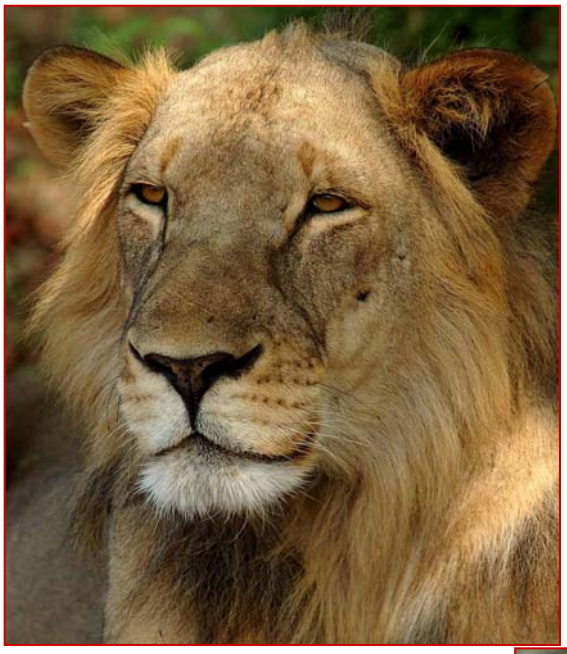
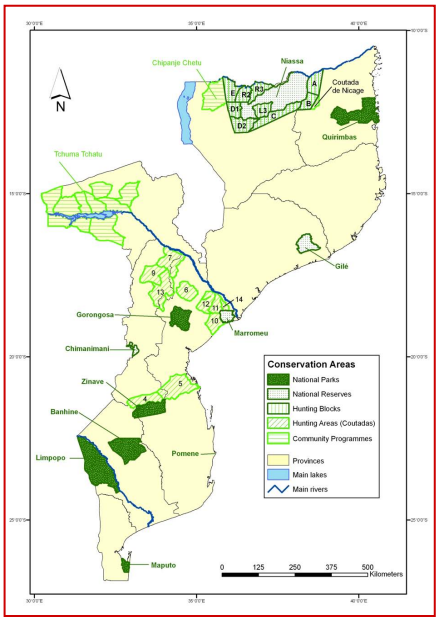
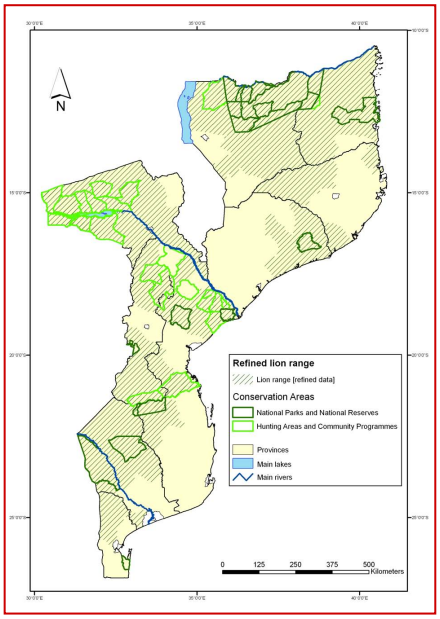
CONSERVATION STATUS OF THE LION (*Panthera leo* Linnaeus, 1758) IN MOZAMBIQUE







June 2009

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

The IUCN-SSC organised two regional workshops, one for West and Central Africa (2005) and one for Eastern and Southern Africa (2006), with the intention to gather major stakeholders and to produce regional conservation strategies for the lion. Mozambican authorities, together with local stakeholders, took part in the regional exercise for establishing the Regional Conservation Strategy for the Lion in Eastern and Southern Africa. They recognised the importance of establishing a National Action Plan for the Lion in Mozambique and realized the lack of comprehensive information for reviewing the lion profile in the country.

A survey has been launched to update the conservation status of the lion in Mozambique. The final report of this survey is expected to become a comprehensive material for submission as a contribution to a forthcoming National Action Plan workshop.

The current report is the final product of the whole survey made of three phases. The methods used are explained and results are provided. A database has been set up to collect and analyse the information available as well as the information generated by specific inquiries. Nine thematic maps have been drawn. The lion range in Mozambique is still quite extensive with a surface ranging between 515 000 and 610 000 km², *i.e*. 66 to 78% of the terrestrial surface of the country. An assessment of the lion population size has been attempted with a tentative number of 2 700 individuals in Mozambique at this stage. The lion appears unevenly distributed: although more lion range (71%) lies in non-gazetted areas outside Protected Areas (named Conservation Areas in this country), a majority of the lion observations come from Protected Areas including National Parks, National Reserves, Hunting Blocks, *Coutadas* (Game Reserves), Community Programmes and *Fazendas do bravio* (Game Ranches). In line with the regional Lion Conservation Units (LCU), 3 national LCUs are suggested for Mozambique. Human/lion conflicts are of great concern in this country, especially in northern (Niassa and Cabo Delgado Provinces) and western (Tete Province) Mozambique.

Cover picture: Lions in Niassa National Reserve *(©Colleen Begg)*

RESUMO:

A IUCN-SSC (Comissão de Sobrevivência das Espécies da UICN) organizou dois workshops regionais, um para África Ocidental e Central (2005) e um para África Oriental e Austral (2006), com o objectivo de reunir os maiores actores e produzir estratégias regionais de conservação do Leão. As autoridades moçambicanas em estreita colaboração com os actores locais, participaram no exercício regional para estabelecer a Estratégia Regional de Conservação do Leão em África Oriental e Austral. Concordaram na importância de definir um Plano Nacional para o Leão em Moçambique assim como tomaram consciência da ausência de dados exaustivos para avaliar o estatuto do leão no país.
Um inventário foi iniciado para actualizar o estatuto de conservação do leão em Moçambique. É esperado que o relatório final deste inventário tornar-se-á um documento exaustivo a ser submetido como uma contribuição no futuro workshop sobre o Plano Nacional de Acção.
O presente relatório é o produto final do conjunto deste inventário constituído por três fases. Os métodos utilizados são explicados e os resultados propiciados. Uma base de dados foi estabelecida para recolher e analisar a informação disponível assim como a informação proporcionada por inquéritos específicos. Nove mapas temáticos foram desenhados. A área de distribuição do leão em Moçambique é bastante extensa com uma superfície cobrindo entre 515 000 e 610 000 km², seja 66 a 78% da superfície terrestre do país. Uma avaliação do número da população de leão foi feita, propiciando um número provisório de 2 700 indivíduos em Moçambique nesta altura. O leão aparenta ser irregularmente distribuído: embora a maioria da área de distribuição do leão (71%) estender-se fora das Áreas Protegidas (chamadas Áreas de Conservação neste país), a maioria das observações de leão são feitas dentro das Áreas Protegidas incluindo: Parques nacionais, Reservas Nacionais, Blocos de caça, Coutadas, Programas Comunitários e Fazendas do bravio. Conforme as Unidades regionais de Conservação do Leão (*Lion Conservation Units*, LCU), 3 LCUs nacionais são propostas para Moçambique. Os conflitos Homem/Leão constituem um problema muito importante em Moçambique com destaque para: o norte (Províncias de Niassa e Cabo Delgado) e o oeste (Província de Tete).

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ACRONYMS

ALWG	African Lion Working Group
CBNRM	Community based natural resources management
CSG	Cat Specialist Group (IUCN-SSC)
DNAC	*Direcção Nacional de Áreas de Conservação* (National Directorate of Conservation Areas, MITUR)
DNTF	*Direcção Nacional de Terras e Florestas* (National Directorate of Land and Forests, MINAG)
DPA	*Direcção Provincial da Agricultura* (Provincial Bureau of Agriculture)
DPT	*Direcção Provincial do Turismo* (Provincial Bureau of Tourism)
IGF	Fondation Internationale pour la Gestion de la Faune (International Foundation for Wildlife Management)
IUCN SSC	International Union for the Conservation of Nature, Species Survival Commission
LCU	Lion Conservation Unit
MINAG	*Ministério da Agricultura* (Ministry of Agriculture)
MITUR	*Ministério do Turismo* (Ministry of Tourism)
PAC	Problem Animal Control
SGDRN	*Sociedade para a Gestão e Desenvolvimento da Reserva do Niassa* (Society for the Management and Development of Niassa Reserve)
SPFFB	*Serviços Provinciais de Florestas e Fauna Bravia* (Provincial Services for Forestry and Wildlife; within DPA)

I. INTRODUCTION

1. BACKGROUND

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

Mozambican authorities, together with local stakeholders, took part in the regional exercise for establishing the regional strategy and recognised the importance of establishing a national action plan. Mozambican authorities expressed the will to embark on a lion action plan exercise in Mozambique. They envisaged conducting this exercise by holding a national workshop using the most recent participative approaches in planning conservation (IUCN/Species Survival Commission, 2008). By doing so, they realized the lack of comprehensive information for reviewing the lion profile in Mozambique. This study is attempting to provide the forthcoming national workshop with comprehensive material on the lion status within the country.

2. PLANNING

The final purpose of the present study is to assess the conservation status of the lion in Mozambique. The study comprised three phases:

- **Phase 1: Preliminary survey**

Phase 1 gathered data available on the lion conservation status in Mozambique (data acquisition between May and July 2008; data analysis and report writing between August and September 2008). This phase has produced a general picture of the former knowledge on the lion conservation status in the country (*Chardonnet et al.,* 2008b). By doing so, the preliminary phase identified the gaps in knowledge and paved the way to carry out the next two phases.

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

Phase 2 investigated the gaps in knowledge formerly identified by Phase 1. New data acquisition has been carried out through complementary field inquiries between November 2008 and January 2009.

- **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 Mozambique (between January and February 2009).

Expectedly, this final document will be presented as a contribution to the national workshop for establishing the National Action Plan for lion conservation in Mozambique. It is worth stressing that the production of the final status review (also named either status report or species profile) will be an output of the national workshop.

3. FOLLOW UP

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

According to the IUCN/SSC/Species Conservation Planning Task Force (IUCN/Species Survival Commission, 2008), the classic academic structure of a species status review comprises the following chapters:

1. Species description
2. Species functions and values
3. Historical account
4. Current distribution and demographics
5. Habitat and resource assessment
6. Threats
7. Conservation and management

Since this report is the product of a limited team of experts, it will be presented to the forthcoming national workshop participants as a contribution to their participative debate during the first session of the workshop (Status review). During this session, the participants will get the opportunity to validate, amend, update, refine and revise the report.

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

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

II. METHODOLOGY

1. DATA ACQUISITION

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

- **Existing information**

Existing information come from:

- Scientific and technical literature, either published or unpublished;
- Existing databases run by Mozambican authorities, mainly the DNAC [*Direcção Nacional de Áreas de Conservação,* National Directorate for Conservation Areas: MITUR (*Ministério do Turismo*, Ministry of Tourism)] and the DNTF [(*Direcção Nacional de Terras e Florestas,* National Directorate of Land and Forests: MINAG (*Ministério da Agricultura*, Ministry of Agriculture)].

- **Information generated**

Information generated by this survey come from:

- Personal communications of resource persons;
- Inquiries conducted among Mozambican authorities and safari operators.

The information was collected during two missions carried out specifically for this survey:

- Phase I (Preliminary survey), between 28 May and 07 June 2008. The contact network established long before this period helped completing the data acquisition until the end of July 2008;
- Phase II (Filling the gaps' survey), between 1 November and 15 December 2008. The contact network helped completing the data acquisition until the end of January 2009. This survey has focused on the Provinces of Cabo Delgado, Niassa, Sofala, and Tete.

1.1. Existing information

- **Literature**

Peer-reviewed literature and technical reports provide information about lion issues in Mozambique. To make it more convenient, information has been organized according to the geographical scale of their respective scopes: continental, regional, national and local (Conservation Area and others). In all cases, only information related to Mozambique has been used. By convention, all the information dated more than 5 years ago (before 2003) has been considered as historical accounts, not as contributions to the current status of the lion.

Table I: Sources of information used in the survey

Source of information		Information	Type of information	Period
Existing information	MITUR	Map of Conservation Areas (Except for Community Programmes)	GIS tool	
		Aerial surveys in National Parks or Reserves	Technical report	2004-2007
		Surveys of Carnivores in Niassa Reserve (SGDRN)	Technical report	2004-2008
		Human/lion conflicts reported in Conservation Areas	Existing database	2007-2008
		Lion hunting (quotas and offtakes)	Existing database	2007-2008
	MINAG	Map of Provinces and Districts	GIS tool	
		National forest inventory	Existing database	2008
		Conflict reported in non-gazetted areas	Existing database	2006-2008
	Various	Historical data, scientific papers	Literature	
Information generated	Study team: IGF Foundation, MITUR, MINAG	Provincial Directions of Tourism	Inquiry	2008
		Provincial Directions of Agriculture	Inquiry & personal communications	2008
		Safari operators	Inquiry & personal communications	2008
		Park / Reserve administrators; NGOs; Others	Inquiry & personal communications	2008

- **Continental scale**

Information on lion in Mozambique may be found in two recent surveys conducted at continental scale (Chardonnet, 2002; Bauer & Van Der Merwe, 2004). The two surveys were based on published papers, unpublished reports and personal communications of informed persons (wildlife managers, experts, etc.). Bauer & Van Der Merwe (2004) compiled estimates of 100 known African lion populations, mostly located within Protected Areas (Map A, Appendix I). Lion populations of unknown or unestimated size were not included. Chardonnet (2002) compiled estimates for 144 lion populations grouped into 36 isolated subpopulations (Map B, Appendix I). Both gazetted and non-gazetted areas were considered.

Based on habitat suitability models, a putative lion range across Africa has been proposed by the African Mammal Databank (1999; http://www.gisbau.uniroma1.it/amd/homespec.html; Map C, Appendix I).

Information about Human/lion conflicts throughout Africa were recently reviewed by FAO, based on published papers, unpublished reports and personal communications of resource persons (Chardonnet *et al.*, 2008a).

- **Regional scale**

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

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

- **National scale**

According to the National Archives of Mozambique, historical information on lion in Mozambique exist as far back as the XVIIth century. During the second half of the XIXth century, numerous information were provided on lions in Mozambique thanks to explorers and hunters such as David Livingstone in 1857, Edouard Foa in 1895, Frederick Vaughan Kirby in 1896, and later R. Maugham in 1910.

However, only papers published from mid XXth century were used here to assess the historical distribution of lion across Mozambique. Galvão (1943) collated his observations of wildlife including lions (Map E, Appendix I). In their "Check list and atlas of the mammals of Mozambique", Smithers & Lobão Tello (1976) wrote a brief chapter on lion in Mozambique with a lion range map (Map F, Appendix I).

More recently, within the framework of a national forest inventory carried out by the MINAG, a predictive model based on habitat suitability was used to draw a putative lion

range in Mozambique (Ghiurghi & Urbano, 2007; Map G, Appendix I): the presence of lion was assessed from direct and indirect observations made during the forest inventory survey and from interviews of informed persons (Ghiurghi & Urbano, 2007; Map H, Appendix I). Additively a country-wide large mammals' survey has been recently carried out by the MINAG (MINAG, 2008). Information on species distribution, abundance and human/wildlife conflicts were collected through aerial surveys, structured interviews with local people and collection of existing literature and Mozambican authority databases. Regarding the lion specifically, no original data has been generated by this survey.

