 1 (sn) - 1997							Benjamin Chakhaza, <i>pers. com.</i>
	Machinga	Liwonde NP		2 (sn) - 1998							Chris Badger, Samuel Nyanyale, <i>pers. com.</i>
	Machinga	Liwonde NP			1 (psn) - 2004						Raphael Chiwindo, <i>pers. com.</i>
	Mangochi		1 (gun)								Joloamu Barnaba, <i>pers. com.</i>
	Mangochi			2 (gun) - 1994							Elesani Zakochera, <i>pers. com.</i>
	Mulanje										
	Mwanza										
	Neno										
	Nsanje										
	Phalombe										
	Thyolo										
	Zomba										

sn: snared; psn: poisoned; pit: pit trapped

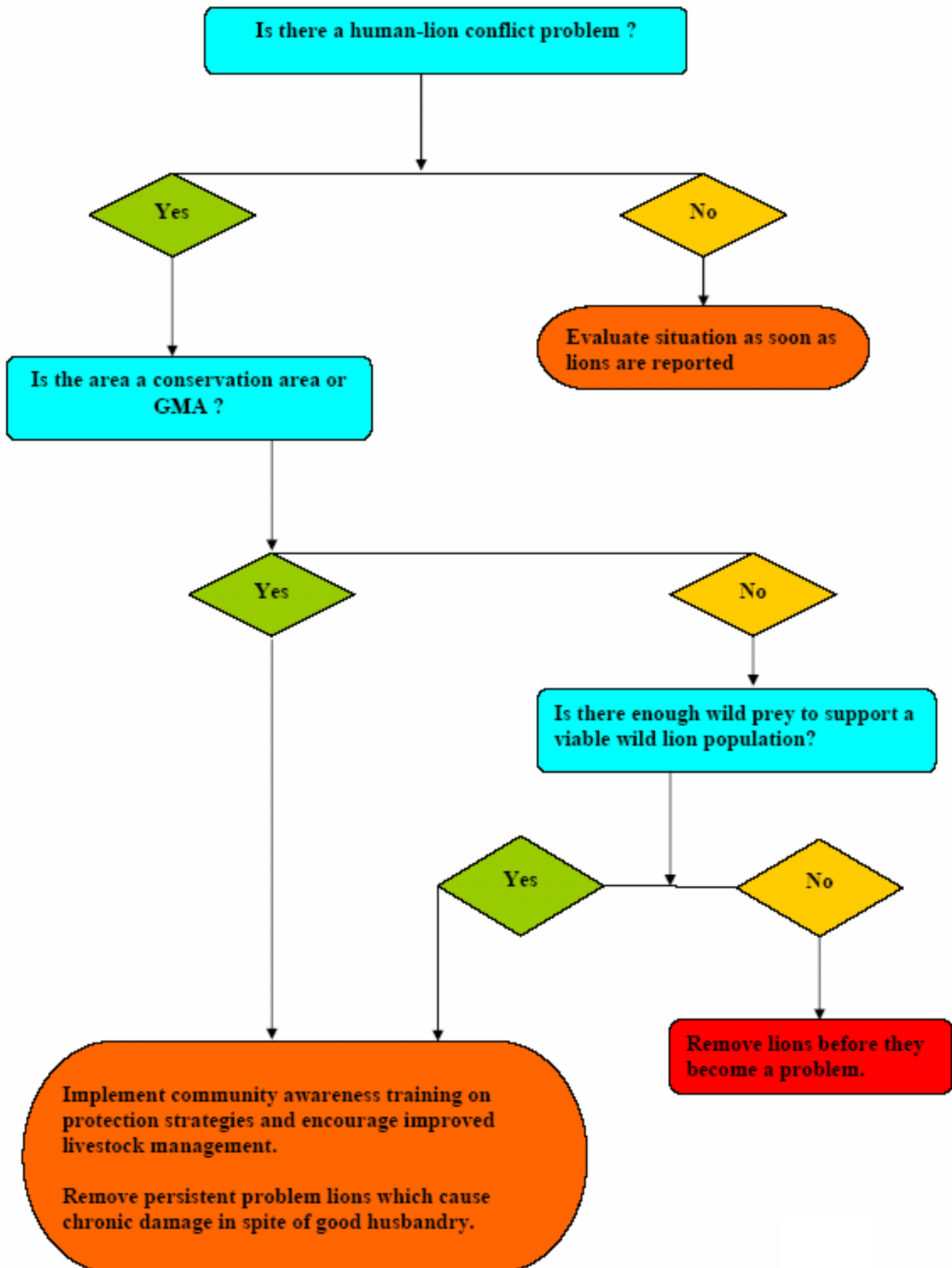


Figure 1: Recommendation for a decision making process to manage human/lion conflicts (Courtesy FAO, 2005a & J. Anderson); GMA = Game Management Area.

Table XIV: Assessment and ranking of threats to LCUs in Malawi 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
Kasungu	II	Small ³		Lots ⁵		None	Medium ⁴	None	Lots ¹	Lots ²
Liwonde	II	Small ³		Lots ⁵		None	Medium ⁴	None	Lots ¹	Lots ²
Mangochi	III	Small ³		Lots ⁵		None	Medium ⁴	None	Lots ¹	Lots ²
Namizimu	III	Small ³		Lots ⁵			Medium ⁴	None	Lots ¹	Lots ²
Nkoto Kota	II	Small ³		Lots ⁵	None	None	Medium ⁴	None	Lots ¹	Lots ²
Nyika	II	Small ³		Lots ⁵		None	Medium ⁴	None	Lots ¹	Lots ²
Vwaza Marsh	II	Small ³		Lots ⁵		None	Medium ⁴	None	Lots ¹	Lots ²
Threat ranking score*		7	0	0	0	0	0	0	21	14

^aNumbers in superscript indicate the rank of this particular threat compared to the others

*Threats are ranked by scoring every threat for the number of times it ranked first (3 points), second (2 points) and third (1 point)

During the present survey, the informants were consulted about their perceptions (i) of threats to lion survival in areas where lion was still present and (ii) of drivers of lion's extinction in areas where lion had disappeared. Because resident lions only survive in a few PAs, the ranking of threats only addressed the PAs while the ranking of the drivers of lion's extinction mostly addressed non-gazetted areas (*i.e.* Districts). According to the informants:

- In areas of Malawi where lion is present, the top threats to lion conservation, by order of importance (Table XV):
 - 1) Unintentional killing of lions;
 - 2) Loss of suitable habitat;
 - 3) Inefficacy of management for lion conservation;
 - 4) Lack of prey;
 - 5) Human encroachment.
- In areas of Malawi where lion is no more present, the main drivers of lion's extinction included, by order of importance (Table XV):
 - 1) Loss of suitable habitat;
 - 2) Human encroachment;
 - 3) Lack of prey;
 - 4) Deforestation;
 - 5) Inefficacy of management for lion conservation.

Unintentional killing of lions was reported as the top ranking threat to lion conservation by the respondents of the present survey (Table XV) while it was ranked as the fifth threat by the participants to the Regional Strategy (Table XIV).

Respondents to the present inquiry then identified loss of suitable habitat as a major threat (Table XV). This result matched the perception of the Regional Strategy where habitat conservation appeared as the top ranking threat and resource extraction was listed as the second major threat (Table XIV).

Inefficacy of management for lion conservation was the third listed major threat perceived by the respondents of the present survey (Table XV) while it was not mentioned as a threat by the Regional Strategy (Table XIV).

Lack of prey was the fourth listed major threat in the present inquiry (Table XV), as well as by the participants to the Regional Strategy.

The small size of the population 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.

The differences in the perception of threats to lion survival by the informants of the present survey and the Regional Strategy might be due to the people involved in the respective studies: most of the respondents to the present survey were local stakeholders from Malawi while participants to the Regional Strategy were mainly scientists from other countries.

Table XV: Ranking of drivers of lion's extinction and threats to lion conservation at national scale according to the present survey

Drivers of lion's extinction	Percentage of informants (N=62)
Loss of habitat	80
Human encroachment	61
Lack of prey	56
Deforestation	35
Inefficient management	30
Unintentional snaring/trapping	24
Livestock occurrence/retaliation	10

Threats	Percentage of informants (N=37)
Unintentional snaring/trapping	65
Loss of habitat	59
Inefficient management	57
Lack of prey	48
Human encroachment	35
Deforestation	16

2.2. Major threats to lion conservation in Malawi

Wilderness areas in Malawi are under huge pressure. Natural habitats are facing steady and steep decline owing to the demand for land and resources by a rapidly growing population. Nearly all the threats mentioned by the informants of the present survey and by 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 Malawi, lions may be killed either legally (PAC) or illegally (poaching and retaliatory killing). All these causes responsible for lion mortality are indiscriminate (any sex and age may be eliminated).

- **Problem Animal Control**

The number of lions killed by PAC operations is quite high and likely underestimated because of probable unreported PAC cases. As already mentioned in the PAC section, although PAC is an important legal method of conflict mitigation, it could be greatly improved in view of the indiscriminate and poorly controlled mechanism in place.

- **Poaching**

Lions may be intentionally poached for cultural, commercial or medicinal purposes. In Malawi, there is no cultural killing of lions except maybe in Mzimba District, where Zulu people (originating from South Africa) use lion skin as symbol of power during dances (Edson Sichali, *pers. com.*). Although not documented, it is believed that lions might be killed

for medicinal purposes all over Malawi (*e.g.* for its fat which when eaten is believed to boost courage, Edson Sichali, *pers. com.*).

More often, lions are unintentionally caught in wire snares set for ungulates (Table XIII). Illegal game hunting for bushmeat is largely carried out with snares in Malawi, especially in Liwonde and Lengwe NPs (Table XVI). Snares may be responsible for serious and even lethal injuries to lions (Hofer *et al.*, 1996).