Human/wildlife conflicts, including conflicts involving lions, were recently surveyed in Mozambique (Magane, 2004; FAO, 2005). Data were collected from interviews of senior officials of *Direcção Provincial do Turismo* (Provincial Bureau of Tourism; DPT) and *Direcção Provincial da Agricultura* (Provincial Bureau of Agriculture; DPA), Districts administrators, as well as local communities where human/wildlife conflicts had been reported.

- **Local scale**

  - **Conservation Areas**

A few historical surveys have been conducted in some Conservation Areas, notably in Gorongosa National Park (De Alcantara, 1956), Gilé National Reserve (Dutton *et al.*, 1973), Chimanimani National Reserve (Dutton & Dutton, 1973) and in several spots across the country (Tinley *et al.*, 1976).

Most of the information on wildlife in Conservation Areas come from aerial surveys: Banhine National Park (Stalmans, 2004 and 2007a), Gorongosa National Park (Dunham, 2004), Limpopo National Park (Whyte & Swanepoel, 2006), Maputo Special Reserve (Matthews & Nemane, 2006) and Zinave National Park (Stalmans, 2007b). Since aerial surveys are not appropriate to observe lions, only a few records of lion presence come from these sources.

Since 2004, a long-term carnivore monitoring programme is ongoing in Niassa National Reserve (Begg & Begg, 2005, 2006, 2007, 2009; Begg *et al.*, 2007). Another long-term programme has recently been set up to monitor African wild dog in Quirimbas National Park (André, 2006).

  - **Others**

A wildlife survey has been carried out in the northern part of Machaze District, Manica Province (Ghiurghi & Pariela, 2007). Information provided in this report come from an aerial survey and a ground survey including structured interviews, spot light sessions by car at night and a few additional transects by foot.
A recent survey has been carried out in Messalo Wilderness Area, Macomia District, Cabo Delgado Province to assess the species occurrence and distribution using routine line transects (Ntumi *et al*., 2008).
Historical accounts of lion records were provided in a survey of the history of Mozambican populations in Cabo Degaldo Province (Liesegang, 2003). Recent accounts of human/lion conflicts in Muidumbe District were found in a report focusing on lion-killings and witchcraft (Israel, *in prep*.).

- **Existing database**

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

For information, the direct technical management of Mozambican wildlife falls under the responsibility of two ministries, according to their respective areas of competence:

  - MITUR: the DNAC is in charge of National Parks, National Wildlife Reserves, Community programmes and Hunting Areas, the latter comprising Hunting Blocks and *Coutadas* (Game Reserves);
  - MINAG: the DNTF is responsible for National Forest Reserves, *Fazendas do bravio* (Game Ranches), Multiple Use Areas or non-gazetted areas.

Nota: Conservation Areas in Mozambique ("*Áreas de Conservação*") comprise: National Parks, National Reserves, Game Reserves ("*Coutadas"*) and Hunting Blocks, the latter being located within the Niassa National Reserve. Other Protected Areas [understood as areas gazetted for conservation (IUCN, 1994)] comprise Game Ranches ("*Fazendas do bravio")* and Community Programmes (apart from the Tchuma Tchatu and Chipenje Chetu Community Programmes, classified as Conservation Areas).

- **Human/lion conflict**

Both DNAC and DNTF keep records of human/wildlife conflicts in their respective areas of responsibility. The DNTF's database started in 1997 at Provincial scale and has been set at District scale since 2006. The DNAC database started directly at District scale in 2007.

- **Lion hunting quota/offtake**

All hunting quotas, including for lions, are published every year and are set for each area where hunting is permitted. Information on lion quota and lion offtake in 2007 and 2008 come from DNAC, DNTF, DPT Tete and safari operators.

- **Digital maps**

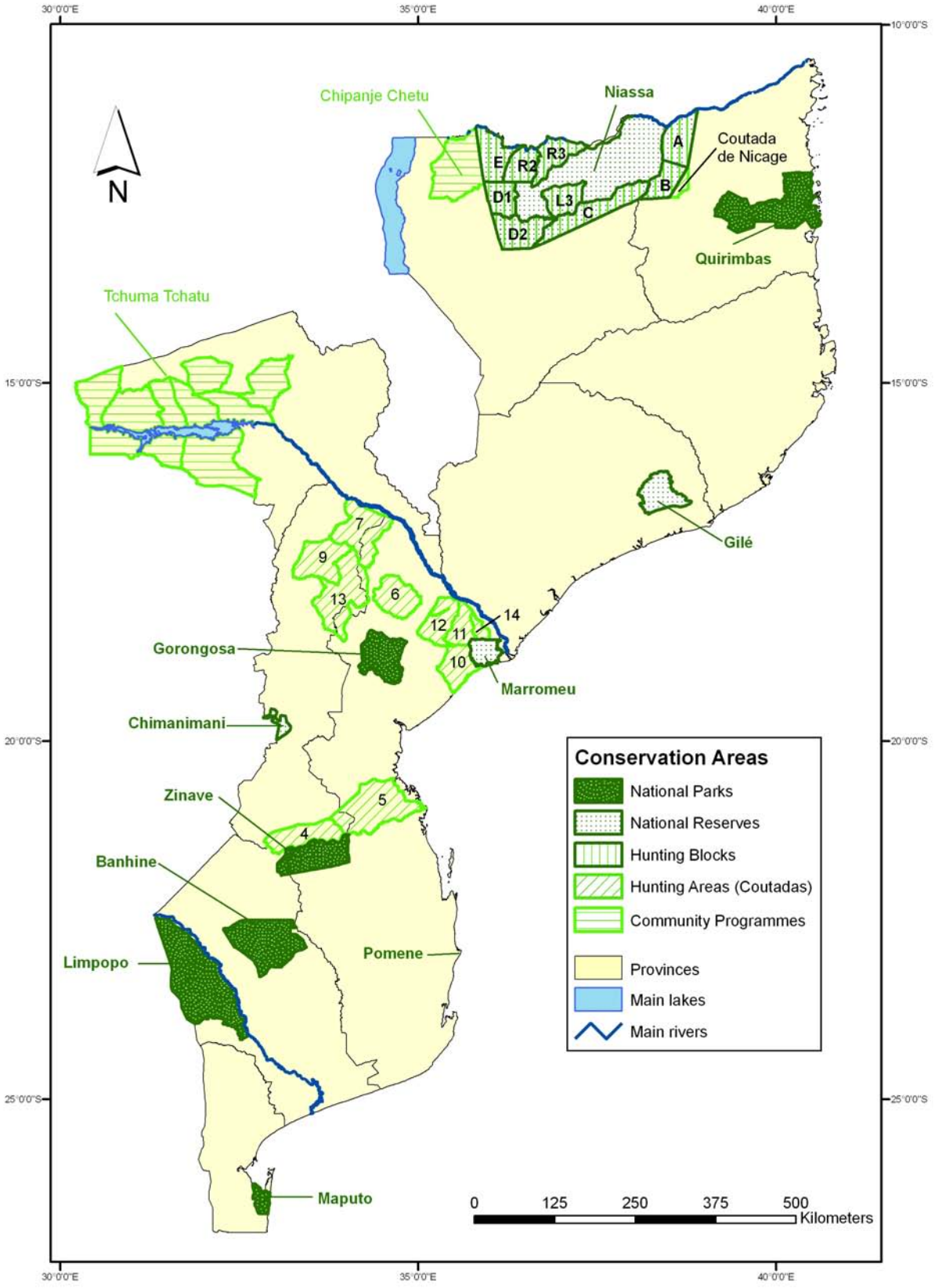
DNAC has provided the digital outlines of all Conservation Areas except for Community Programme Areas (Map 1). Because the digital outlines of the Tchuma Tchatu Community Programme were not available, we had to produce our own set of shapes (using ArcGis 9.2) from a printed map provided by the DPT of Tete Province.

DNTF has provided the digital outlines of Provinces and Districts (Map 2).

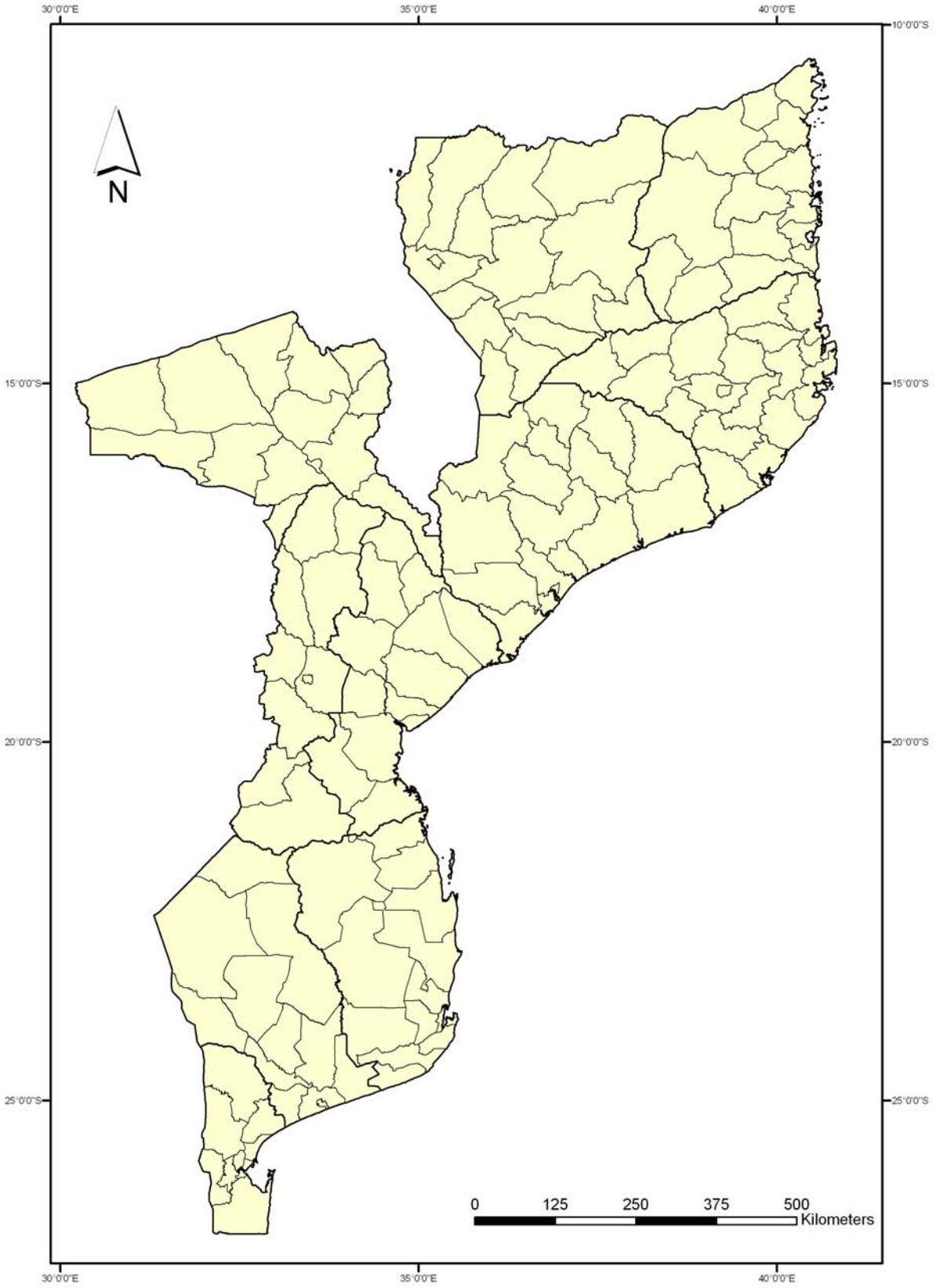
1.2. Information generated

- **Personal communications**

Direct interviews were conducted with 34 resource persons (17 during the preliminary mission and another 17 during the second field mission). 3 more persons sent detailed information in electronic format.



Map 1: Network of Conservation Areas considered in this survey (from DNAC and DPT of Tete)



Map 2: Administrative network of Districts (from DNTF)

- **Inquiries**

In preparation of the preliminary survey, questionnaire forms (Appendix II) were set up with the DNAC and targeted towards: (i) DPTs (MITUR), (ii) DPAs (MINAG) and (iii) safari operators.

Informants were asked to provide information about:

- Lion presence over the past 5 years;
- Frequency of lion's observations;
- Lion population size estimates when appropriate;
- Periodicity and type (livestock losses or human casualties) of human/lion conflicts;
- Hunting quota and offtake when appropriate.

During the second field survey, all informants (DPTs, DPAs, safari operators, Conservation Areas' managers and local authorities) were met and the inquiries were filled by the IGF field officer. He took advantage of two meetings for submitting the questionnaire to a wide range of informants, namely, the CPLP Workshop on Conservation Areas – Maputo (3-7 November 2008) and the safari operators annual meeting – Lichinga, Niassa Province (3 December 2008). A more complete questionnaire form (Appendix II) had been prepared, with additive information about:

- Lion population trends over the last 5 to 10 years;
- Threats to lion survival;
- Most conflicting animals with human population.

- **DPT inquiry**

During the preliminary survey, questionnaire forms were officially sent by the DNAC to DPT directors with instructions to fill the form. Information was collected within the respective Provinces (N=2). One informant provided information at the level of Conservation Area (Gorongosa National Park).

During the second survey, 26 questionnaire forms filled at District level after the preliminary survey were retrieved at DNAC (Cabo Delgado Province) and DPT of Niassa (Niassa Province). Additionally, 11 DPT officers were interviewed as well as 7 Conservation Areas managers and officers.

- **DPA inquiry**

During the preliminary survey, questionnaire forms (Appendix II) were filled directly with the DPAs Directors during their annual meeting held in Namaacha, Maputo Province, on June 04th 2008 (N=10). Information was collected at District level. A map of Districts was added to the questionnaire form to help informants to report the presence and relative abundance of lions in the Districts within their respective Provinces.

During the second survey, three additional interviews were carried out with heads of the Provincial Services for Forestry and Wildlife (SPFFB), respectively in Tete, Sofala and Niassa Provinces.

- **Safari operator inquiry**

During the preliminary survey, questionnaire forms (Appendix II) have been sent by DNAC to safari operators. Additionally, instructions to fill the form were presented during the safari operator annual meeting held in Tete on May 21st 2008. Information has been collected at the level of each Hunting Area (N=4).

During the second survey, 2 questionnaire forms filled after the preliminary survey were retrieved at DNAC (for *Coutadas* 9 and 13), and 19 safari operators were interviewed.

- **Local authorities inquiries**

During the second survey, 12 interviews were carried out with local authorities (at the level of Districts or Communities).

2. DATA ANALYSIS

2.1. Database

Every single information collected (technical or scientific reports, inquiries, personal communications) was entered into a simple database. The database is made of two tables that have been used to draw synthetic thematic maps (see below):

- **Table at the level of the Districts**

Table A [131 lines & 94 columns (10.01.09)] gathers information from all the Districts about lion presence, frequency of lion observations, frequency and type of conflicts and level of knowledge.

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

Table B [44 lines & 64 columns (10.01.09)] gathers information on lion at the level of the Conservation Areas.

This table has been used to assess the lion range in Conservation Areas and, combined with the first table, to assess the lion range outside Conservation Areas, *i.e*. in non-gazetted areas. Using a GIS platform (ArcGis 9.2), Conservation Area surfaces were excluded from the District surfaces in order to estimate the lion range in non-gazetted areas. Surfaces of islands, main urban areas as well as Cabora Bassa and Niassa lakes were excluded from the surface evaluation.

Because the level of knowledge has been dramatically improved between phase I and phase II of the study (with 26 inquiries concerning Conservation Areas), this table has been used concomitantly with table A to build thematic maps (§II.2.2).

The combined table is the basis for estimating the abundance of lions in Mozambique. The lion abundance has been estimated by two methods:

- Documented lion numbers were added to assess the minimal lion population abundance;
- For units (Conservation Areas or Districts) without specific information on relative abundance, the abundance has been extrapolated as follows:
  - The density estimate in the geographically closest unit documented has been used as a base of reference (n.b. because no data were available inside and outside Limpopo National Park, estimate from the neighbouring Kruger National Park, South Africa, has been used);
  - Correcting factors have been applied to the density estimate of the base of reference for each unit, with gradual values depending on (i) the type of unit for which abundance was extrapolated (inside Conservation Areas or outside CA's, *i.e.* Districts), and (ii) the estimated frequency of observation of lions in the given unit;
  - A conservative approach has been adopted.

2.2. Maps

The database has been used to produce thematic maps. Data gathered in each table have been used and superposed to draw thematic maps, with data concerning Conservation Areas 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**

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

The classification of the level of knowledge is based on two criteria: (i) the number of information collected for a given area & (ii) whether or not all the information collected for the given area are consistent or show discrepancies. Four levels of knowledge have been defined: questionable, poor, medium, high (Table II). Each area is classified accordingly.

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

Level of knowledge	Consistent information	Contradictory information
	Number of sources	Difference between number of source for lion presence and absence (minimal number of sources)
Questionable	1	0 or 1 (2)
Poor	2	2 (4)
Medium	≥ 3	≥ 3 (5)
High	≥ 3 with specific survey or ≥ 6	≥ 6 (8)

- **Lion range**

The estimate of lion range derived from a binary system of occurrence or absence records. The lion was considered present when at least one direct or indirect observation had been recorded during the past 5 years only. The lion was considered absent when no observation had been made during the past 5 years.

Two categories of lion range have been proposed based on the level of knowledge assessed:

- **Raw lion range:** Lion range based on raw data (100% of the database) during the last 5 years;
- **Refined lion range:** Lion range based on refined data during the last 5 years:
  - Any single information was excluded;
  - Where information were inconsistent or contradictory, the presence or absence of lion was decided based on the estimated quality of the information when the level of knowledge was 'Questionable'. The data have been validated when the level of knowledge was at least classified as 'Poor';
  - Independently of the level of knowledge, lion presence was attested in a given area as soon as a lion was removed as Problem Animal Control (PAC) (source: MINAG conflict database).

- **Frequency of lion observations**

The frequency of observations was recorded over the past 5 years and categorized into four classes defined as follows:

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

- **Level of Human/lion conflict**

The level of Human/lion conflict was estimated according to the frequency of conflicts reported since 2006 (3 years of data recording) and impact of conflict (number of human casualties and/or livestock losses). It was categorized into five classes defined as follows:

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

- **Gaps in knowledge**

Gaps in knowledge have been identified by matching two criteria:

- **Criterion 1:** level of knowledge

  A gap was considered where the knowledge was insufficient. The rationale is that only Districts (or Conservation Areas) with low level of knowledge were worth investigating. A score was given to each District (or Conservation Area) 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 observation was high. The rationale is that it was not productive to investigate Districts (or Conservation Areas) with low frequency of observation. A score was given to each District (or Conservation Area) in respect to this criterion: a high score was attributed where the frequency of observation was high (*i.e.* weekly), a low score where lions were rarely observed (*i.e.* yearly).

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

Table IIIa: Criteria used for identifying gaps in knowledge (per District or Conservation Area) and their scoring mechanism

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

Table IIIb: Global scoring and ranking of the gap in knowledge for each District or Conservation Area

For each area:	
Total score of the gap = criterion A + criterion B	**Ranking of the gap**
0	Minor
0.5	Mild
1	Mild
1.5	Major
2	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

Historical reports on lion presence in Mozambique are numerous, although, to our knowledge, little information is available on a precise historical distribution. In addition, the lion range was considered difficult to determine in Mozambique because of a long history of civil unrest (Novell & Jackson, 1996). However, most historical accounts tend to show a widespread distribution to the point that, anciently, very few locations in Mozambique did not have lions.

- **Before mid XXth century**

Very old sources of information on lion in Mozambique have not been considered here. However, it is interesting to notice that, during the late XIXth and the early XXth century, many explorers and hunters reported abundant lion stories all along the Zambezi valley from the Tete area to the rivermouth (Livingstone, 1857; Foa, 1895; Frederick Vaughan Kirby, 1896; Maugham, 1910).

- **1943**

In his hunting tourism map, Galvão (1943) pointed out the lion presence in the following areas: center of Gaza Province, north-western of Inhambane Province, south-western and west center of Manica Province, north-eastern of Tete Province, west center of Niassa Province and north-eastern of Cabo Delgado Province (Map E, Appendix I).

- **1947**

The presence of lion in Tete Province was mentioned by Matheson (1947).

- **1956**

The lion was included into the mammals check list of National Park of Gorongosa by De Alcantara (1956).

- **1959**

The presence of man-eater lions was reported in Tete Province (Moatize and Mutarara Districts), along the sea coast in Cabo Delgado Province, as well as in Mandimba District, Niassa Province (Taylor, 1959).

- **1976**

Smithers & Lobão Tello (1976) proposed a map for the lion range showing a very widespread distribution of the species throughout the country at that time (Map F, Appendix I). Very few locations were devoid of lion: the lion was present in the whole country except southern Inhambane Province, northern Sofala Province, western Zambezia Province and center of Niassa Province.

- **1990**

In their impressive encyclopaedia on the Mammals of the Southern African Subregion, Skinner & Smithers (1990) stated: "*Lion occurs widely north of the Zambezi River in Mozambique [...] In Mozambique South of the Zambezi River, they occur widely, except along the Zimbabwe border in the west, in the eastern Inhambane District and not south of about 24°S except as vagrants from Kruger National Park.*"

- **2002**

According to the criterion used in the current study (§II.2.2), the two recent continental surveys on lion status (Chardonnet, 2002; Bauer & Van Der Merwe, 2004) are recorded as historical accounts because they are older than the threshold of 5 year-old. In both cases the information dated 2002 even though the publication of Bauer & Van Der Merwe dated 2004. The Chardonnet's survey (2002) estimated a lion range in Mozambique (Maps A and B, Appendix I) and considered 4 subpopulations of lion in Mozambique (Map B, Appendix I):

  - **Subpopulation n° 25**: most of Niassa Province, western Cabo Delgado Province, Nampula and Zambezia Provinces;
  - **Subpopulation n° 30**: north-eastern Sofala Province;
  - **Subpopulation n° 27**: most of Tete Province and north-eastern Manica Province;
  - **Subpopulation n° 31**: southern Manica Province and the western Gaza Province.

Still from the same source (Chardonnet, 2002):

  - **Transfontier subpopulations**: 3 of the 4 subpopulations identified were regarded as transfrontier ones;
  - **Distinct subpopulations**: whether sub-population n° 27 was separated from sub-population n° 30 was considered as doubtful.

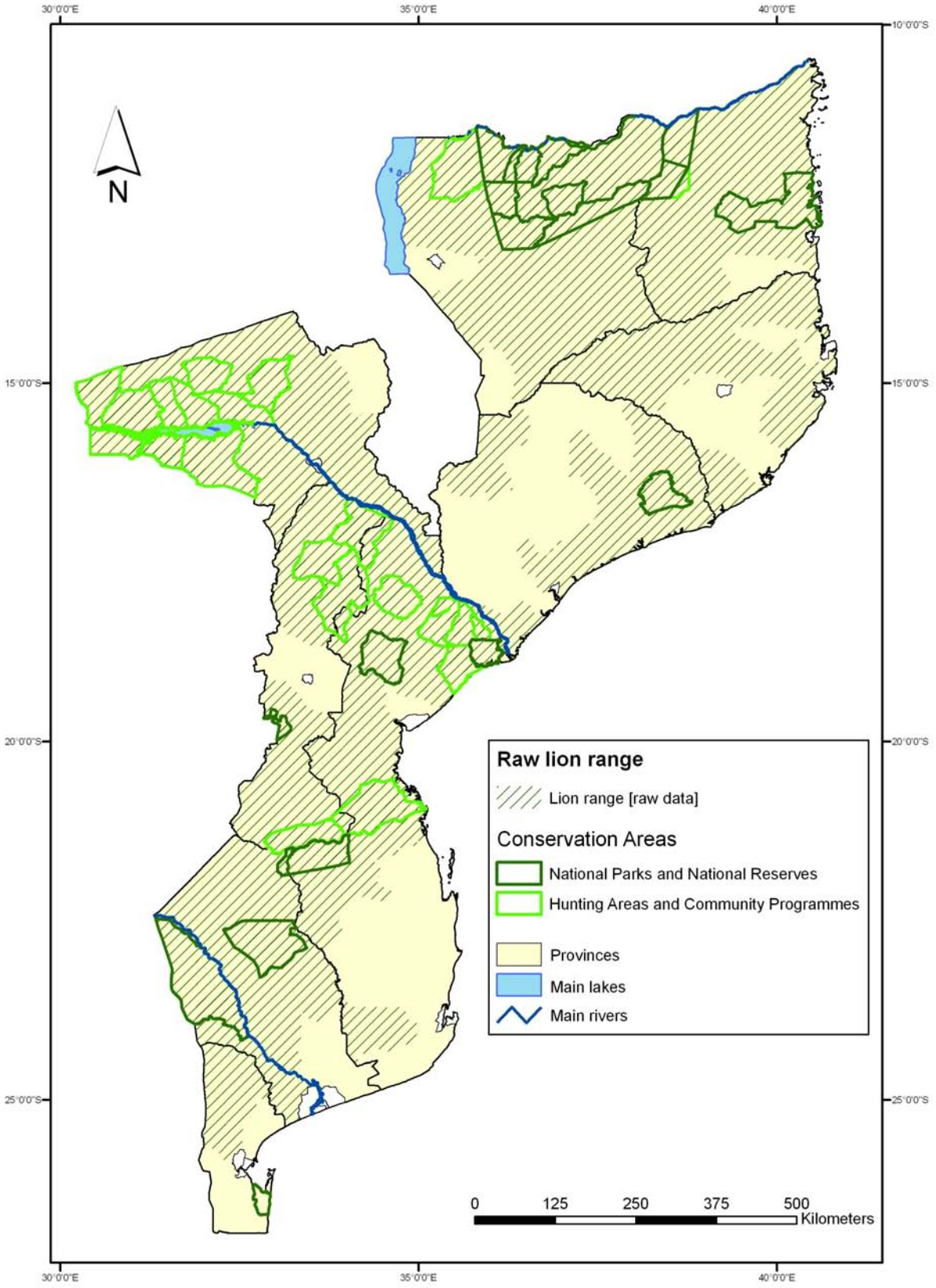
1.2. Current range

- **Range**

The current lion range (or distribution area) in Mozambique has been estimated by using the database of information collected on lion records during the past 5 years (after 2003).

Two estimations have been proposed, based on the robustness of the data:

  - **Range estimation based on raw information** (*i.e.* the entire database) (Map 3; Appendix III)



Map 3: Lion range in Mozambique (by December 2008) based on raw data (100% of the database) during the last 5 years

The lion range encompasses:

- A global surface of about 610 000 km², *i.e.* 78% of the total surface of Mozambique, excluding lakes and islands;
- 88 out of the 128 terrestrial Districts, *i.e.* 69% of all terrestrial Districts.

Since this map is based on the entire database, it includes some data which are not robust and tends to overestimate the lion range.

- **Range estimation based on refined information** (*i.e.* excluding questionable information) (Map 4; Appendix III)

The lion range encompasses:

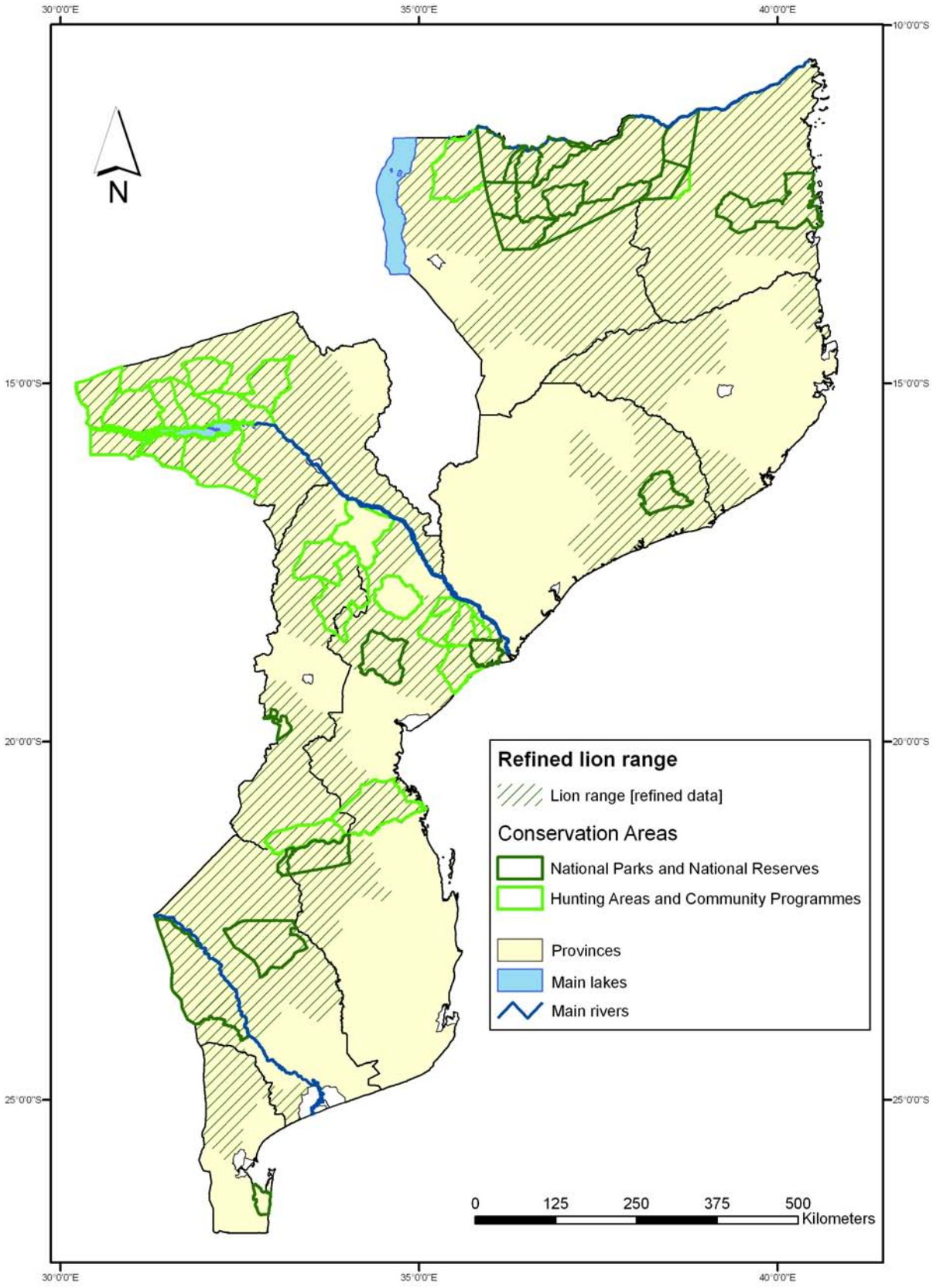
- A global surface of about 515 000 km², *i.e.* 66% of the total surface of Mozambique, excluding lakes and islands;
- 69 out of the 128 terrestrial Districts, *i.e.* 54% of all terrestrial Districts;
- A surface of 366 000 km² in non-gazetted areas (*i.e.* 71% of the lion range) and of 149 000 km² (*i.e.* 29% of the lion range) within Conservation Areas;
- 35 out of the 40 Conservation Areas listed; the absence of lion is attested in 2 Conservation Areas (Pomene National Reserve and Maputo Special Reserve) and suspected in 3 other Conservation Areas (Chimanimani National Reserve, *Coutada* 6 and *Coutada* 7).