Table XVI: Number of wire snares collected by game scouts in recent administrative years (source: Annual Reports of Protected Areas).

Protected Area	2006/2007	2007/2008	2008/2009	2009/2010
Kasungu NP	263	215	73	N/A
Lengwe NP	N/A	N/A	1182	N/A
Liwonde NP	N/A	N/A	2749	5424
Nyika NP	317	N/A	N/A	N/A
Nkhota-Kota WR	127	193	575	N/A
Vwaza Marsh WR	N/A	N/A	N/A	107

▪ Retaliatory killing

Retaliatory killing of lions likely occurs everywhere man and lion share land. Only a few cases were reported during the present survey (Table XIII). Between the early 1980s and the early 2000s, 8 lions were reported killed by local communities to either defend their own life or protect their livestock (six lions by using local-made guns and two by poisoning; Table XIII).

Higher levels of retaliatory killing have been linked to higher 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) which compiled 4 sets of mitigation measures: (i) Lion management; (ii) Human management; (iii) Livestock management; (iv) Environment management.

○ Lion pathology

Pathology as a whole is (i) a direct threat when responsible for lion mortality and (ii) an indirect threat when affecting the lion prey base. To our knowledge, no study on these issues has been carried out in Malawi.

Lions in Malawi might be 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.* rabies, canine distemper virus(CDV)).

In East Africa, CDV is one of the most threatening pathogens for lion. Lion populations of Serengeti and Ngorongoro Crater have been depleted by severe outbreaks of CDV during the last 40 years (Packer *et al.*, 1999; Kissui & Packer, 2004). The lower impact of CDV outbreaks on the Serengeti lion population compared to the Ngorongoro Crater population illustrate that larger populations are more resilient. 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.

As another example, bovine tuberculosis in buffalo especially and other mammal species in general is well-known to be transmitted to lions and to increase morbidity and mortality in infected lions (*e.g.* Keet *et al.*, 1998; Michel *et al.*, 2006).

- **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. Land-use conversion, habitat degradation and human settlement in natural ecosystems negatively impact wildlife.

Malawi is one of the African countries with the highest human density; in 1999, it was ranked on fifth position after Rwanda, Burundi, Nigeria and Gambia (United Nations, 1999). The Malawi's human population size was 9.9 million people in 1998 (NSO, 1998), *i.e.* 105 habitants/km² and reached 13.1 million in 2008 (NSO, 2008a; Figure 2.a), *i.e.* 140 habitants/km². The average annual growth rate of human population since the 1960s is close to 3% (NSO, 2008a; Figure 4.b). Human density is particularly high in South Eastern Malawi and Southern part of the Central Region (Figure 2.a). Most of Malawi's human population remains rural with more than 85% of the total population (NSO, 2008a).

90% of Malawi's population live with less than US\$2 a day (UNDP, 2009) and 74% with less than US\$1.25 a day (UNDP, 2010). Poverty affects particularly the rural communities and is especially acute in households relying exclusively on livestock and food crop production. Living conditions in rural areas are often harsh and food security is a major challenge. Anaemia affects almost three-quarters of children under 5 years and more than 2 women out of 5 (FAO, 2010).

Agriculture is essential in Malawi economy, accounting for 30% of the gross domestic product (GDP) and being the main source of livelihood for more than three-quarters of the population (NSO, 2008b). In 2007, the total area under crop in Malawi was 2.3 million hectares, *i.e.* 24% of the national land surface and 30% of the non-gazetted land surface (ASD, 2007; Figure 2.b); 77% of agricultural parcels were customary lands (ASD, 2007). Pesticide is used in only 2% of cultivated parcels in the country (ASD, 2007).

The livestock industry accounted for almost 10% of the GDP in 2005, representing a major contribution to the national food supply (FAO, 2005b). Almost 60% of households in Malawi owned or kept livestock or poultry, however only 6% of households owned at least one head of cattle (ASD, 2007). In 2007, 20% of Malawi land was used as rangeland for grazing 2.6 million goats, 884,132 heads of cattle, 792,364 pigs and 76,613 sheep (Figure 3; ASD, 2007). The highest densities of livestock units were recorded in the Northern Region and the Southern part of the Central Region (Figure 3). There is a general consensus for recognizing the rapid growth of the livestock heads in the country, mostly since the early 2000s (Figure 4a). However, livestock holdings do not increase in accordance with the rapid human population growth, which results in fewer livestock per capita and leads to lower tolerance to depredation (between the 1970s and the 2000s, the mean yearly human increase was 13 times higher than the mean yearly increase for livestock units; Figure 4b).

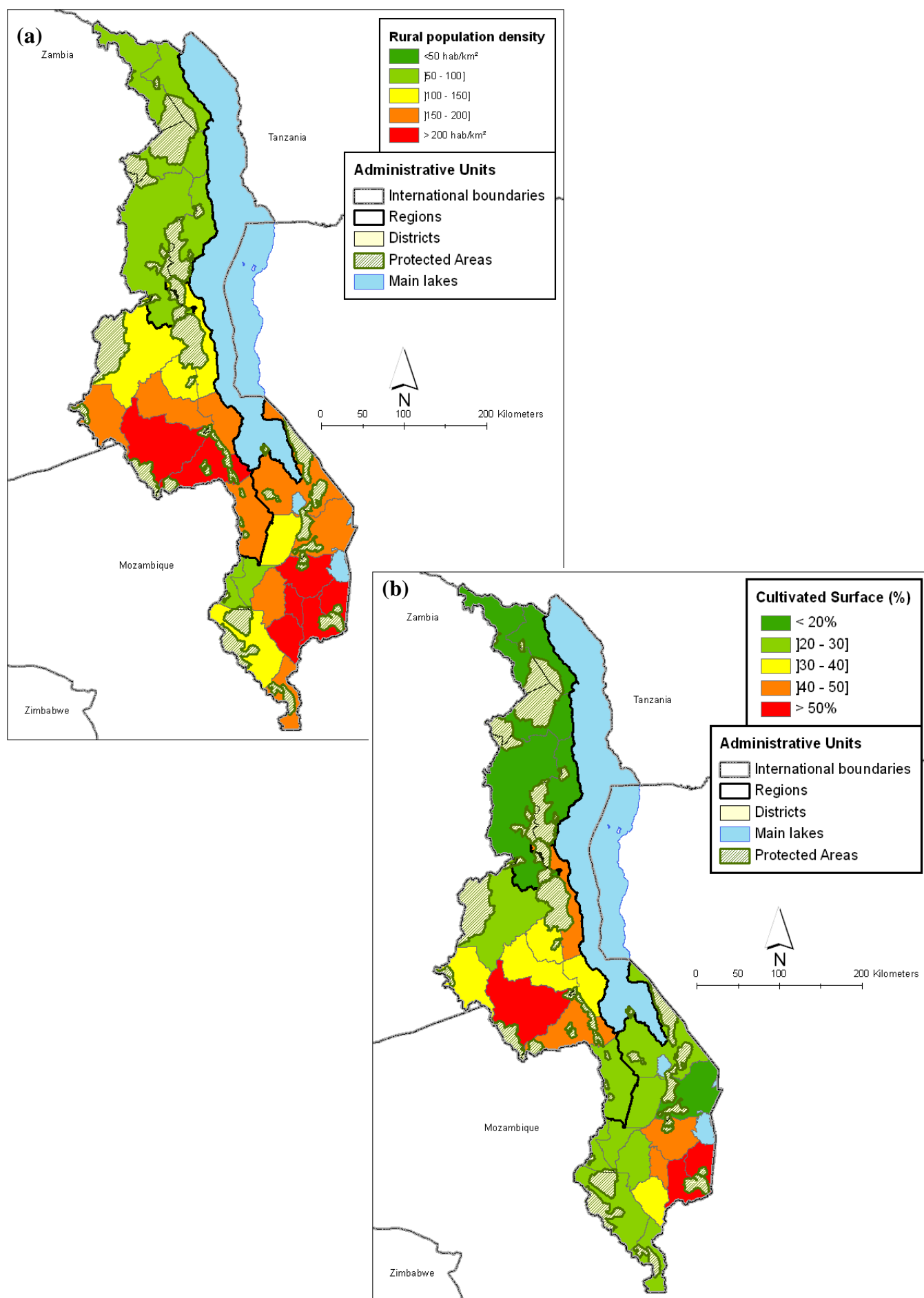


Figure 2: a - Human rural population density per District in 2008 (from NSO, 2008a); **b** - proportion of permanent crops per District in 2007 (from ASD, 2007)