- **Lion Conservation Units**

Regarding LCUs, the regional Eastern and Southern Africa Lion Workshop (Johannesburg, 8-13 January 2006) contributed to refine the subpopulations formerly proposed by Chardonnet (2002) by identifying 6 (six) LCUs in Mozambique (IUCN SSC Cat Specialist Group, 2006; Map D, Appendix I):

- **LCU 25**: Niassa National Reserve;
- **LCU 26**: surroundings of Niassa National Reserve;
- **LCU 42**: Gilé National Reserve and surroundings;
- **LCU 35**: South Western Tete Province;
- **LCU 43**: Gorongosa National Park, Marromeu National Reserve and surroundings;
- **LCU 49**: Limpopo National Park and surroundings.

In addition, the same source considered a potential range linking LCUs 42, 35 & 43 where lion might occur (IUCN SSC Cat Specialist Group, 2006; Map D, Appendix I).



Map 4: Lion range in Mozambique (by December 2008) based on refined data (excluding questionable information) during the last 5 years

From the proposed lion ranges (Map 3 and 4), 3 (three) LCUs are suggested for Mozambique (Map 5):

- **LCU 25/26/42**: most of Niassa Province including Niassa National Reserve, Quirimbas National Park, surrounding areas and most of Cabo Delgado Province as well as Gilé National Reserve and surroundings;

- **LCU 35/43**: most of Tete Province, Gorongosa National Park, Marromeu National Reserve, the surrounding network of *Coutada*s and surroundings;

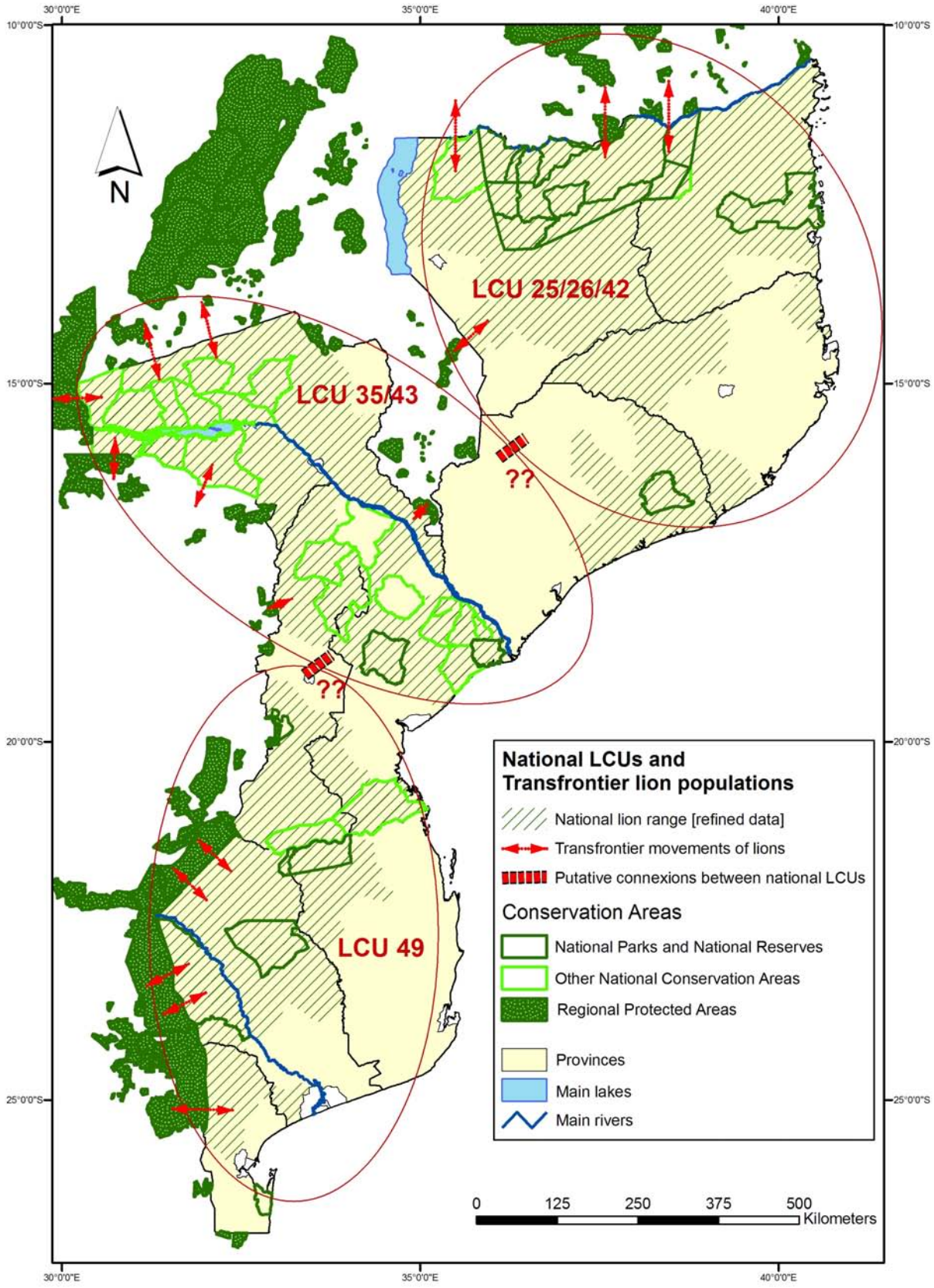
- **LCU 49**: Limpopo National Park, Banhine National Park, Zinave National Park and western Gaza Province.

- **LCU connexions**

Two categories of connexion were considered:

- **Connexions beyond borders:** All the national LCUs proposed appear being transfrontier LCUs (Map 5). Informants from Mozambique and bordering countries helped localizing main corridors used by transfrontier lion populations to cross Mozambican borders:
  - South Africa: with the gradual removal of the border fence, some lions move from Kruger National Park in South Africa to Limpopo National Park in Mozambique (Sam Fereira, *pers. com.*);
  - Zimbabwe: a group of lions is known to move between Gairezi Wildlife Management Area and Nyangui State Forest in Zimbabwe and Manica Province in Mozambique (Hillary Madzikanda, *pers. com*.); also lions move between Gonarezhou National Park in Zimbabwe and Gaza Province in Mozambique;
  - Zambia: lion movements occur all along the Zambia border with Tete Province in Mozambique (Matthew Becker, *pers. com*.; Wilroad Chansa, *pers. com*.; Paula White, *pers. com*.);
  - Malawi: lions move between Namizimu Forest Reserve and Mangochi Forest Reserve in Malawi and Niassa Province in Mozambique (Clement Mbota and Obedi Mkandawire, *pers. com*.);
  - Tanzania: in the region of the Selous-Niassa Wildlife Corridor lions are crossing the Ruvuma river, as elephants and wild dogs do (Colleen Begg, *pers. com.*); lion movements across the border also occur eastwards nearby Negomano bridge (Colleen Begg, *pers. com*.) and westwards (Mohamed Madehele, Silvanus Okudo and Erasmus Tarimo, *pers. com*.).

- **Connexions within Mozambique:** We considered that regional LCUs 25, 26 and 42 are connected, as well as regional LCUs 35 and 43 (Map 5). However, whether and to which extent the three recognised national LCUs (25/26/42, 35/43 and 49) are interconnected still has to be investigated.



Map 5: National LCUs and transfrontier lion populations, showing the suspected corridors used by lions to cross Mozambican borders

2. LION ABUNDANCE

2.1. Historical abundance

Historical reports on lion abundance in Mozambique are numerous, especially in the Zambezi valley, both upstream and downstream, mainly on the southern bank of the river (Livingstone, 1857; Foa, 1895; Kirby, 1896; Maugham, 1910; Matheson, 1947). All historical accounts mention that the lion was a widespread and abundant species throughout Mozambique. In 1896, Frederick Vaughan Kirby (quoted by Shortridge, 1934) even stated: "*In parts of Portuguese East Africa, Lions are probably more numerous than in any other part of South Africa*".

However, no precise figure of historical estimates of Mozambican lion abundance were found before 2002 when two surveys supplied the first assessments of lion population sizes in Mozambique:

- 400 lions [min: 240 - max: 560] (Bauer & Van Der Merwe, 2004);
- 955 lions [668 – 1 242] (Chardonnet, 2002).

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

2.2. Current abundance

- **Regional workshop 2006**

The last estimate of lion abundance in Mozambique originated from the Eastern and Southern Africa Lion Workshop (IUCN SSC Cat Specialist Group, 2006). According to this source, by adding all lion population sizes per LCU concerning Mozambique, the cumulative estimate for all LCUs related to Mozambique was 3 325 lions [3 100 – 3 550].

However, because three of these LCUs included transfrontier lion populations, this value cannot be accepted as a figure for Mozambique since it comprises contiguous lions on other sides of the Mozambican border.

- **This study 2008**
    - **Lion censuses**

In Mozambique, proper lion census attempts using conventional techniques have only been made in Niassa National Reserve (Begg & Begg, 2005, 2006, 2009; Begg *et al.*, 2007): the long term monitoring survey conducted since 2004 by the Niassa Carnivore Project gives a lion population estimate of 800-1 000 individuals within the Reserve.

In Gorongosa National Park, the individual identification of the lion prides by continued observation throughout recent years (Carlos Lopes Pereira, *pers. com.*) may be considered as a global inventory of the lion population in the Park. In the intensive management area (covering a surface of about 630 km²), where lions are monitored on a regular basis, the lion population size is estimated at 34 individuals. In the whole Park, the minimum lion population is estimated at 60 individuals.

Today, Gorongosa National Park and Niassa National Reserve are the only areas in Mozambique where accurate estimates of lion densities are available (Table IV).

Table IV: Available accurate estimates of lion densities in Conservation Areas

Conservation Area	Specific area	Density (/100km²)	Surface (km²)	Minimal population size	Reference
Niassa National Reserve	Within 10km of primary and secondary rivers	3	-	-	Begg & Begg, 2006
	Beyond 10km of primary and secondary rivers (inland)	1	-	-	
	Whole Reserve	2	42 000	800	
Gorongosa National Park	Intensive management area	5	628	34	Carlos Lopes Pereira, *pers. com.*
	Other areas	1	3 047	26	
	Whole Park	2	3 675	60	

This study has attempted to review the available figures of lion abundance estimates which have been documented (Table V). By adding all these figures, the total minimal estimate of lions in Mozambique comes to a little more than 1 200 individuals. If this figure can be considered as minimal, it cannot be accepted as a global population size since most of lion areas are not yet properly documented in terms of lion abundance.

Based on the data available, and by using the method described, we extrapolated the lion abundance where information was lacking and we consequently estimated the entire lion population size in Mozambique at about 2 700 individuals (Table V).

- **Frequency of lion observations**

Lions were observed (Appendix III):

- Once or twice a year in 40 Districts (*i.e*. 58%);
- Monthly in 18 Districts (*i.e*. 26%);
- Weekly in 11 Districts (*i.e*. 16%).

Districts where lions were most often observed (lion strongholds) were located (Map 6):

- In and around the Niassa National Reserve;
- In the northern part of Cabo Delgado Province;
- In the western part of Tete Province;
- In the Gorongosa National Park/Marromeu National Reserve complex;
- Within the Limpopo National Park.

In non-gazetted areas, lions were reported episodically apart in the north-eastern part of Cabo Delgado Province (Districts of Palma, Mocimboa da Praia, Muidumbe and Macomia), and in some Districts of Tete Province (Appendix III).

Table V: Lion range and population size estimates in Mozambique (December 2008) - continued

National LCU	Gazetted area	Non-gazetted area (District)	Surface (S; Km²)	Population size assessment (PA)	Calculated density CD (lions/100 Km²) = PAx100/S	Speculative density* SD (lions/100 Km²) = CDxA/100	Speculative population size PS = SDxS/100	Total population size TP = PA+PS	Source of population size estimate
LCU 25/26/42 Niassa/Gilé	Niassa National Reserve core area		16 737						
	Hunting block A		3 189						
	Hunting block B		2 217						
	Hunting block C		4 543						
	Hunting block D1		2 231						
	Hunting block D2		3 433						
	Hunting block E		3 166						
	Hunting block R2		2 321						
	Hunting block R3		2 715						
	Hunting block L3		2 362						
	Subtotal Niassa National Reserve		**42 914**	**900**	**2,10**				**Begg & Begg, 2006**
	Quirimbas National Park		7 649			1,38	106		this study
	Messalo Wilderness area		330	20	6,06				Julie Garnier, *pers. com.*
	Chipenje Chetu Community Programme		6 065	50	0,82				Howard Hunter, *pers. com.*
	Coutada de Nicage		544			2,10	11		this study
		Ancuabe	3 954			0,26	10		this study
		Balama	5 540			0,26	15		this study
		Lago	6 557			0,26	17		this study
		Lalaua	4 562			0,10	5		this study
		Macomia	2 712			0,52	14		this study
		Majune	8 453			0,26	22		this study
		Malema	6 082			0,10	6		this study
		Mandimba	4 688			0,26	12		this study
		Marrupa	13 178			0,52	69		this study
		Maua	8 079			0,35	28		this study
		Mecuburi	7 257			0,10	8		this study
		Mecufi	1 254			0,26	3		this study
		Meluco	2 845			0,35	10		this study
		Memba	4 517			0,10	5		this study
		Metarica	4 877			0,26	13		this study
		Mocimboa da Praia	3 524	20	0,57				Sergio Vaiga, *pers. com.*
		Montepuez	14 761			0,35	52		this study
		Mueda	8 622			0,52	45		this study
		Muembe	5 276			0,26	14		this study
		Muidunbe	2 123			0,52	11		this study
		Namuno	6 037			0,26	16		this study
		Nangade	3 005			0,52	16		this study
		Nipepe	5 031			0,26	13		this study
		Palma	3 576	20	0,56				Sergio Vaiga, *pers. com.*
		Pemba	1 239			0,26	3		this study
		Quissanga	103			0,35	0		this study
		Ribaue	6 292			0,10	7		this study
		Sanga	4 169			0,26	11		this study
	Subtotal Niassa		**205 814**	**1 010**			**543**	**1 553**	
	Gilé National Reserve		2 861			0,26	8		this study
		Gilé	8 342			0,10	9		this study
		Ile	5 662			0,10	6		this study
		Maganja Da Costa	7 674			0,10	8		this study
		Moma	5 814			0,10	6		this study
		Pebane	8 021			0,10	8		this study
	Subtotal Gilé		**38 375**				**45**	**45**	
	Subtotal Niassa / Gilé		**244 189**	**1 010**			**587**	**1 597**	
LCU 49 Greater Limpopo	Limpopo National Park		10 485			1,71	179		this study
	Banhine National Park		6 047			0,41	25		this study
	Zinave National Park		3 888			0,41	16		this study
	Hunting Area (*Coutada*) n°4		3 194			0,26	8		this study
	Hunting Area (*Coutada*) n°5		6 355			0,26	16		this study
		Bilene	2 180			0,10	2		this study
		Chibabava	6 252			0,10	6		this study
		Chicualacuala	9 889			0,21	20		this study
		Chigubo	11 863			0,10	12		this study
		Mabalane	7 043			0,21	14		this study
		Mabote	11 903			0,10	12		this study
		Machanga	760			0,10	1		this study
		Machaze	9 431			0,10	10		this study
		Magude	6 961			0,21	14		this study
		Massangena	7 074			0,21	15		this study
		Massingir	2 371			0,34	8		this study
		Moamba	4 577			0,10	5		this study
		Mossurize	5 019			0,10	5		this study
		Sussundenga	6 483			0,10	7		this study
	Subtotal Greater Limpopo		**121 775**				**376**	**376**	