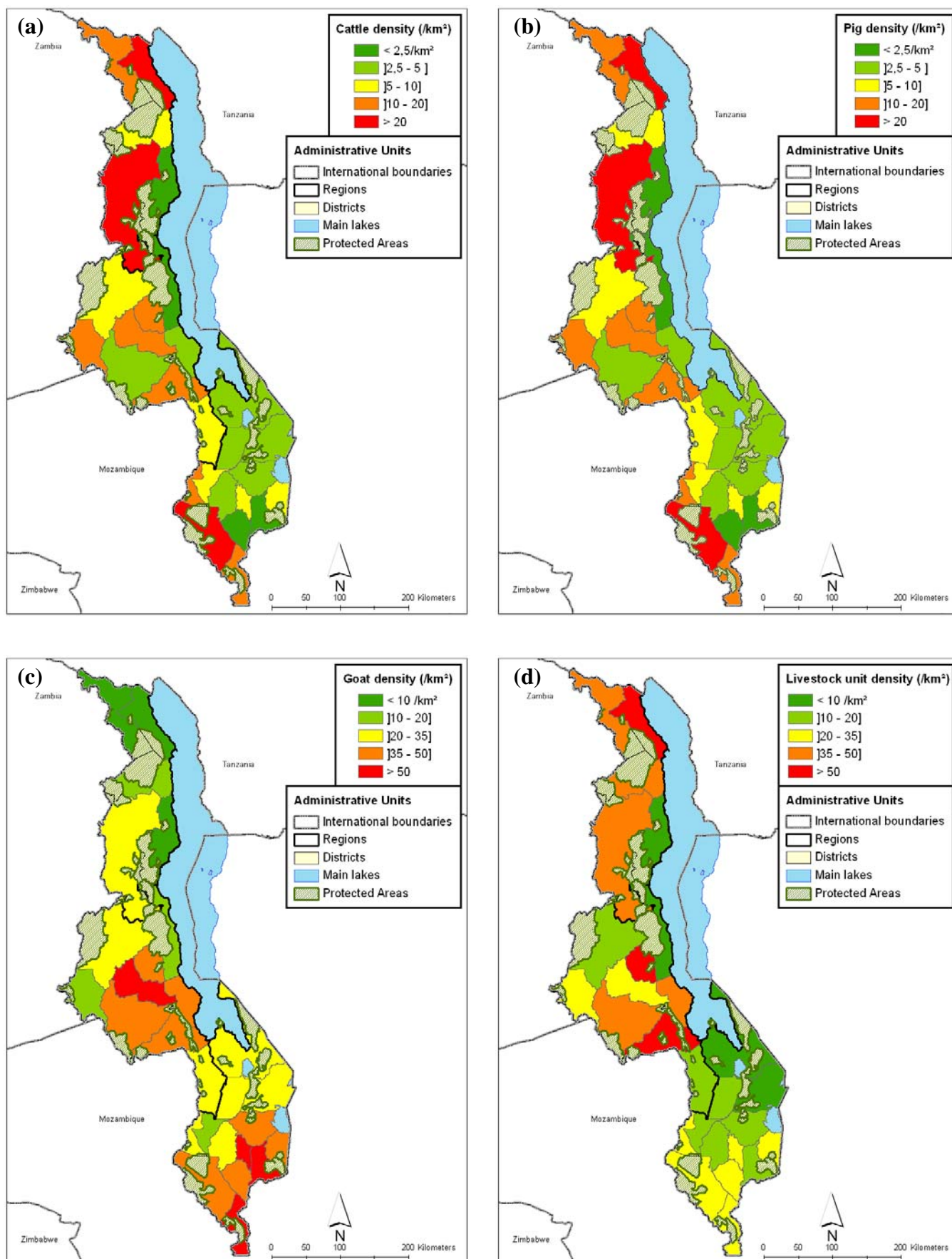


Figure 3: Density of livestock in Malawi in 2007 (from ASD, 2007), (a) for cattle, (b) for pig, (c) for goat and (d) for livestock unit (where cattle=0.5 unit, pig=0.2 unit and goat=0.1; adapted from FAO, 2005b).

Figure 4a: Livestock trends in Malawi between 1970 and 2010 (from MAFS, *pers. com.*)

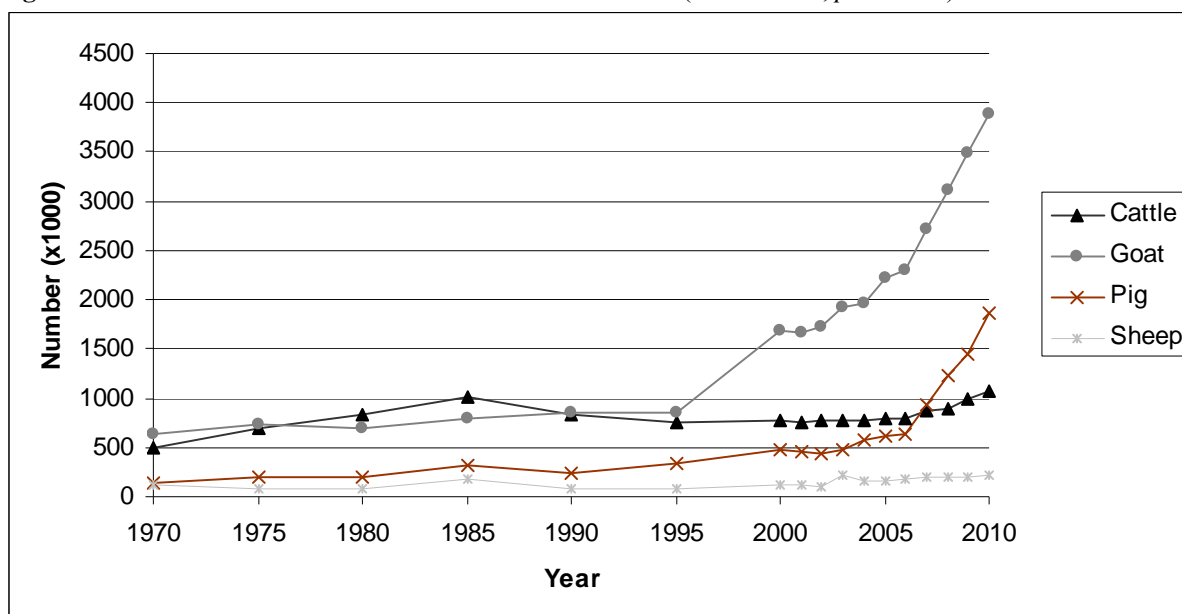
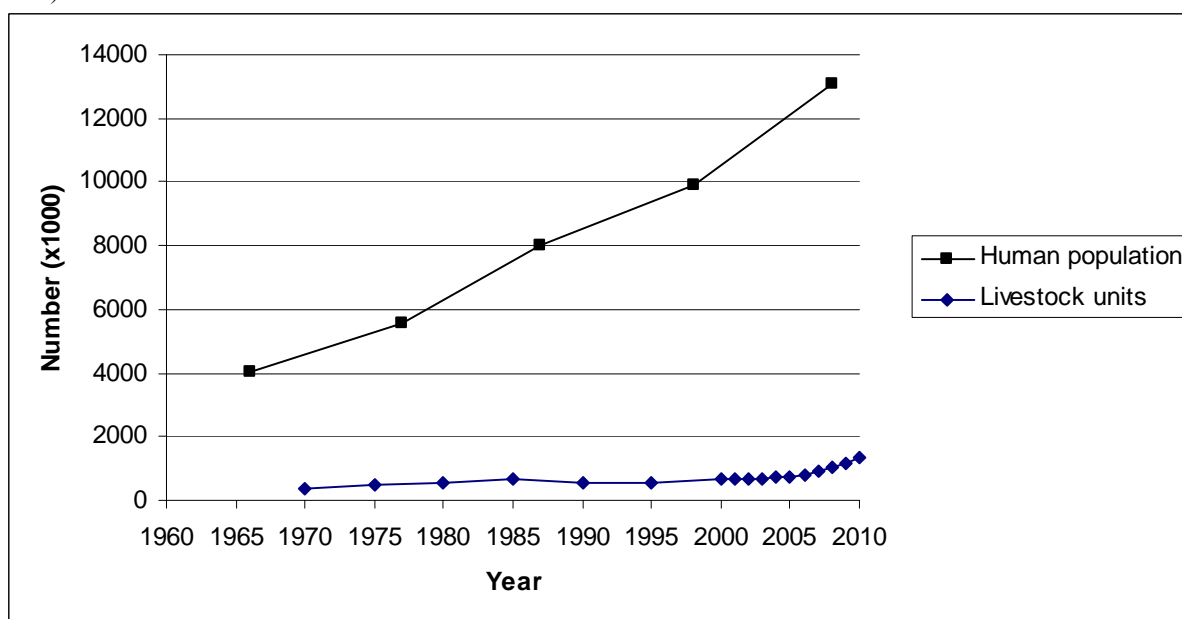


Figure 4b: Livestock units (where cattle=0.5 unit, pig=0.2 unit and sheep & goat=0.1; adapted from FAO, 2005b) and human population trends in Malawi between 1966 and 2010 (from NSO, 2008 and MAFS, *pers. com.*)



○ 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 the one of people who do not cohabitate with wildlife. The cohabitation 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 vermins that have to be eradicated.

In Malawi, there is a cultural deep fear of lions, still conveyed by stories told to children. This feeling of fear may appear disproportionate in view of the low occurrence of recent incidents

in Malawi (Tables VII & X), especially when comparing with the high number of human-beings killed by lions in Tanzania (lion attacks in Tanzania may have resulted in more than 560 lethal attacks between 1990 and 2004 and injured at least 308 human beings; Packer *et al.*, 2007) or in Mozambique (*e.g.* 70 people killed by lions in Cabo Delgado Province between 2000 and 2001; Chardonnet *et al.*, 2009).

Most informants to the present survey, apart from those belonging to DNPW, were first astonished by the forthcoming action plan for lion conservation in Malawi and were afraid that lions could be re-stocked in the country.

Livelihood also greatly determines attitudes and perceptions of local communities in respect to the lion. Traditional pastoralists, probably more than agro-pastoralists, particularly suffer from the conflict with lions because of their high dependency upon livestock and their lack of alternative income sources. The amount of losses also drives the level of hostility of local communities towards lion (Stander, 1997).

Finally, the loss of grazing land to PAs, and the lack of tangible benefits or revenue from conservation have greatly undermined the support of local communities to carnivores conservation. As a global response, the Malawi Government has been encouraging long term integrated approaches for human/lion conflict mitigation, such as Community Based Natural Resources Management (Malawi Government, 2007).

○ **Habitat loss**

The human encroachment in wildlife corridors and the widespread destruction of wildlife habitat are major threats to lion conservation. “*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 the present survey, human encroachment and habitat loss through land conversion of wilderness areas into farm land were mentioned as the most serious threats to lion conservation in Malawi by many informants.

In 1975, 44,560 km² (*i.e.* 47% of Malawi terrestrial land) were classified as forest (FAO, 2005c); by 2000 it dropped to 35,670 km² (*i.e.* 38% of Malawi terrestrial land), of which 21% were made up of FRs, NPs and WRs, leaving only 17% as forest areas still existing in non-gazetted land (FAO, 2005c).

In 2005 the forest cover was estimated to be less than 26% of Malawi terrestrial surface (Halle & Burgess, 2006) and the rate of deforestation was ~2.8% per year (one of the highest rates of annual deforestation in Africa). The deforestation rate was the highest at 3.4% in the Northern Region because the other two regions were already heavily deforested (Halle & Burgess, 2006). 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. Firewood is the main source of energy for cooking in Malawi, accounting for 96% in rural areas (NSO, 2008a).

Wildlife corridors between distant wilderness areas (NPs, WRs and FRs) no longer exist, meaning that PAs in Malawi are isolated. Human expansion and subsequent harassment by people have increasingly restricted the lion to PAs. 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). Because of the higher magnitude of the human/lion conflicts 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).

- **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 decrease of the wild prey basis and a modification of lions' diet (*e.g.* Funston & Mills, 2006). Secondly, droughts negatively impact livestock husbandry making 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 conflicts. Furthermore, surplus killing by lions of cows weakened by droughts is likely to occur.

- **Decrease in wild prey availability**

Decrease of wild preys is a major driver of human/lion conflicts. In areas where natural prey availability becomes low, lion may switch to a livestock-orientated diet. This contributes to amplify the antagonism of local communities with associated retaliation and preventive killing of lions. The lion wild prey basis is mainly influenced by anthropogenic factors such as poaching, habitat loss to agriculture and human settlements.

In most PAs for which information have been gathered during the present survey, lion's preys have been drastically depleted since the early 1990s (Table XVII). In Majete WR, game species have been reintroduced since 2003 (Hogerheijde, Hall-Martin & Ndadzela, 2008) and the Reserve has been completely fenced in 2008 so that the increase of prey's stock does not benefit to lions. An other PA where wildlife has increased since the early 1990s is Liwonde NP (Table XVII), but once again this increase has been supported by reintroduction and restocking (Wilderness Trust, 2010).

- **Small population size**

An eventual low genetic diversity in small and isolated populations is sometimes considered as a possible factor responsible for the decline of carnivores (O'Brien *et al.*, 1987; Wildt *et al.*, 1987).

2.3. Particular threats associated with lion translocations

- **Background**

Relocating lions within their range, or to parts of their former range, is used as a management tool despite proving often unsuccessful (Fischer & Lindenmayer, 2000). Any translocation project should comply with the guidelines for reintroductions set by the Reintroduction Specialist Group of the IUCN Species Survival Commission (IUCN SSC Reintroduction Specialist Group, 1998).

Should projects involving lion relocations be planned in Malawi, they would have to be properly designed and implemented. A chart was specifically drawn for helping decision-makers to adopt the right attitude towards this kind of project (Figure 5).

Table XVII: Trends of main lion's preys in a few documented Protected Areas (* from Simons *et al.*, 1991; ** from McShane, 1985; other sources are DNPW reports)**KASUNGU NATIONAL PARK**

SPECIES	1989*	1995	2009
Elephant	500	391	129
Eland	54		35
Buffalo	1069	327	411
Zebra	298	85	70
Roan	356	97	121
Sable antelope	324	141	
Kudu	99	46	
Hartebeest	482	135	153
Puku	71	97	289
Bushbuck	10	10	92
Reedbuck	281		317
Impala	36		35
Common duiker	387	51	188
Warthog	413	108	129
Bushpig	378		35

LIWONDE NATIONAL PARK

SPECIES	1989	2006	2007	2008	2009
Elephant	400	751	857	805	928
Eland	0	63	71	62	79
Buffalo	0	553	657	781	864
Zebra	0	110	65	74	78
Roan	0	45	40	43	43
Sable antelope	276	800	508	527	736
Kudu	35	207	314	187	409
Hartebeest	0	100	89	70	118
Waterbuck	1167	2451	2517	2566	3539
Bushbuck	25	399	297	449	604
Reedbuck	14	39	76	89	72
Impala	388	2356	3187	2652	4163
Common duiker		111	156	146	325
Warthog	67	1655	1618	1547	3156

NYIKA NATIONAL PARK

SPECIES	1989*	1999	2005	2008
Eland	3564	992	952	1198
Zebra	245	263	476	300
Roan	577	853	827	611
Bushbuck	41	108	138	93
Reedbuck	4673	2050	964	1120
Common duiker	67	167	187	171
Warthog	93	178	175	192
Bushpig	101	17	38	41

LENGWE NATIONAL PARK

SPECIES	1998	2002	2008
Buffalo	4144	1548	921
Kudu	302	229	329
Nyala	2527	1040	608
Bushbuck	-	26	49
Reedbuck	-	11	18
Impala	4250	3480	2329
Common duiker	-	12	20
Warthog	390	742	505
Bushpig	-	24	30

MAJETE WILDLIFE RESERVE

SPECIES	1989*	2003	2007
Elephant	125	0	72
Eland	0	0	53
Buffalo	16	0	365
Zebra	0	0	69
Sable antelope	829	0	228
Kudu	228	25	145
Hartebeest	0	0	31
Waterbuck	248	25	232
Nyala	0	0	43
Bushbuck	28	Present	78
Reedbuck	0	Present	91
Impala	0	0	277
Common duiker	117	Present	136
Warthog	20	20	116

VWAZA MARSH WILDLIFE RESERVE

SPECIES	1985**	1989*	1996	2009
Elephant	250	200	582	151
Eland	75	25	1	0
Buffalo	900	1759	178	57
Zebra	250	68	0	25
Roan	700	120	93	175
Sable antelope	20	23	11	26
Kudu		0	0	45
Hartebeest	700	273	174	83
Puku	15	20	0	54
Bushbuck	700	56	0	11
Reedbuck	300	147	54	33
Impala	600	95	0	82
Common duiker	1000	17	55	34
Warthog	1500	197	11	88
Bushpig	700	6	0	

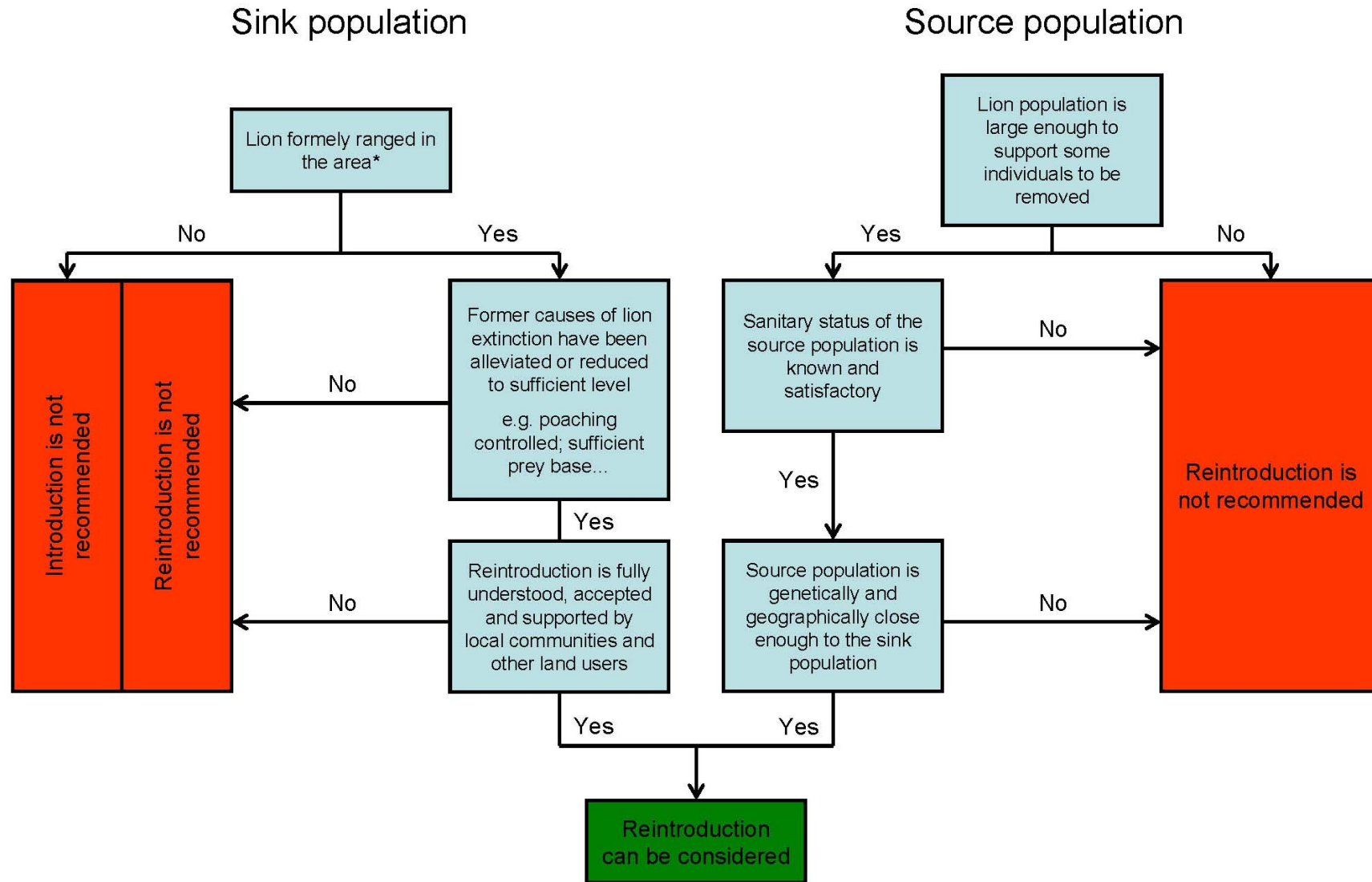


Figure 5: Decision making process for implementing a lion population translocation (*also valid in case of population re-enforcement, where lions still occur in low number)

- **Risks associated with lion translocations**

- **Genetic risks**

In Zambia, the lion population of the Luangwa ecosystem has been shown genetically well distinct from the lion population of the Kafue ecosystem, so that Zambia Wildlife Authority now opposes translocations of lions from one ecosystem to another within the country -as well as from other countries- in order to preserve the variety of genetic strains and avoid genetic pollution in Zambia (Paula White, *pers. com.*). Even though such genetic studies have not been conducted in Malawi so far, similar measures could be applied to Malawi as a precautionary principle to preserve the genuine diversity of the local lions. Reintroduction should not be considered when a genuine lion population exists nearby and can eventually come in contact with the reintroduced lions.