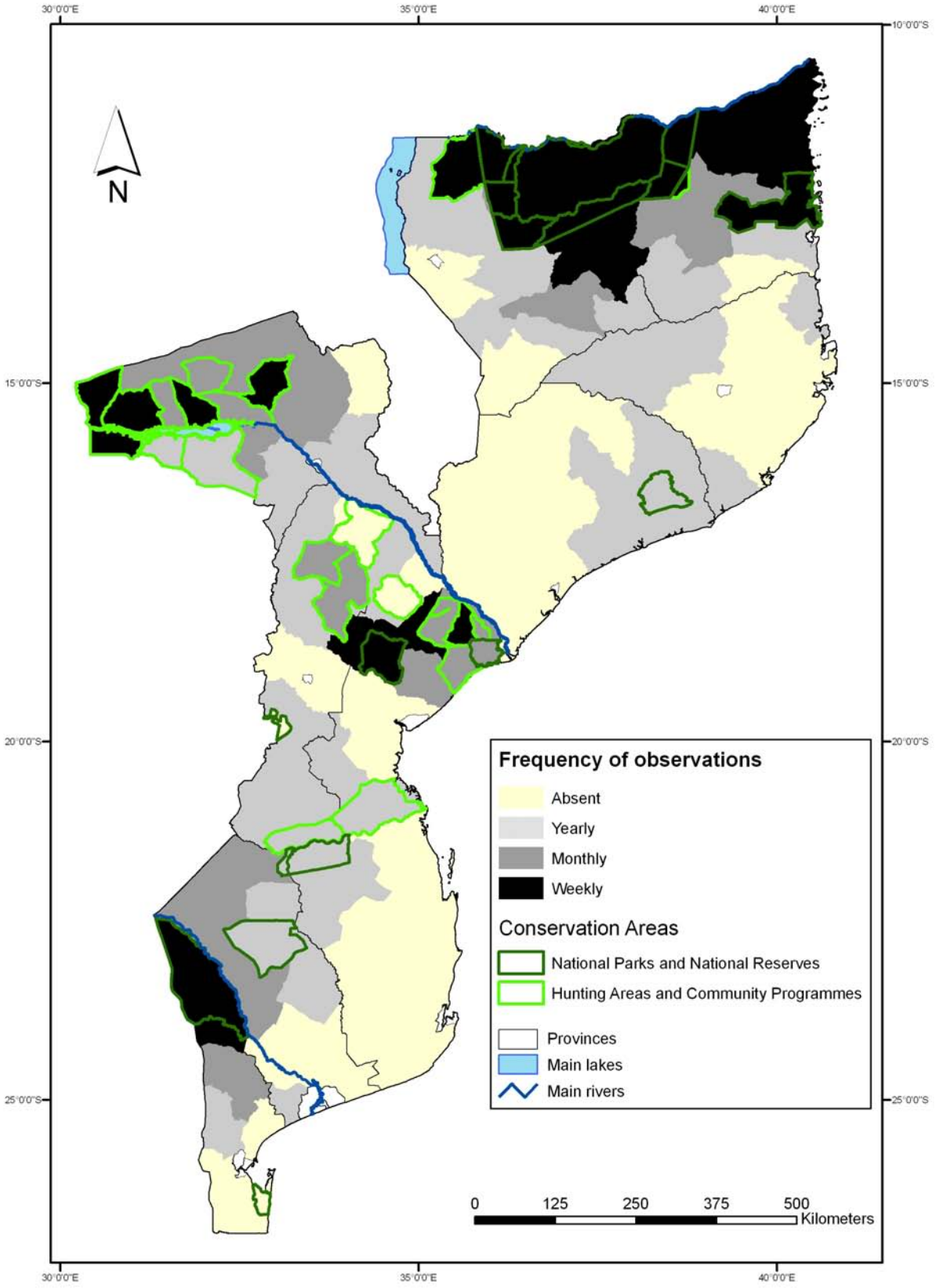
Table V: Lion range and population size estimates in Mozambique (December 2008) - end

National LCU	Gazetted area	Non-gazetted area (District)	Surface (S; Km²)	Population size assessment (PA)	Calculated density CD (lions/100 Km²) = PAx100/S	Speculative density SD (lions/100 Km²) = CDxA/100	Speculative population size PS = SDxS/100	Total population size TP = PA+PS	Source of population size estimate
LCU 35/43 Gorongosa/ Marromeu/ Tete province	Daque Community Program		7 156	25	0,35				Cebe Mostert, *pers. com.*
	Ntuvi Community Program		2 484			0,35	9		this study
	Chinthopo Community Program		2 735	75	2,74				Simon Rodgers, *pers. com.*
	Chifunde Community Program		3 683			1,37	51		this study
	Chipera Community Program		3 200			0,69	22		this study
	Chiputu Community Program		2 969			0,69	20		this study
	Nhenda Community Program		2 933	*13*	1,70		50		Bernhard Van Dyk, *pers. com.*
	Extension Community Program		2 477			1,01	25		this study
	Muze Community Program		4 640	15	0,32				Feriado Alferes, *pers. com.*
	Chawalo Community Program		3 632	*30*	1,70		62		Carel Martins, *pers. com.*
		Cahora Bassa	4 091			0,34	14		this study
		Changara	6 612			0,17	11		this study
		Chifunde	6 135			0,34	21		this study
		Chiuta	7 119			0,34	24		this study
		Luenha	2 246			0,17	4		this study
		Macanga	7 192			0,34	25		this study
		Maravia	5 789			0,34	20		this study
		Moatize	8 428			0,17	14		this study
		Mutarara	6 367			0,17	11		this study
		Zumbu	2 638			0,34	9		this study
	Subtotal Tete Province		**92 526**	**115**			**392**	**507**	
	Gorongosa National Park		3 675	60	1,63				Carlos Lopes Pereira, *pers. com.*
	Marromeu National Reserve		1 552	15	0,97				Carlos Bento, *pers. com.*
	Hunting Area (*Coutada*) n°9		3 761	8	0,21				Matthew Miller, *pers. com.*
	Hunting Area (*Coutada*) n°10		2 589	8	0,31				Alberto Magaia, *pers. com.*
	Hunting Area (*Coutada*) n°11		1 868	*6*	0,50		9		Pacheco Faria, *pers. com.*
	Hunting Area (*Coutada*) n°12		2 717	8	0,29				Julian Moller, *pers. com.*
	Hunting Area (*Coutada*) n°13		5 905	*4*	N/A				Matthew Miller, *pers. com.*
	Hunting Area (*Coutada*) n°14		646	6	0,93				Tony Wicker, *pers. com.*
		Barue	5 472			0,11	6		this study
		Chemba	3 086			0,11	3		this study
		Cheringoma	3 253			0,82	27		this study
		Gorongosa	3 770			0,54	21		this study
		Guro	5 731			0,11	6		this study
		Macossa	2 735			0,11	3		this study
		Maringue	2 775			0,41	11		this study
		Marromeu	1 155			0,48	6		this study
		Muanza	5 191			0,54	28		this study
	Subtotal Gorongosa/Marromeu		**55 881**	**109**			**120**	**229**	
	Subtotal Gorongosa / Marromeu / Tete province		**148 407**	**224**			**511**	**735**	
TOTAL			**514 371**	**1 234**			**1 475**	**2 709**	

italic : the area monitored is smaller than the Conservation Area surface

**: A is the corrective factor*

nb: because assessments of lion population size are speculative, they can not be used for quota setting



Map 6: Frequency of lion observations in Mozambique (by December 2008). Absent: lion presence not recorded in the area; Yearly: lions were seen only once a year or not every year; Monthly: lions were seen every month or seasonally; Weekly: lions were seen regularly throughout every year.

2.3. Population trends

Historical estimates of lion abundance in Mozambique are lacking, which prevents performing documented population trend analysis.

- **Trends at medium scale timing (last 30 years)**

However, it has been shown that most wildlife species now have a much more restricted distribution than they had before 1976 (MINAG, 2008). In the same way, all the informed people met during the field survey unanimously considered that the last civil war (1976-1992) has contributed to global wildlife depletion all over the country.
Consequently, although the lion still appears widespread in Mozambique (Map 4), we may assume that this species has followed the same pattern of trend as its preys over the last 30 years.

- **Trends at short scale timing (last 5 to 10 years)**

More recently, within the last 5 to 10 years, it seems that the lion tends to recover in the country: 29 out of the 45 interviewed persons who provided information about lion population trends considered that lions were increasing in their area (*i.e.* 65%; Table VI).

Informants provided information at the scale of Conservation Areas (N=24), Districts (N=14) or Provinces (N=7). While lions were considered as increasing by more than 70% of Conservation Area and Province informants, the situation was more balanced at District level (*i.e*. around 40% of informants considered lion as increasing and around 40% as decreasing; Table VI).

Table VI: Perception of lion population trends according to area type

Area category	Lion population trend	N	% within area category
Conservation Areas	Increasing	18	75
	Decreasing	4	17
	Stability	2	8
Districts	Increasing	6	43
	Decreasing	6	43
	Stability	2	14
Provinces	Increasing	5	71
	Decreasing	1	14
	Stability	1	14

3. HUMAN/LION CONFLICT

3.1. Magnitude of the conflict

- **Historical account**

As far back as one studies the historical relationship between humans and lions in Mozambique, conflicts resulting from the cohabitation with lion come up as prevalent throughout the country.

In the mid-XIXth century, Livingstone stated that the lions were so abundant that his party often passed little huts made in trees, indicating the places where some of the inhabitants had slept when benighted in the fields. As numbers of his men frequently left the line of march to take out certain birds from their nests, or to follow the honey guides, "*they excited the astonishment of our guides, who were constantly warning them of the danger they thereby incurred from Lions*" (Livingstone, 1857). This was south of the Zambezi near the rivulets Kapopo and Ue, slightly north of the Lobole Hills; and describing conditions about twenty miles farther on in his journey he again refers to the abundance of lions (Matheson, 1947).

According to Matheson (1947), on both the north and the south banks of the lower Zambezi dwelt natives whose beliefs made them refrain from killing lions and allowed these carnivores to multiply unchecked. We may note that it is of this precise region that Maugham, English consul to Portuguese East Africa, wrote more than half a century after Livingstone's journey (1910): *"South of the Zambesi and near the Mozambique Company's boundary on the Mupa River, Lions are particularly abundant, and many man-eaters occur. To such an extent, indeed, do they carry their depredations that it is no uncommon experience to pass large well-built villages which have been completely abandoned owing to the number of people taken. In these districts it is not unusual for the native huts to be enclosed in a high palisading designed as a protection, and interwoven with thorn bushes, but in spite of these precautions great casualties occur."* Similarly, of Bandar on the northern bank of the Zambezi, lower down the river and nearer the junction of the Zambezi and the Shiré, in the country of the Makanga tribe, Maugham was informed that *"Lions are especially and unpleasantly numerous."* (*in* Matheson, 1947). The belief which protected the Lion, and permitted its unchecked increase even in an area where it was frequent and dangerous, as recorded by Livingstone and Werner, shows the caution necessary in assessing the probable reaction of primitive man to his animal environment (Matheson, 1947).

John Taylor, a professional hunter, was regularly asked to kill man-eater lions, mainly in north-eastern Tete Province and in the coastal area of Cabo Delgado Province (Taylor, 1959). Presence of man-eating lions was also reported in Mandimba District, Niassa Province (Taylor, 1959).

Gerhard Liesegang (2003) gave the following account on lion occurrence in Mavago District, Cabo Delgabo Province: "*After WWI, ca. 1925, lion populations had very much increased apparently due to the confiscation of firearms and some outlying areas were abandoned due to the "war of the lions". Lion hunters were prominent to ca. 1930. The Niassa company paid a prime on lion and leopard shots. This ceased when the state took over and as a result around 1934 lion populations have increased very much*."

- **Human/lion conflicts throughout Mozambique**

Today, southern Tanzania and northern Mozambique appear on top of the list of all African regions with most human casualties to lions (Chardonnet *et al.*, 2008a). This might be related to the rarity of livestock due to tse tse fly occurrence.

According to the FAO study (2005) in Mozambique, the lion has been and is still involved in recurrent conflicts with people and human activities. However, in this country the lion does not come first on the list of problem animals: it was not mentioned as the most conflicting animal when compared to crocodile and elephant. Elephant was mentioned as the most conflicting animal by 84% of the informants (N=48), while lion was considered as the most conflicting animal only in the District of Maravia, Tete Province. Among predators, crocodile was considered as the most conflicting animal by 70% of the informants (N=36), while lion was mentioned as the most conflicting animal by 7 informants. This result has been confirmed by a recent survey of wildlife distribution, abundance and human/wildlife conflict intensity throughout Mozambique (MINAG, 2008).

In our inquiries, 38 out of the 69 Districts included within the lion range (*i.e.* 55%) have reported human/lion conflicts during the last 3 years (Appendix III).

Across Districts where conflicts have been recorded:

- Frequencies of conflicts were evenly distributed (Map 7): 11 Districts faced conflicts at high frequency (*i.e*. 29%), 13 Districts faced conflicts at medium frequency (*i.e*. 34%) and 14 Districts faced conflicts respectively at low frequencies (*i.e*. 37%);
- Human casualties were reported in 18 Districts (*i.e*. 47%) while conflicts only involved livestock losses in the remaining 20 Districts (Map 7).