- **Sanitary risks**

Lions are susceptible to a number of diseases. In Kruger NP, tuberculosis at least is raising concerns due to the now free movements of lions to Limpopo NP and also in regard to translocations further else. In Southern Africa, a lot of lions are bred in captive situations with associated health risks. Some lion diseases are more difficult to control (tuberculosis, FIV, etc.) than others (distemper, rabies, etc.), which makes it difficult to exert full control of the health risk in any translocation project.

- **Behaviour risks**

Captive lions as source population should always be avoided (*e.g.* Fischer & Lindenmayer, 2000), not only for sanitary or genetic reasons, but also for their modified behaviour: animals having lost part of their fear to humans are more likely to become responsible for livestock or human losses and to be eliminated by local communities.

- **Image risks**

In Southern Africa, thousands of lions are bred in captivity for multipurpose reasons including hunting. The issue of so-called “caned lions” is a serious issue for the governments, the conservation community and the hunting community as well.

Mitigation solutions are currently under discussion. In terms of communication, the image of the country given by the caned-lions hunting industry is disastrous. No need here to detail the obscure genetics of these lions with strain mixing, biased genetic selection, lack of traceability, etc.

- **General guidelines**

- **Introduction: where & when the species does not exist and was never present before**

No introduction of lion should ever take place, according to the African Lion Working Group (ALWG). The reasons are numerous, notably ecological (the ecosystem is not prepared to stand such a large predator) and social (local communities have no previous experience of cohabitating with the large carnivore).

- **Reintroduction: where & when the species used to be present and then became extinct**

Reintroduction of lions could only be envisaged when conditions supporting the decision making process are positively met (Figure 5), *i.e.* when: (i) the factors responsible for the local extinction of the species have now become under control (otherwise it is pointless), (ii) the social acceptance is reasonably high within local communities, (iii) the ecological constraints are released, *e.g.* natural habitat, prey basis, predator competition, etc., (iv) there is some kind of benefit to do it.

- **Re-enforcement: where & when new individuals are added to a given existing population of the species**

Re-enforcement of lions could only be considered when conditions supporting the decision making process are positively met (Figure 5), and in only one particular case, where & when genetic drift -due to inbreeding in a very low population size- threatens the survival of the local population.

- **Proposed guidelines for Malawi**

If a lion reintroduction project is to be envisaged in Malawi, the following guidelines are recommended regarding:

- **The whole project**

The project should be properly studied beforehand by performing a site specific feasibility study.

- **The source population**

- Mozambican lions from LCU 35 (Tete Province) or Zambian lions from LCUs 30, 31 & 32 should be given the preference;
- At least, full sanitary check up of translocated individuals at the time of translocation and, even better, health inquiry within the source population are to be carried out;
- Only wild lions from unfenced areas can be translocated.

- **The sink population**

If there is a sink population, *i.e.* if indigenous lions remain on site, no other lions (not a single one) should be brought in and all efforts should be directed to rehabilitate the genuine lion population. In terms of health and genetics, it is always safer to spend efforts and money on rehabilitating a remaining local population of lions than to translocate exotic lions from elsewhere. Although it is much easier and much more spectacular to translocate lions from elsewhere, it is never the best option.

- **The receiving area**

The receiving area place must be properly investigated in terms of prey basis, proximity of livestock and people, poaching and sanitary status (notably tse tse fly occurrence if the source population comes from a tse tse free area).

As long as poaching exists in the receiving PA, a reintroduction of lions would be useless because prey numbers would remain too low for sustaining a viable lion population. This may result in lions ranging outside the PA for preying on livestock (Thomson, 1998). Furthermore, considering the low tolerance of Malawians towards lions, a strong public awareness strategy would be needed prior any reintroduction of lions.

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APPENDICES

APPENDIX I: Lion range maps published in literature

- **Map A:** African lion range according to Chardonnet (2002);
- **Map B:** African lion range according to African mammal databank (1999);
- **Map C:** Probability of lion presence across Africa according to Loveridge & Canney (2009);
- **Map D:** Eastern and Southern African lion range and Lion Conservation Units according to IUCN SSC Cat Specialist Group (2006).

APPENDIX II:

- Inquiry forms

APPENDIX III:

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

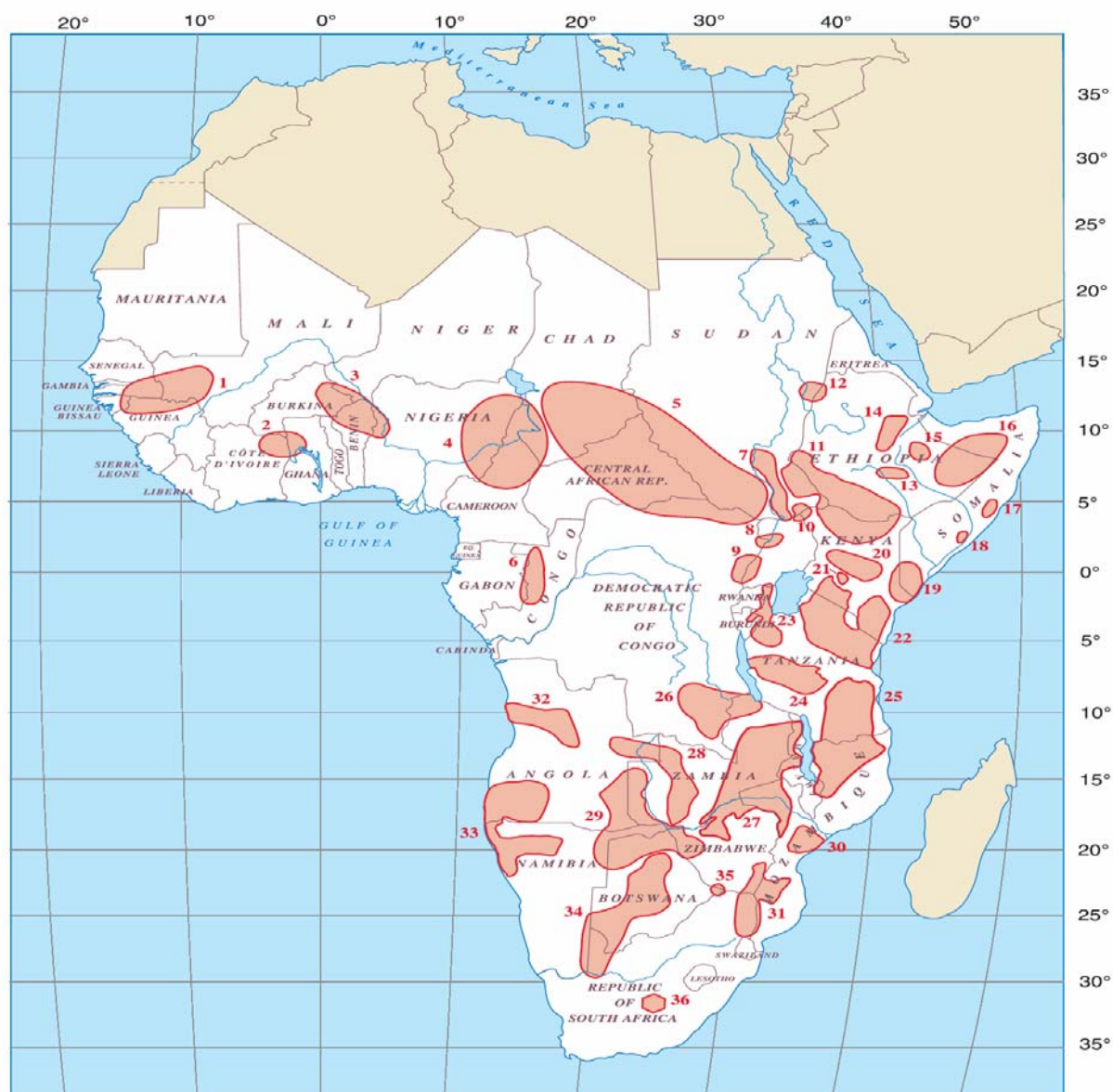
APPENDIX IV:

- Survey's synthetic database

APPENDIX V:

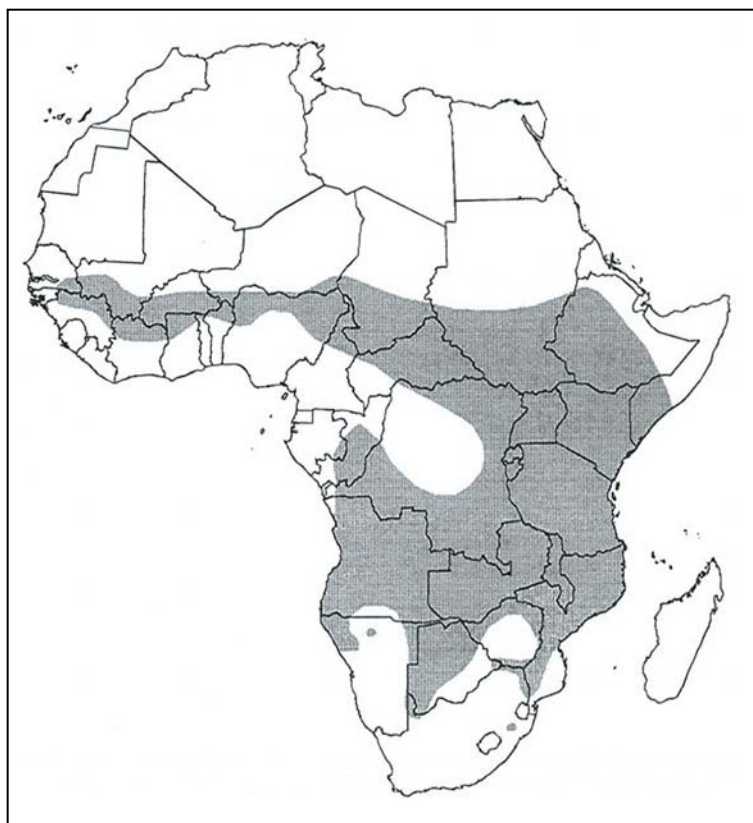
- Some legal aspects of people's defence against wildlife damage

APPENDIX I: Lion range maps published in literature



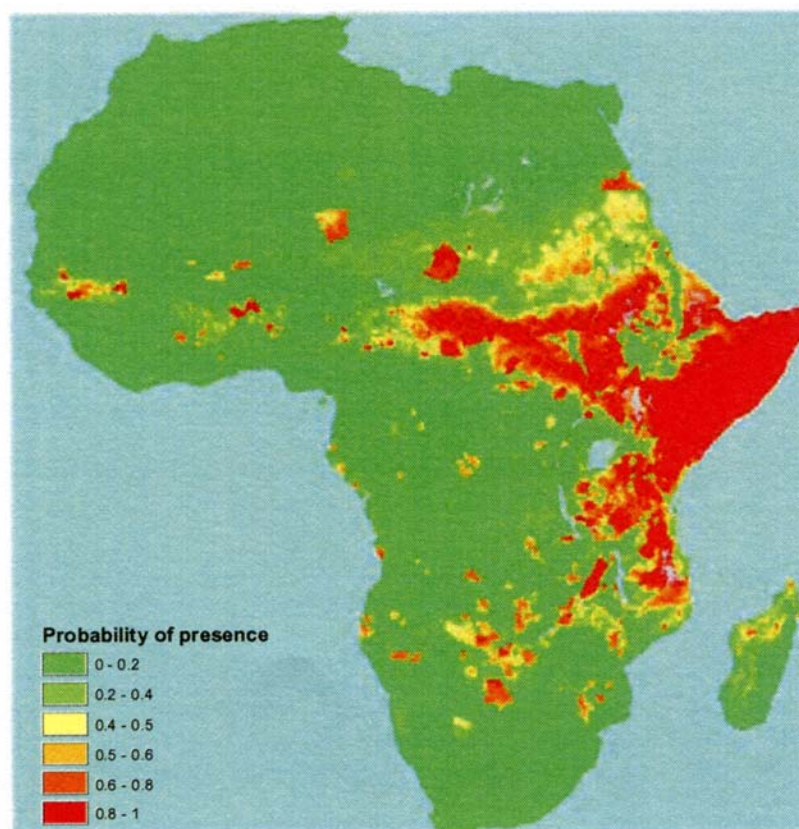
Map A: African lion range according to Chardonnet (2002)

APPENDIX I: Lion range maps published in literature

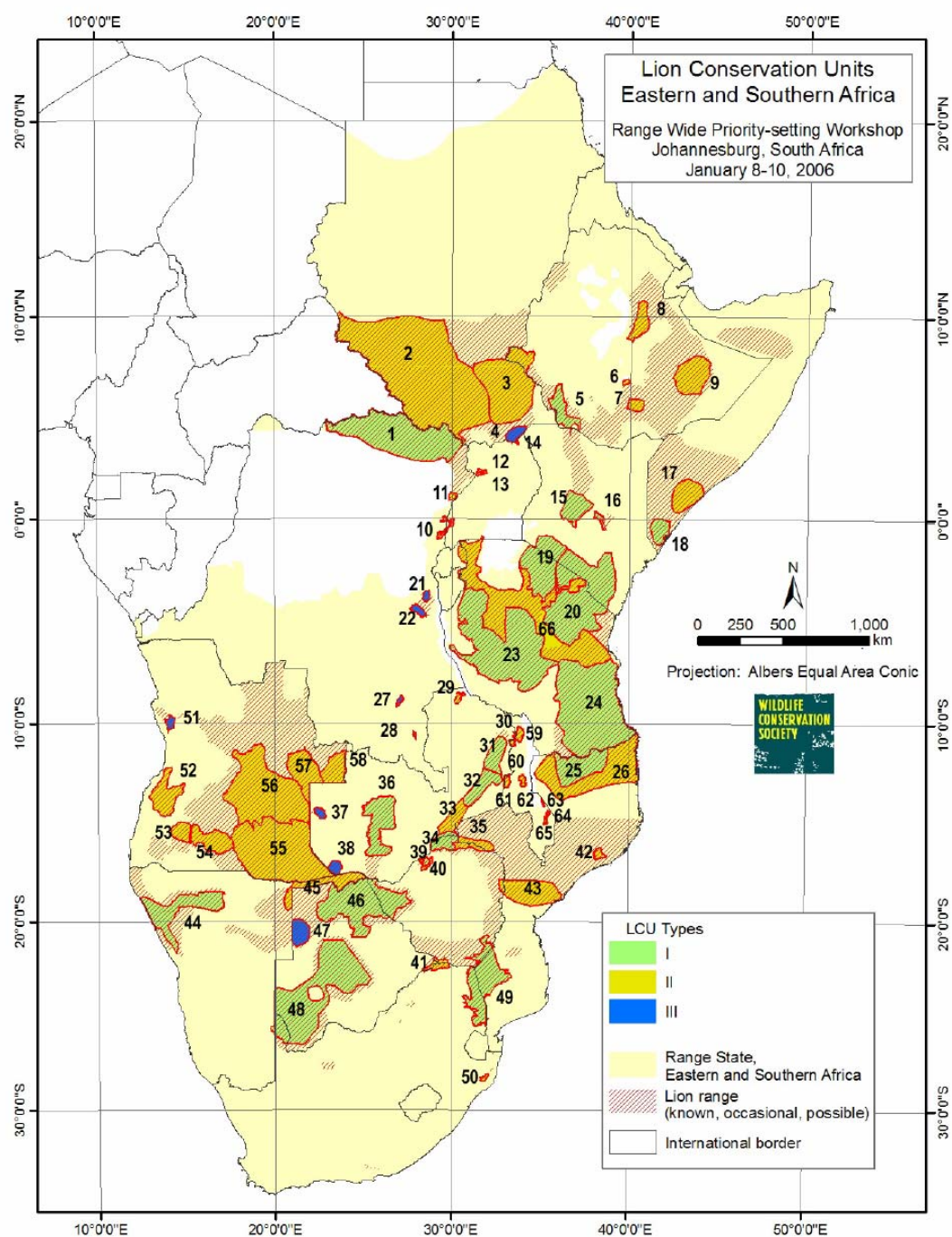


Map B: African lion range according to African mammal databank (1999)

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



APPENDIX I: Lion range maps published in literature



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

APPENDIX II: Inquiry form A - continued



« LION » QUESTIONNAIRE



PLEASE, FILL ONE QUESTIONNAIRE FOR EACH AREA UNDER YOUR MANAGEMENT
FILL BOX A FOR A PROTECTED AREA OR BOX B FOR A NON-PROTECTED AREA

Date : _____

A - DETAILS OF THE PROTECTED AREA

Region: _____ District: _____
Name of the Protected Area: _____
Name of the company managing the Protected Area (if any): _____
Area (km²): _____ Is the Area fenced? _____ Yes / No

B - DETAILS OF THE NON-PROTECTED AREA

Region: _____ District: _____ Main city: _____
Features delimitating the area: North: _____
South: _____
West: _____
East: _____

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 2009? _____ in 2010: _____
How many lions have you seen in 2009? _____ in 2010: _____
Average number of lions seen per year over the last 5 years? _____

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

S	Weekly	Monthly	Yearly	Rarely	I	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)? _____ / _____

APPENDIX II: Inquiry form A - end

7. Approximate area occupied by lions (km²): _____

8. Maximum number of lions seen together (year and location): _____

9. How often do you hear lion roaring? _____

Weekly / Monthly / Yearly / Rarely / Never

10. Has the number of lions increased or decreased since 5 years? _____

Increase / Decrease / Stable / Don't know

11. Has the number of lions increased or decreased since 20 years? _____

Increase / Decrease / Stable / Don't know

LION PREYS - TOP FIVE SPECIES

Species	Low abundance	Medium Abundance	High Abundance

HUMAN/LION CONFLICTS

1. Have you seen poached lions? _____ Yes / No

Details of the last cases of poached lions you have noticed:

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)

Year/Month	Humans killed	Humans injured	Livestock losses	Official killings as Problematic Animal Control	Unofficial killings of problematic lions

4. Which wild animal causes the most problems? _____

5. Which predator causes the most problems? _____

THREATS TO THE SURVIVAL OF LIONS

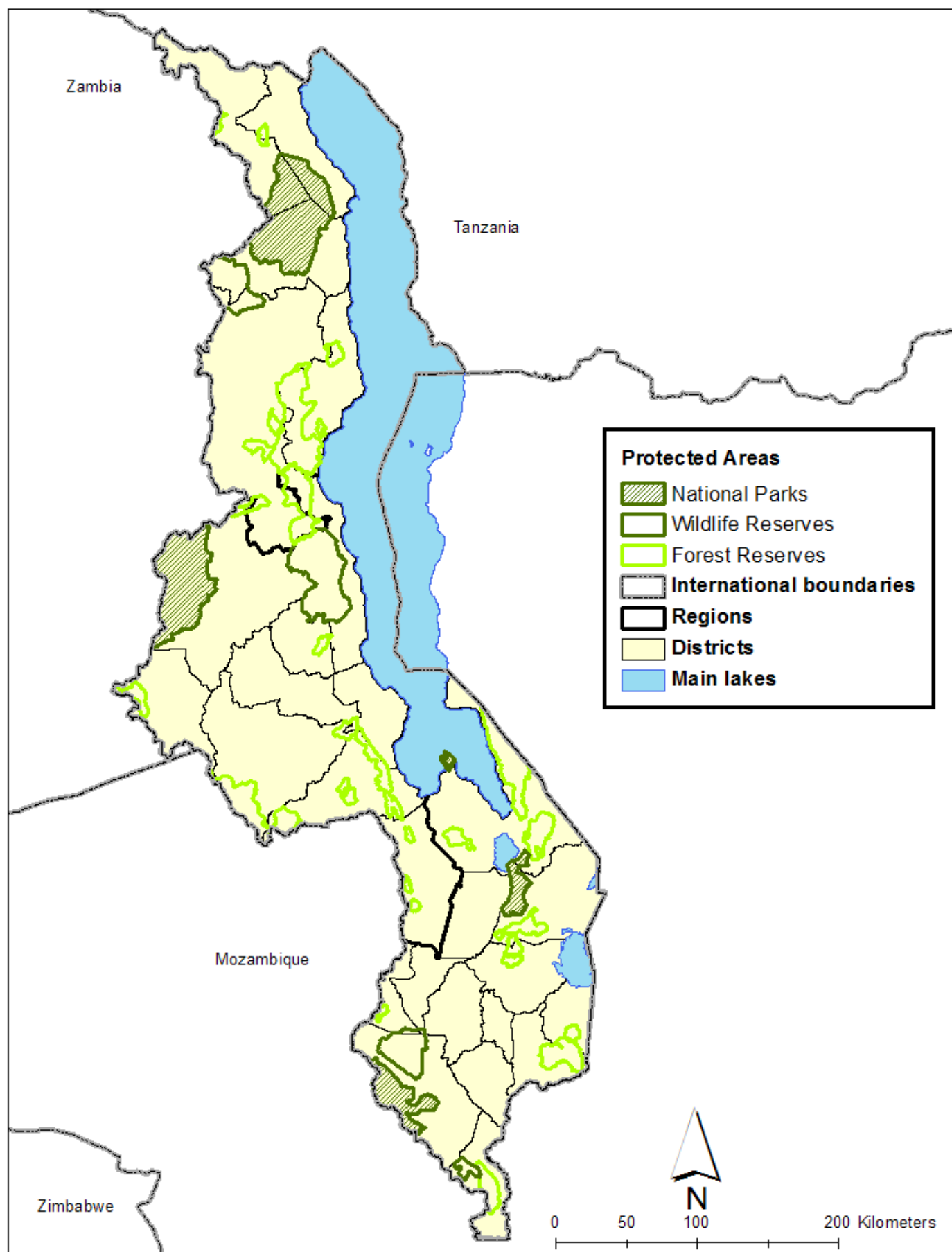
What are the most severe threats to lion survival (+++: important threat; ++: medium threat; +: lower threat)?

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....

APPENDIX II: Inquiry form B



APPENDIX III: List of informants who have contributed to the present survey [LAR: Livestock and Agriculture, DNPW: Department of National Parks and Wildlife, FD: Forestry Department, LC: Local Communities, NGO: NGO/Researchers]

Name	Network	Name	Network	Name	Network
Anderson Josiya	LAR	Doreen Kachirigwe	DNPW	John Ngalande	FD
Benard Nkwanda	LAR	Driano Zeno	DNPW	Joloamu Barnaba	FD
Bonface Phiri	LAR	Edson Sichali	DNPW	Jonathan Mzamu	FD
Chimwemwe Mwambu	LAR	Ellen Mwapeya	DNPW	Joseph Maganga	FD
Clemence Nkhoma	LAR	Ezlon Jere	DNPW	Julio Chiwalo	FD
Conrad Soko	LAR	Fyson Suwedi	DNPW	Kelvin Banda	FD
Crowde Mngamba	LAR	George Banda	DNPW	Kennedy Adamson	FD
Davis Gondwe	LAR	George Zulu	DNPW	Leimos Mlaviwa	FD
Denison Mnkondya	LAR	Godfrey Mhone	DNPW	Martha Zidana	FD
Dyton Stima	LAR	Harrison Phula	DNPW	Masautso Chikuwi	FD
Edwyn Mwamyongo	LAR	Hawela Kataya	DNPW	Mathews Mkawapatira	FD
Emma Sikoya	LAR	Hetherwick Msiska	DNPW	Matias Underson	FD
Erick Nsisamala	LAR	Ian Luhanga	DNPW	Matias Gondwe	FD
F. Kachoma	LAR	Jackwell Chibwe	DNPW	Mighty Felemu	FD
F. Mulenga	LAR	Jeffrey Bonongwe	DNPW	Monfot Somanje	FD
Felix Chirombo	LAR	Joseph Chigamula	DNPW	Mozes Chirongo	FD
Franck Kaukonde	LAR	Khumbo Mwagonja	DNPW	Mr. Chriwa	FD
G. Kiposa	LAR	Leonard Moyo	DNPW	Mwayi Mphoka	FD
G. Munthali	LAR	Leonard Sefu	DNPW	Patricia Mboti	FD
Gambuleni Genti	LAR	Mrs. Chulu Kataya	DNPW	Patrick Makupete	FD
Gaston Mbewe	LAR	Mark Tengeletu	DNPW	Paulo Muhosha	FD
Gertrude Masonje	LAR	Matias Elisa	DNPW	Peter Mcheka	FD
James Maulidi	LAR	Matias Seven	DNPW	Rex Namwada	FD
Joseph Katema	LAR	Miles Zidana	DNPW	Robert Jamitoni	FD
Joseph Lukunya	LAR	Mr. Lisausyo	DNPW	Samuel Phiri	FD
Joseph Mangalusa	LAR	Mutheto Ndhlamini	DNPW	Semu Simulemba	FD
Laston Zammimba	LAR	Phillip Namagonga	DNPW	Stevy Iron	FD
Leman Levi	LAR	Ponsiano Kwendanguwo	DNPW	Sydney Bandawe	FD
Lisford Kapalamula	LAR	Raphael Chiwindo	DNPW	Sydney Kananji	FD
Lwitiko Mwailima	LAR	Ronald Zalera	DNPW	W. Banda	FD
Martin Nuka	LAR	Sabax Kashom	DNPW	Wellington Nyondo	FD
Moses Katseka	LAR	Samson Mkumbwa	DNPW	William Kalua	FD
Mr. Chikama	LAR	Samuel Nyanyale	DNPW	Wilson Munkhundya	FD
Mr. Gomani	LAR	Shadcick Maloya	DNPW	Winkly Mwale	FD
Mr. Trinta	LAR	Timothy Maseko	DNPW	Wysman Msiska	FD
Osborn Ngwira	LAR	Tizola Moyo	DNPW	Gaston Macheka	LC
Patrick Makawa	LAR	Vega Jackson	DNPW	Dickon Chawinga	LC
Philip Munthali	LAR	Western Mhango	DNPW	Henry Mvula	LC
Romus Nkhata	LAR	William Mgoola	DNPW	Mwechisenga	LC
Roosevelt Gondwe	LAR	Agness Dziwago	FD	Clifford Mwale	NGO
Saulos Nyirenda	LAR	Ajibu Liwasa	FD	Dorian Tilbury	NGO
Thomas Chimbaza	LAR	Alick Mitawa	FD	Duncan Yearley	NGO
W. Phiri	LAR	Baird Nangwale	FD	Elesani Zakochoera	NGO
Yvonne Phiri	LAR	Benuts Phiri	FD	Goulven le Bahers	NGO
Alex Chunga	DNPW	Charles Kamwemde	FD	Lynn Clifford	NGO
Alexious Phiri	DNPW	Chikondi Kulapani	FD	Patricia Ndadzela	NGO
Alifeyo Kamwera	DNPW	Chispine Phiri	FD	Tony Finch	NGO
Alphius Lipiya	DNPW	Chispine Soko	FD	Wilfred Ndovi	NGO
Amos Chipzalo	DNPW	Douglas Makombe	FD	Angel Gondwe	Tourism
Anthony Chikuemba	DNPW	Duncan Masonje	FD	Chris Badger	Tourism
Arupheyu Camwera	DNPW	Evans Nyirongo	FD	Jack Kabwilo	Tourism
Benard Kumwenda	DNPW	Fidelis Nthenda	FD	Luclus Daimon	Tourism
Benjamin Chakhaza	DNPW	Fredy Maluwaya	FD	Mark Sprong	Tourism
Blessings Msikuwanga	DNPW	Goodson Taliana	FD	Pheroce Pendame	Tourism
Brave Madise	DNPW	Harry Chalira	FD	Tennessee Juwao	Tourism
Brighton Kumchedwa	DNPW	Herbert Malata	FD		
Brighton Wadi	DNPW	Jackson Chilongo	FD		
Clement Chamanga	DNPW	James Banda	FD		
Connex Mbewe	DNPW	Jean Chiwambo	FD		
Dines Kabota	DNPW	John Banda	FD		