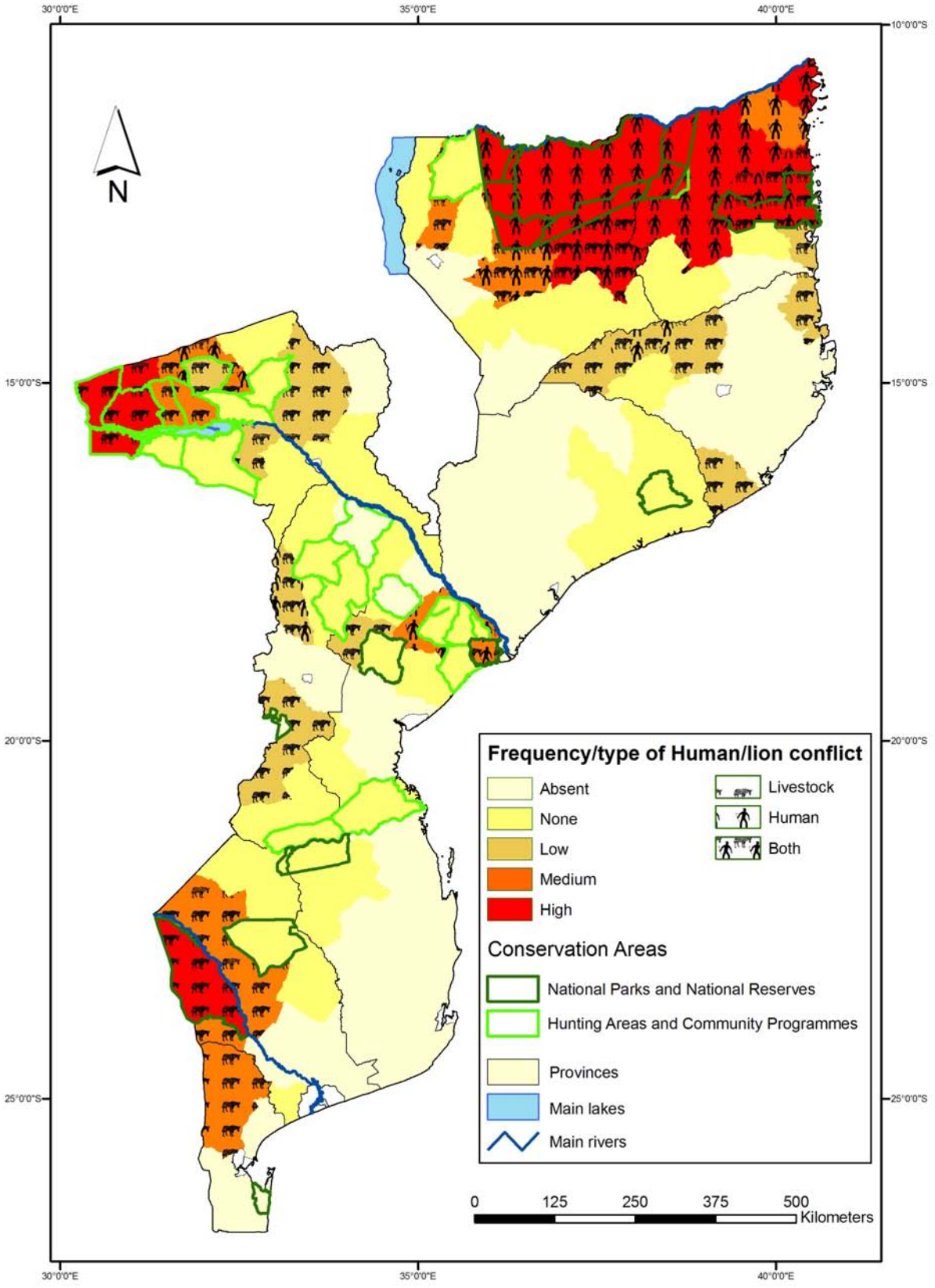
- **Human/lion conflicts at Province level**

Our inquiries show that 4 Provinces face a relative high level of conflicts between lion and human activities (Map 7):

- Cabo Delgado, which appears as the Province most affected by man-eating lions (Table VII);
- Niassa;
- Tete;
- Gaza.

As a reminder, the map on conflicts (Map 7) only refers to the last three years: 2006, 2007 and 2008.

An apparent increase in conflicts with lions is reported by some informants in southern Tete Province, Limpopo complex of Gaza Province and some locations in Cabo Delgado Province.



Map 7: Frequency and type of Human/Lion conflict in Mozambique (by December 2008). Absent: lion presence not recorded in the area; None: conflict presence not recorded in the area; Low: conflicts were reported once or twice and losses did not involve human death; Medium: conflicts were reported every year and/or involved at least one human death; High: conflicts were reported several times per year and involved human casualties and/or high number of livestock losses.

- **Cabo Delgado Province**

The human/lion conflict problem appears more severe in Cabo Delgado than in any other Province. 48 people were officially killed by lions between 1997 and 2004 (Table VIII; FAO, 2005).
According to Begg *et al.* (2007), an escalation in lion attacks has been experienced in Cabo Delgado Province, particularly on the Mueda plateau. Reports suggested that 46 people were killed between 2002 and 2003 in Muidimbe district on the Makonde plateau (Israel, *in prep*.) with 70 people killed between 2000 and 2001 by lions in Cabo Delgado (Begg *et al.*, 2007).
This survey confirmed that Cabo Delgado has the most severe problem with man-eating lions (Map 7). A specific issue of concern about lion attacks on humans in this Province was raised by most sources of information. The district of Palma has often recorded human casualties and several stories of human killing lions are commonly heard (Table VII; Baldeu Chande, *pers. com*.; Carlos Bento, *pers. com*.). Lions were even killed within the city of Pemba, in 2004 (even injuring a person coming out of the casino; Colleen Begg, *pers. com*.) and in 2007 (Resia Cumbi, *pers. com*.). In 2008, a couple of young lions has been responsible for more than 20 human casualties (Table VII; Vaiga, 2009) in Palma and Mocimboa da Praia Districts.
The lion population in Cabo Delgado might be connected with the south-eastern Tanzanian lion population where there have been at least 500 attacks on human since 1990 (Packer *et al.*, 2005).
As a result, 13 lions have been killed as PAC in this Province since 2007 (Table VII).

- **Niassa Province**

Human/lion conflicts have been reported yearly in the Niassa Province and FAO (2005) mentions at least 9 people killed and 6 injured between 1987 and 2006. Within the Niassa National Reserve there have been at least 73 lion attacks for a minimum of 34 people killed and 37 injured since 1974 with a minimum of 11 people killed and 17 injured in the last 6 years alone (Begg *et al*., 2007).

No casualty was recorded in Niassa villages in 2007 (Begg & Begg, 2009). In the last 3 years, 4 people have been killed and 3 injured (Table VII). However, at least two of the injuries to people from lions were provoked attacks as the lions were either in a snare or being hunted for skins (Colleen Begg, *pers. com*.). There has been no official PAC of lions in Niassa Reserve in the past 3 years, but lions are being killed through inadvertent snaring, snaring for skins and snaring for retaliatory attacks (Colleen Begg, *pers. com*.).
The western complex of Mavago and Msawize villages still has to be surveyed and several more attacks may remain unreported (Begg & Begg, 2009). 50% of the attacks have occurred in the village with the lions entering living areas and on 4 occasions pulling people out of the huts, 34% have occurred in the fields and only 18% in the bush (Begg *et al.*, 2007).

- **Tete Province**

Frequent Human/lion conflicts were reported in Tete Province (Table VII). Conflicts mainly involved livestock losses although 2 human casualties were recorded in Maravia District in 2007 (DPA inquiry).

Table VII: Available records on Human/Lion conflicts in Mozambique, for the past three years only (2006 - 2008)

Province	Conservation Area	District	Livestock losses			Human casualties[1]			Lion killed as PAC[2]			Source
			2006	2007	2008	2006	2007	2008	2006	2007	2008	
CABO DELGADO	QUIRIMBAS NP	MACOMIA MELUCO QUISSANGA		11 goats	30 goats		4	7		1	3	MITUR + Park manager
		MACOMIA			8 goats							MINAG (up to 09/08)
					13 goats							DPT
		MECUFI		3 bovids						4		MINAG (up to 09/08)
				13 goats; 3 dogs	3 goats					3		DPT
		MELUCO								1		MINAG (up to 09/08)
								1			1	DPA
		MOCIMBOA DA PRAIA						2			2	MINAG (up to 09/08)
		MONTEPUEZ					1					DPT
		MUEDA				3		1/0				Safari opetor
							3					DPT
		PALMA					6	2/16				MINAG (up to 09/08)
								22			2	DPA
	NIASSA NR	MUEDA					2/4					Colleen Begg, *pers. com.*
NIASSA		MAJUNE		1 dog								
		MARRUPA					1					
		MAJUNE									1	DPT
		MARRUPA		26 goats; 7 dogs			15/0	1				MINAG (up to 09/08)
							1			1		SPFFB
					5 goats			1			1	DPT
		MAVAGO							1			SPFFB
		MECULA					1/0	1/2				DPT
TETE		CAHORA BASSA	6 bovids; 2 donkeys (DPT)		8 goats							Tchuma Tchato manager
		CHIUTA		14 goats								Tchuma Tchato manager
		MACANGA			12 goats							Tchuma Tchato manager
		MAGOE			2 donkeys							Safari operator
		MARAVIA		3 donkeys; 1 dog	5 bovids							Local Authority
					12 bovids		2					DPA Staf
		ZUMBU		80 goats; 25 bovids	25 goats							Tchuma Tchato manager
				+ 200 goats; 10 pigs	+ 200 goats; 10 pigs					1		Safari operator
GAZA	LIMPOPO NP	CHICUALACUALA MASSINGIR		32 bovids; 2 goats; 4 donkeys	7 bovids; 8 goats							MITUR
		BILENE							1			MINAG (up to 09/08)
		CHICUALACUALA		20 bovids; 2 goats	17 bovids; 1 goat					1		MINAG (up to 09/08)
		MASSINGIR			6 bovids							MINAG (up to 09/08)
MANICA		BARUE		18 bovids			1/0			1		MINAG (up to 09/08)
		SUSSUNDENGA		8 bovids; 6 goats								MINAG (up to 09/08)
MAPUTO		MAGUDE		15 bovids; 4 goats; 10 sheeps	12 bovids; 24 goats; 3 sheeps		0		1	4	3	MINAG (up to 09/08)
		MOAMBA		2 bovids	9 bovids; 5 goats		0			2	4	MINAG (up to 09/08)
NAMPULA		LALAUA						2/0			1	MINAG (up to 09/08)
		MECUBURI		1 bovid; 1 goat								MITUR
		MOMA		2 bovids			0	0		1		MINAG (up to 09/08)
SOFALA	MARROMEU NR	MARROMEU		8 goats			1					Park Agent
		CHERINGOMA				1			1	1		District, SFFB
ZAMBEZIA		ILE									1	MINAG (up to 09/08)
		MAGANJA DA COSTA									1	MINAG (up to 09/08)
		NICOADALA			2 goats							MINAG (up to 09/08)

[1] : injured/killed; 1 number when only killed persons [2] : Problem Animal Control

The District of Zumbu apparently supports the highest level of livestock losses in the country, although informants have provided different estimates (Table VII). The western part of Magoe District (within the Chinthopo Community Programme) also supports high livestock losses (Jorge Pedro Valente, *pers. com.*; Cornélio Coelho Miguel, *pers. com.*), but estimates were not available.
According to FAO (2005), and the survey estimate (Table IV), the Province has a healthy lion population and the problem still appeared lower than one might expect.

- **Gaza Province**

Both people and cattle have been killed in the Province (FAO, 2005). 3 people were killed between 1997 and 2004 (Table VIII; FAO, 2005). Problem lions are said to have increased when lions started to move out of the Kruger and Gonarezou National Parks. Although no human casualty has been recorded since 2006 (MINAG), livestock losses to lion have been increasingly reported in the past three years in Chicuacuala and Massingir Districts (MINAG and MITUR Databases).

- **Maputo Province**

Apparently, there is an emerging human/lion conflict in Maputo Province. 3 people have been killed between 1997 and 2004 (Table VIII; FAO, 2005). Occasionally lions get out of the Kruger National Park into the Province where considerable killing of livestock have been reported (FAO, 2005).
It has been assumed that "diminished lions infected with tuberculosis in Kruger National Park, South Africa, have been observed killing livestock in adjacent areas of Mozambique" (Bartolomeu Soto, *pers. com.* in Chardonnet *et al.*, 2008a). In December 2004, lions from the Kruger National Park killed 18 heads of Brahman cattle in the Province (FAO, 2005). The situation appears particularly of concern in Magude, where around 30 bovids, 30 goats and 15 sheep were lost to lions in the past 2 years (Table VII).
However, attacks of livestock by lions might be considered as not that severe compared to livestock losses due to management deficiencies, e.g. in October 2008, 80 heads of cattle died from shortage of water (O País, 5 november 2008). The official retaliation in Maputo Province, with 14 lions killed as PAC since 2006, might be regarded as out of proportion when compared to livestock and human losses undergone elsewhere.

3.2. Biases in conflict assessment

- **Under-reporting**

Numerous observers such as Anderson and Pariela (FAO, 2005) or Begg (Begg *et al.*, 2007) consider tremendous under-reporting of Human/lion conflicts in Mozambique. As an example, over 18 months, between 2000 and 2001, 70 human casualties are known to have occurred in Cabo Delgado Province (Begg *et al.*, 2007) while Table VIII only reports 48 between 1997 and 2004. As a matter in fact, some casualties of isolated persons in remote wilderness are likely overlooked. Furthermore, some people might be reluctant to report a casualty when witchcraft is suspected.

Table VIII: Official records of Human casualties in Mozambique between 1997 and 2004 (Courtesy Magane, 2004)

Province	Human casualties	Lion killed
Cabo Delgado	48	13
Niassa	3	1
Nampula	3	1
Zambezia	1	2
Tete	0	1
Manica	0	0
Sofala	1	2
Inhambane	0	0
Gaza	3	4
Maputo	3	1

- **Overestimation**

Historical accounts are confirmed by recent reports to assume that, in some rural societies of the sub-region, witchcraft may be responsible for disguised casualties unduly attributed to the lion, thus overestimating the number of accidents due to real lions.

In the late XIXth century, David Livingstone, travelling in Mozambique along the southern bank of the Zambezi towards its mouth, found himself, although approaching the Portuguese settlement of Teté, in a district where there were « *a great many Lions and Hyaenas, 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).

Later in Malawi, just next to Mozambique, Norman Carr described the so-called "spirit-lions" named "*walenga*", which are locally regarded as former revengeful chiefs (Carr, 1969).

More recently in Mozambique (in the 1980s), some lion attacks were believed to be the work of witchcraft and "spirit-lions" not bush lions; this appears to have declined within the Niassa National Reserve in the 1990s, due to the death of the powerful traditional healer who lived in Mecula (Begg *et al.*, 2007). In the 2000s, the same phenomenon appeared in Cabo Delgado Province, and led to a sort of political rebellion (Israel, *in prep.*).

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

In Niassa National Reserve, spirit lions are named "*lisimba liancuzunza*" in KiCyao language, "*caramo otantusia*" in KiMakua language and "*simba wa kuzusha*" in KiSwahili language (Colleen Begg, *pers. com*.).

3.3. Conflict mitigation

- **General approach**

Like in many countries, the control of problem animals in Mozambique is addressed by the Law (Artigo 25, Capitulo IV, Lei n°10/99 de 7 de Julho 1999 : Lei de Florestas e Fauna Bravia; Artigo 68, Capitulo IV, Decreto n°12/2002 Aprovando o Regulamento da Lei n°10/99 de 7 de Julho 1999 : Lei de Florestas e Fauna Bravia).

Anderson and Pariela (FAO, 2005) stated: "*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*". The same authors have proposed a logical framework for a decision process to manage problem lions, which is only a recommendation at this stage (Figure 1).

- **Lion PAC**

Problem lions are subject to be removed and eliminated through a Problem Animal Control (PAC) process which falls under the authority of the MINAG. PAC authorizations are provided by MINAG.

The offtake of lions as PAC is carried out by (i) government teams specially appointed, (ii) some safari operators upon government request and (iii) local communities duly identified and led by the local government authorities.

According to the MINAG Provincial Services for Forestry and Wildlife, at least 51 lions were killed as PAC in the last two years (Table IX), which differs from the 41 lions killed as PAC during the same years according to a range of sources at District level (Table VII).

The number of lions killed as PAC seems to escalate at a growing rate. According to Magane (2004), only 25 lions were killed in 8 years between 1997 and 2004 (Table VIII). The number of lions eliminated as PAC has apparently doubled between 2007 (17) and 2008 (34) (Table IX).

The number of lions killed as PAC is considerably higher than the number of lions hunted as trophy animals:

- In 2007 the number of lions eliminated by PAC operations (17) was twice the number of lions hunted by the tourism hunting sector (9);
- In 2008 the number of lions eliminated by PAC operations (34) was 2.4 times higher that the number of lions hunted by the tourism hunting sector (14).

Furthermore, the high levels of PAC are not only more than double the sport hunting quota, but is also likely to be having a greater negative effect on lion population because PAC is indiscriminate, eliminates all sexes and ages, and even results in the death of cubs through infanticide.

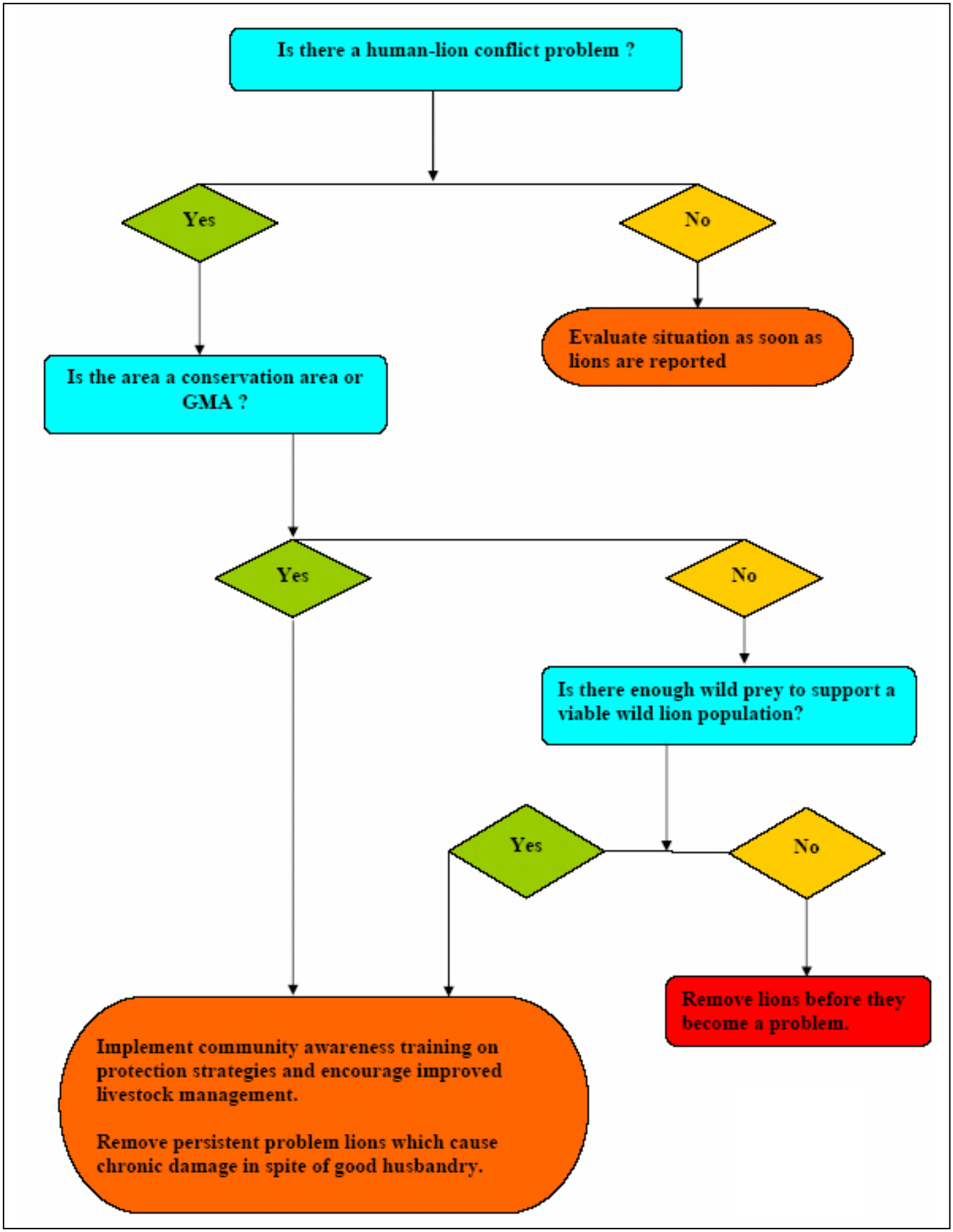


Figure 1: Recommendation for a decision making process to manage Human/lion conflict (Courtesy FAO, 2005); GMA = Game Management Area.

For the last two years, the killing of lions as PAC has been mainly carried out in Cabo Delgado, Gaza and Maputo Provinces. In Maputo Province the lions are said to come from the Kruger National Park, South Africa. In Gaza Province there are resident lions as well as lions originating from Kruger National Park and Gonarezhou National Park, Zimbabwe.

Table IX: Lion killed as PAC in 2007 and 2008 (according to the MINAG Provincial Services for Forestry and Wildlife Annual Reports for 2007 & 2008)

Province	Lion killed as PAC	
	2007	2008
Cabo Delgado	6	7
Niassa	1	0
Nampula	0	0
Tete	0	0
Zambezia	0	2
Manica	0	0
Sofala	0	1
Inhambane	0	0
Gaza	1	16
Maputo	9	8
Total	17	34

4. LION HUNTING

Informal harvesting of lion is not allowed in Mozambique. If practised, it is treated as poaching and subject to fines and penalties as any illegal activity.

Formal harvesting of lion is strictly controlled in Mozambique. Lion hunting is governed by law, mainly the Forestry and Wildlife Law (Law 10/99) and its regulations (Decree 12/2002). According to the forestry and wildlife regulations, the lion is considered as a game species, not as a protected species.

Lions are hunted in Mozambique through (i) tourism or sport hunting by foreign tourist hunters and (ii) recreational hunting by national citizens. However lion harvesting is also carried out through Problem Animal Control (PAC) involving problem lions (see § III.3.3 - Lion PAC).

Lion hunting is only permitted:

- In some defined areas: *Coutada*s (Game Reserves), Hunting Blocks of Niassa National Reserve, Community Based Natural Resources Management Areas (CBNRM programs), fazendas do bravio (Game Ranches) and Multiple Use Areas (under special conditions only);
- During a defined hunting season which is the same as for other game species:
  - From April to September in Multiple Use Areas;
  - From June to November in the other areas.

Lion hunting is regulated with a fixed annual quota established jointly by the MITUR and MINAG through an Inter-ministerial Diploma. Lions killed as PAC are not included into this quota and PAC authorizations are provided by MINAG.

- **Lion quota**

  - **Quota setting**

    - Rules

    The annual lion hunting quota is attributed:
      - For each specific area where hunting is permitted;
      - Per hunting season;
      - Revised annually by the relevant wildlife authority (DNAC/MITUR & DNTF/MINAG);
      - For adult male lions only.

    - Areas

    The annual lion hunting quota is set for two categories of areas:
      - Areas mostly used by international tourism hunters: (i) *Coutada*s (Game Reserves), (ii) Hunting Blocks of Niassa National Reserve, (iii) areas under CBNRM (community based natural resources management) programme and (iv) fazendas do bravio (Game Ranches);
      - Areas only used by Mozambican citizens: Multiple Use Areas or non-gazetted areas. Only Mozambicans can hunt lion in these areas (under special conditions only). The lion quota is much lower in open areas compared to the first category of areas, although these areas are larger.

  - **Quota figures**

    - Global figure

According to the DNAC, the evolution of the national quota for lion was 52 in 2007, 111 in 2008 and 60 in 2009 (DNAC database; Table X).

However, some discrepancies appear between various sources of information:
  - In 2007: compared to the figure of 52 provided by DNAC, the quota was 55 according to safari operators interviewed, and 68 according to the DPT of Tete Province;
  - In 2008: compared to the figure of 111 provided by DNAC, the quota was 106 according to safari operators interviewed.

    - Breakdown

As an example, the national quota for lion was attributed as follows in 2007:
  - 58% to Hunting Areas (N=30);
  - 13 % to Game Ranches (N=7);
  - 29% to non-gazetted areas (N=15).

Table X: Hunting quotas and lion offtake in 2007 and 2008 for Conservation Areas and non-gazetted areas (N/A indicates that quotas were not set for this year) (Source: DNAC & DNTF)

			Lion tourism hunting in Mozambique									
			2007					2008				2009
			Quota			Offtake		Quota		Offtake		Quota
Province	Area category	Area name	According to DNAC & DNTF	Information from DPT Tete	Information from safari operators	According to DNAC	Information from safari operators	According to DNAC & DNTF	Information from safari operators	According to DNAC & DNTF	Information from safari operators and SGDNR	According to DNAC & DNTF
Niassa	Hunting Block	Bloco A	2			1		2			0	1
		Bloco B	3			2		3			1	1
		Bloco C	4		3	1	3	4	3		1	1
		Bloco D1	3		2	0	2	2			1	1
		Bloco D2	3			2		3				1
		Bloco E	3		2	2		2			1	1
		Bloco L3	0			0		2			0	1
		Bloco R2	0			0		0		0		1
		Bloco R3	0			0		0		0		1
	Areas de utilização multipla especifica	Ch. Chetu	N/A		4	N/A	0	8			0	2
		B. Lurio	N/A			N/A		4			0	4
		Nungo	N/A			N/A		6	3		0	2
		Messalo	N/A			N/A		2				2
		B. Lureco	N/A			N/A		2				2
	Game ranch	MWA	N/A			N/A		N/A		N/A		2
	Non-gazetted Area		2			0		2		0	0	0
Cabo Delgado	Game ranch	N. Safaris	2			0		4		4		2
		Mtsewa	N/A			N/A		N/A		N/A		1
		Hunters Mozambique	N/A			N/A		N/A		N/A		2
		Namoto Safaris	N/A			N/A		N/A		N/A		2
		Muangaza Safaris	N/A			N/A		N/A		N/A		2
		Mwirite Safaris	N/A			N/A		N/A		N/A		1
	Coutada	*Coutada* de Nicage						3			2	1
	Non-gazetted Area		5			0		5				0
Nampula	Non-gazetted Area		1			0		0		0		0
Zambezia	Game ranch	Mahimba G.F.	0			0		0		0		0
		Africa Tour	N/A			N/A		N/A		N/A		0
		Real Safaris	N/A			N/A		N/A		N/A		0
		Nharre	N/A			N/A		N/A		N/A		0
		Moçambique Safaris	N/A			N/A		N/A		N/A		0
		Artemis Safaris	N/A			N/A		N/A		N/A		2
	Non-gazetted Area		1			0		1		0		0
Tete	Community Programme	Chinthopo	2	3	2	0	2	6	2		1	3
		Daque	3	3	2	0	0	2			0	2
		Chifunde	0	4		0		4				0
		Muze	0	2	2	0	1	2			0	0
		Chawalo	0	2	2	0	2	2			1	1
		Thuvi	0	2		0	0	2	6		0	1
		Chiputo	0	3		0	0	3			0	0
		Nhenda	0	1		0	0	1			0	1
		Chipera	0	1		0	0	2			0	0
		Chioco	N/A	N/A		N/A		3			0	1
		Bungu	N/A	N/A		N/A		2			0	0
		Capoche	N/A	N/A		N/A		2			0	0
	Non-gazetted Area		2			0		3		0		0
Manica	*Coutada*	*Coutada* 4	1			0		2				0
		Coutada 7	1			0		0			0	0
		Coutada 9	1			1		1			1	1
		Coutada 13	1			0		1	0		0	1
	Non-gazetted Area		0			0		2				0
Sofala	*Coutada*	C.10	N/A			N/A		0		0		0
		C.11	N/A			N/A		0		0		0
		C.12	N/A			N/A		0		0		0
		C.14	N/A			N/A		0		0		0
		Coutada 5	0			0		0		0		0
		Coutada 6	0			0		0			0	0
		Coutada 10	0		1	0	1	1			1	0
		Coutada 11	0			0		0			0	0
		Coutada 12	0			0		0			0	0
		Coutada 14	2			0		1				1
		Coutada 15	1			0		0			0	0
	Game ranch	Muzonaf Safaris	2			0		2				2
	Non-gazetted Area		2			0		2				0
Inhambane	Non-gazetted Area		0			0		0				0
Gaza	Game ranch	Muthemba Safaris	N/A			N/A		N/A		N/A		2
		Imofauna	N/A			N/A		N/A		N/A		2
		Mbabala Safaris	N/A			N/A		N/A		N/A		2
		Gaza Safaris	N/A			N/A		N/A		N/A		1
	Non-gazetted Area		2			0		10				0
Maputo	Game ranch	Sabie Game Park	3			0		0		0		3
	Non-gazetted Area		0			0		0		0		0
Total			**52**			**9**		**111**		**14**		**60**

In 2007, the Niassa Province was the Province with the highest lion quota, representing 39% (N=20; Table X) of the national quota. In all other Provinces, the respective lion quotas per Province represented less than 15% of the national quota.

- **Lion offtake**

  - **Global figure**

The evolution of the national offtake of lion was (Table X):

- In 2007: 9 lions, for an overall offtake percentage of 17%, according to DNAC;
- In 2008: 14 lions, for an overall offtake of 12.6% according to DNAC, SGDRN and safari operators interviewed.

However, some discrepancies appear between various sources of information:

- In 2007: compared to the figure of 9 lions provided by DNAC, the offtake was 19 according to safari operators interviewed;
- In 2008: compared to the offtake figure of 14 lions provided by DNAC, SGDRN and safari operators interviewed, the lion hunting fees paid by safari operators corresponded to 22 lions taken according to DNTF.

  - **Breakdown**

As an example, the following offtake of lion was observed in 2007:

- Lions were mainly hunted in Niassa National Reserve Hunting Blocks, where 8 out of the 18 lions in quota were taken (local offtake percentage of 44%), against 9 out of 16 in 2006 (offtake percentage of 56%) (Begg & Begg, 2007);
- In all the *Coutadas*, only 1 out of the 7 lions on quota was harvested (offtake percentage of 14%);
- No lion was reported as harvested in the Tete Community Programme area.