APPENDIX IV: Survey's synthetic database – District level

Region	District	Answers Absence Presence	Presence			Frequency	Conflict	Conflict type	Level of knowledge	Gaps in knowledge
			Result	Decade of extinction	Visitors					
Northern	Chitipa	20/0	0	70	reg	Yearly	Medium	Livestock	High	None
	Karonga	19/0	0	70	occ	Rarely	Low	Livestock	High	None
	Mzimba	18/0	0	80	occ	Rarely	Low	Livestock	High	None
	Nkhata Bay	16/0	0	80	occ	Rarely	Medium	Human & Liv	High	None
	Rumphi	11/0	0	70	occ	Rarely	Low	Livestock	High	None
Central	Dedza	15/0	0	70	no	Absent	Absent	Absent	High	None
	Dowa	10/0	0	70	no	Absent	Absent	Absent	High	None
	Kasungu	8/0	0	80	no	Absent	Absent	Absent	High	None
	Lilongwe	10/0	0	70	no	Absent	Absent	Absent	High	None
	Mchinji	8/0	0	70	no	Absent	Absent	Absent	High	None
	Nkhota Kota	8/0	0	70	no	Absent	Absent	Absent	High	None
	Ntcheu	8/0	0	70	no	Absent	Absent	Absent	High	None
	Ntchisi	11/0	0	80	no	Absent	Absent	Absent	High	None
	Salima	13/0	0	80	no	Absent	Absent	Absent	High	None
Southern	Balaka	6/0	0	80	no	Absent	Absent	Absent	Medium	Minor
	Blantyre	11/0	0	70	no	Absent	Absent	Absent	High	None
	Chikwawa	15/0	0	70	no	Absent	Absent	Absent	High	None
	Chiradzulu	10/0	0	70	no	Absent	Absent	Absent	High	None
	Machinga	6/0	0	80	occ	Rarely	Low	Livestock	Medium	Minor
	Mangochi	19/0	0	80	reg	Yearly	Low	Livestock	High	None
	Mulanje	12/0	0	70	no	Absent	Absent	Absent	High	None
	Mwanza	6/0	0	80	no	Absent	Absent	Absent	Medium	Minor
	Neno	6/0	0	80	no	Absent	Absent	Absent	Medium	Minor
	Nsanje	14/0	0	80	occ	Rarely	None	None	High	None
	Phalombe	9/0	0	70	no	Absent	Absent	Absent	High	None
	Thyolo	10/0	0	70	no	Absent	Absent	Absent	High	None
	Zomba	10/0	0	70	no	Absent	Absent	Absent	High	None

APPENDIX IV: Survey's synthetic database – Protected Area level

Area name	Type	Answers Absence Presence	Presence			Frequency	Conflict	Conflict type	Level of knowledge	Gaps in knowledge
			Result	Decade of extinction	Visitor					
Nyika	National Park	17/6	0	never	no	Absent	Absent	Absent	High	None
Kasungu	National Park	3/30	1	na	na	Yearly	None	None	High	None
Lengwe	National Park	17/0	0	70	no	Absent	Absent	Absent	High	None
Liwonde	National Park	5/28	1	na	season	Yearly	Low	Livestock	High	None
Lake Malawi	National Park	10/0	0	70	no	Absent	Absent	Absent	High	None
Nkhotakota	Wildlife Reserve	1/35	1	na	na	Monthly	Low	Livestock	High	None
Majete	Wildlife Reserve	18/0	0	70	no	Absent	Absent	Absent	High	None
Mwabvi	Wildlife Reserve	12/1	0	70	occ	Rarely	None	None	High	None
Vwaza Marsh	Wildlife Reserve	1/24	1	na	na	Rarely	None	None	High	None
Phirilongwe	Forest Reserve	8/0	0	90	no	Absent	Absent	Absent	High	None
Mangochi	Forest Reserve	3/17	1	na	season	Yearly	None	None	High	None
Thambani	Forest Reserve	2/0	0	90	no	Absent	Absent	Absent	Poor	Minor
Zomba-Malosa	Forest Reserve	10/0	0	70	no	Absent	Absent	Absent	High	None
Mulanje Mountain	Forest Reserve	7/0	0	70	no	Absent	Absent	Absent	Medium	Minor
Matandwe	Forest Reserve	6/0	0	80	no	Absent	Absent	Absent	Medium	Minor
Chimaliro	Forest Reserve	4/0	0	70	no	Absent	Absent	Absent	Medium	Minor
Dzalanvama	Forest Reserve	19/1	0	80	no	Absent	Absent	Absent	High	None
Mua-Livulezi	Forest Reserve	4/0	0	90	no	Absent	Absent	Absent	Medium	Minor
Mvai	Forest Reserve	3/0	0	80	no	Absent	Absent	Absent	Poor	Minor
Mafinga Hills	Forest Reserve	3/1	0	?	reg	Rarely	None	None	Poor	Mild
Musisi	Forest Reserve	2/0	0	70	no	Absent	Absent	Absent	Poor	Minor
Mtangatanga	Forest Reserve	4/0	0	80	no	Absent	Absent	Absent	Medium	Minor
Perekezi	Forest Reserve	4/0	0	80	no	Absent	Absent	Absent	Medium	Minor
Kaning'ina	Forest Reserve	3/0	0	?	no	Absent	Absent	Absent	Poor	Minor
Ruvuo	Forest Reserve	3/0	0	?	no	Absent	Absent	Absent	Poor	Minor
South Viphya	Forest Reserve	10/1	0	80	occ	Rarely	Low	Livestock	High	None
Dwambazi	Forest Reserve	6/0	0	90	occ	Rarely	Low	Livestock	Medium	Minor
Namizimu	Forest Reserve	2/16	1	na	season	Yearly	Low	Livestock	High	None
Bangwe	Forest Reserve	2/0	0	50	no	Absent	Absent	Absent	Poor	Minor
Chongoni	Forest Reserve	6/0	0	70	no	Absent	Absent	Absent	Medium	Minor
Dedza-Salima Esc.	Forest Reserve	8/0	0	80	no	Absent	Absent	Absent	High	None
Dzonze	Forest Reserve	3/0	0	80	no	Absent	Absent	Absent	Poor	Minor
Liwonde	Forest Reserve	7/0	0	70	occ	Rarely	None	None	Medium	Minor
Mchinji	Forest Reserve	2/0	0	70	no	Absent	Absent	Absent	Poor	Minor
Michese	Forest Reserve	7/0	0	70	no	Absent	Absent	Absent	Medium	Minor
Ntchise	Forest Reserve	4/0	0	80	no	Absent	Absent	Absent	Medium	Minor
Thuma	Forest Reserve	11/2	0	80	no	Absent	Absent	Absent	High	None

APPENDIX V: Some legal aspects of people's defence against wildlife damage

An Act to consolidate the law relating to national parks and wildlife management; to establish the Wildlife Research and Management Board; and to provide for matters incidental to or connected therewith – 15th May, 1992

Part IX- Hunting Dangerous Animals, Killing in Error, Wounding and Molesting Animals

73. The purposes of this Part are-

- (a) to authorize the killing without licence of protected animals under circumstances where human life or property is threatened by the animals which circumstances are defined in sections 79 and 80;
- (b) to make provision with respect to the killing or wounding of protected animals through error or accident;
- (c) to provide for subsequent action to the wounding of a dangerous animal; and
- (d) to prohibit molesting or illtreating wild animals.

74. Any person may kill or attempt to kill any protected animal in defence of himself or of another person or any property, crop or domestic animal if immediately and absolutely necessary: Provided that nothing in this section shall absolve from liability of an offence under this Act, any person who at the time of attempted killing was committing any offence under this Act.

75. Any person may attempt to kill or kill any game animal which is causing material damage to any land, crop, domestic animal, building, equipment or other property of which the person is either the owner or the servant of the owner acting on his behalf in safeguarding the property.

76.-(1) Except as otherwise provided by this Act, or by the conditions of any licence issued under Part VI, the killing of any protected animal under section 74 or 75 shall not be deemed to transfer ownership of the carcass thereof to any person.

(2) Any person who kills a protected animal under section 74 or section 75 shall, as soon as practicable, report the facts to any officer and shall, unless otherwise entitled to retain the same under the conditions of any licence issued under Part VII, hand over the carcass or such parts thereof as the officer may direct.

(3) Any person who contravenes this section shall be guilty of an offence.

77.-(1) Subject to this Act, any person having reason to believe that any protected animal is causing or is about to cause material damage to any land, crop, domestic animal, building, equipment or other property may report the facts to an office.

(2) an officer who receives a report pursuant to subsection (1) shall, as soon as practicable, assess the extent of the threat posed by the said animal and take any necessary action he considers fit in the circumstances.

(3) In deciding what action should be taken to minimize damage to property caused by a protected animal, an officer shall carefully consider the status of the species and if he decides to kill or attempts to kill the animal, he shall do so only as a last resort and if only he has reasonable ground for believing that this course of action will not endanger survival of the species.