5. LEVEL OF KNOWLEDGE AND RESULTING GAPS IN KNOWLEDGE

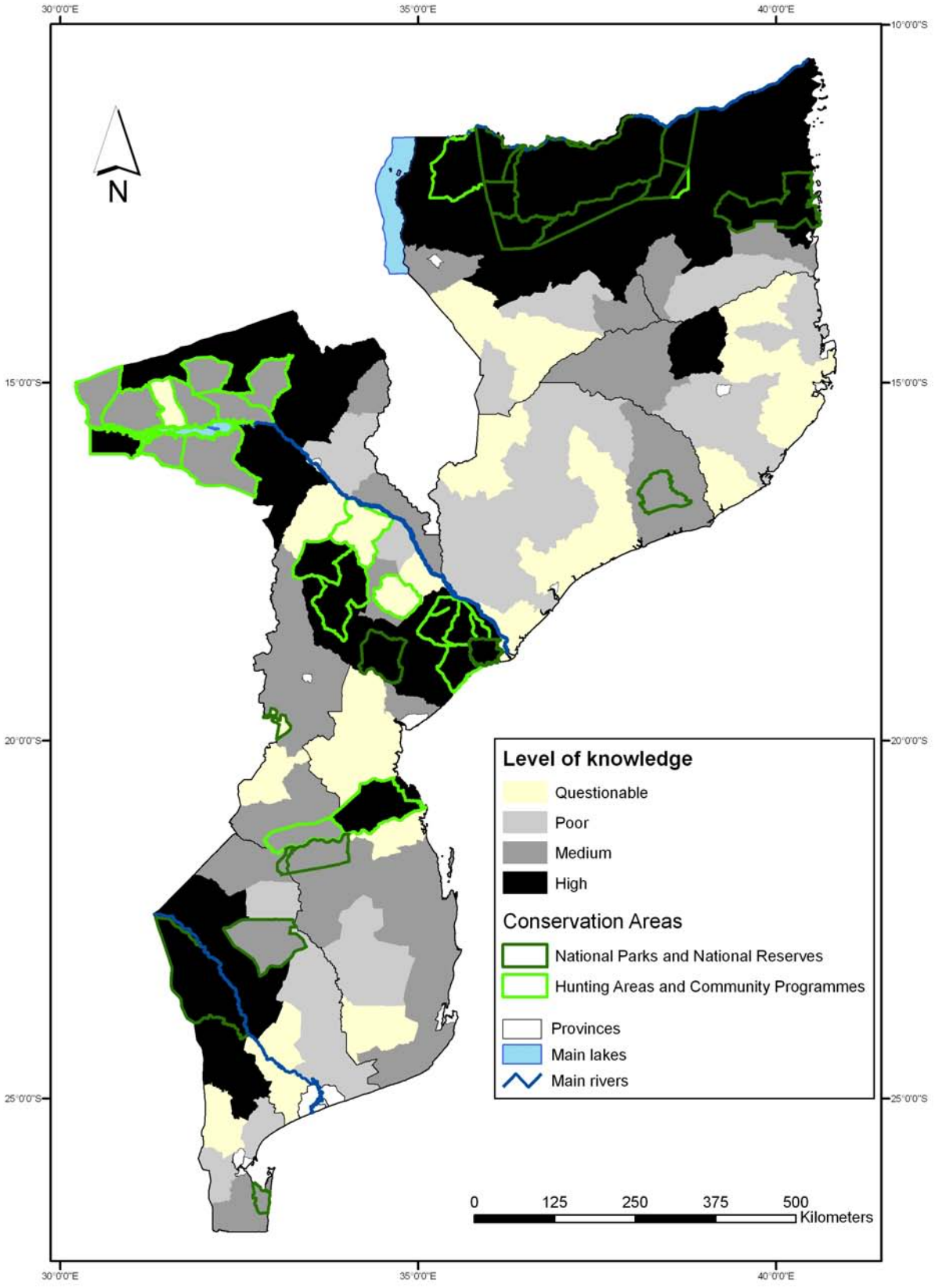
- **Level of knowledge**

  - **Low level of knowledge**

The level of knowledge was considered as questionable or poor in 60 out of the 128 terrestrials Districts, *i.e.* in 47% of the Districts (Appendix III; Map 8). As a reminder, 71% of the terrestrial Districts had these levels of knowledge during phase I of the study (Chardonnet *et al*., 2008b). This demonstrates the significant improvement of knowledge in respect to lion in the country between phase I and II of the study.

  - **Higher level of knowledge**

The level of knowledge was considered as medium or high in 68 out of the 128 terrestrials Districts, *i.e.* in 53% of the Districts (Appendix III; Map 8).



Map 8: Level of knowledge of collated information (by December 2008). Questionable: only one (1) information or two (2) contradictory information; Poor: two (2) unpublished information; Medium: three (3) or more information; High: three (3) or more information including a specific lion survey or more than six (6) information without specific lion survey.

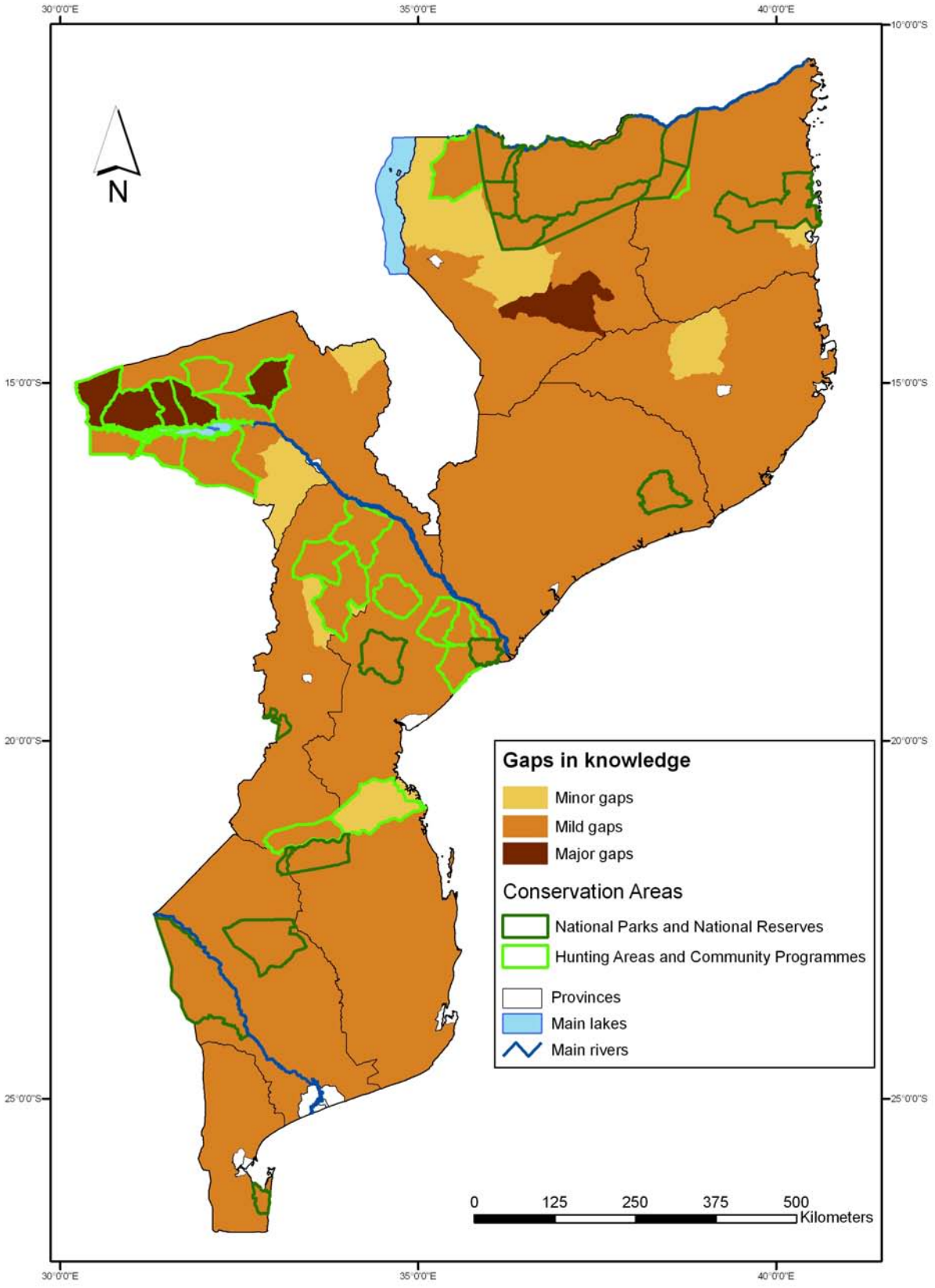
Districts with more than 3 converging sources of information represented 23% and 30% of the terrestrial Districts, respectively for the medium and high levels of knowledge categories (§II.2.2).
The number of different sources of information used to derive thematic maps varied between 2 and 21 for a given District, with a mean value of 6. A few Districts appear better documented than others: the lion status was better known in the Districts located around Niassa National Reserve, Gorongosa/Marromeu Complex and Limpopo National Park as well as in Cabo Delgado and Tete Provinces (Table XI; Map 8); these areas were specifically covered during the second phase of the survey.

Table XI: Mean number of sources of information per District for each Province

Province	**Mean number of sources of information**
Cabo Delgado	9
Gaza	4
Inhambane	3
Manica	5
Maputo	3
Nampula	3
Niassa	8
Sofala	9
Tete	11
Zambezia	3
Total	**6**

- **Gaps in knowledge**

Because the level of knowledge has considerably increased during the second phase of the study, the resulting gaps in knowledge (§II.2.2) have decreased considerably (Map 9) when compared to the phase I (Chardonnet *et al*., 2008b).
The gaps in knowledge remain major only in the District of Maua, Niassa Province, against 19 Districts with major gaps in knowledge after phase I of the study (Chardonnet *et al*., 2008b). Even though the number of informants for this District has been increased between Phase I and II (from N=2 to N=6), contradictory information prevented from reaching a high level of knowledge (§II.2.2).
Moreover, the gaps in knowledge were considered as major in 5 hunting areas of Tchuma Tchatu Community Programme, although consistent information from 4 different informants were collected.



Map 9: Gaps in knowledge (by December 2008) that were assessed by combining level of knowledge and frequency of observation (refer to §II.2.2)

IV. DISCUSSION

1. COMMENTS ON METHODS AND RESULTS

- **Data acquisition**

By looking at Map 8, the general level of knowledge on lion in Mozambique appears medium. The difficulty to collate data is clearly understandable, which explains the strategy of this survey, not to rely solely on existing data, but rather to also generate some more information by meeting resource persons and conducting inquiries.

The bottom-line of this survey is the database which has been set up by/for this study. Most of the information feeding the database has been collected through interviews of informed persons. This approach offers a more cost-effective and less time-consuming alternative to genuine inventories and censuses. Gros *et al*. (1996) have considered this kind of method as the most accurate indirect method to assess carnivore density in areas which are visited. No other method appeared suitable with limited means at the scale of an entire country.

- **Data analysis**

A first bias for estimating the lion range is the choice of the sampling units which have been used for this survey. The database and the maps have been established at (i) the level of Conservation Areas and (ii) the Administrative level of the Districts. As a result, the entire surface of a given District or Conservation Area was included in the lion range as soon as lion observations were reported in that particular District or Conservation Area, even though it does not always imply that lions occur in the entire given District or Conservation Area.

A second bias in respect to the lion range is the lack of accurate digital outlines for *fazendas do bravio* (Game Ranches) as well as the lack of information about lions in these areas. As a consequence, the proposed relative estimates of the lion range in Conservation Areas *vs*. non-gazetted areas should be considered as tentative at this stage, although the total surface of these *fazendas do bravio* remain quite limited today.

- **Gaps in knowledge**

    - **Gaps regarding the lion range**

The Districts have been ranked according to the method previously described (§II.2.2) in order to identify Districts with major gaps in knowledge. Most Districts had mild gaps in knowledge (Map 9). The only Conservation Areas with major gaps in knowledge were located in Tete Province (Tchuma Tchatu Community Programme).

Districts with questionable information (N=10; Appendix III) have not been prioritized in map 8 when lions were rarely observed. However, these Districts still need some investigation to cross-check the little existing information with additional data. For each of these Districts, one of the four following situations is expected:

- Lion presence confirmed;
- Lion absence confirmed;

- Lion presence invalidated;
- Lion absence invalidated.

At this stage, it is assumed that the current lion range in Mozambique is probably closer to Map 4 (refined data) than to Map 3 (raw data).

- **Gaps regarding the lion abundance**

In respect to the lion abundance, the gaps in knowledge are huge and higher than the gaps in regards to the lion range. The rational behind 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.

With a few exceptions, wildlife monitoring has mainly been carried out through aerial surveys in Mozambican Protected Areas. Because aerial surveys are not appropriate to census lions, there is a need to conduct specific lion surveys. Of special concern is the Tchuma Tchatu Community Programme where, apart from educated guesstimates, very few quantifiable data were available to assess the abundance of lions despite numerous evidences of an important lion population in this particular area. We consequently extrapolated lion abundance based on the scarce information available. Since most of lion areas are not yet documented in terms of lion abundance, we acknowledge that the population size proposed in this survey is speculative and needs to be refined.

However, it must be noted that absolute population sizes are note considered as compulsory to properly manage and conserve a given species. Trends are often regarded as more efficient tools. The monitoring of trends need to install a set of valuable indicators to be applied on a long enough period of time. This is especially true for hunting quota setting: the results given on population sizes are not relevant for setting hunting quotas which emphasizes the need for establishing a proper monitoring scheme in all hunting areas whatever category is concerned.

- **Historical account**

Historical reports on lion presence in Mozambique are numerous, although, to our knowledge, little information is available on a precise historical distribution. Most historical accounts tend to show a widespread distribution to the point that, anciently, very few locations in Mozambique did not have lions.
No precise figure of historical estimates of Mozambican lion population size was found before 2002 although all the ancient authors are in agreement about the historical abundance of lion in Mozambique. In 2002, two surveys brought the first assessments of lion population sizes in Mozambique (Chardonnet, 2002; Bauer & Van Der Merwe, 2004); estimates ranged from 250 to 1 250 lions for the all country.

- **Current distribution and demographics**

According to the current survey, the lion is still widespread in Mozambique (Map 4). The present range appears quite surprisingly similar to the one proposed more than 30 years ago by Smithers & Lobão Tello (1976) (Map F; Appendix I), with lions being mainly absent in Inhambane Province, western Zambezia Province and center of Nampula Province. In Niassa Province, the lion seems even more widespread today than 30 years ago.

Lion abundance has been extrapolated to around 2 700 individuals for the whole country. The absence of historical estimates of lion abundance in Mozambique prevents performing documented population trend analysis. However, it has been shown that most wildlife species now have a much more restricted distribution than they did before 1976 (MINAG, 2008). Much in the same way, all the informed persons met during this survey unanimously considered that the last civil war (1976-1992) has contributed to wildlife depletion all over Mozambique. Consequently, even though the lion still appears widespread in Mozambique (Map 4), we may assume that this species has followed the same trend as its preys over the last 30 years.

Although lion seems to recover in many Conservation Areas since the last 10 years (§III.2.3), the situation is more balanced in non gazetted areas, where most of the lion range lies (*i.e.* ~70% of its national distribution).

- **Habitat and resource assessment**

Lion habitat suitability is mainly driven by the integrity of natural habitat and the availability of prey basis.

A predictive model based on habitat suitability has been used to draw a putative lion range in Mozambique (Ghiurghi & Urbano, 2007; Map 10). Based on land cover and land region (potential vegetation) maps, a synthetic environmental map with 36 different classes, each one characterized by a specific land cover/land region combination, was generated. Finally, the frequency of the species' observations within each class was used to characterize the environmental classes' suitability for lion. Because only the habitat suitability has been introduced to the model, the resulting putative lion range produced (Map 10) does not match the lion range assessed in the current study based on interviews of resource persons with field knowledge (Map 4). Consequently, it is assumed that the above mentioned model underestimates the lion distribution area.

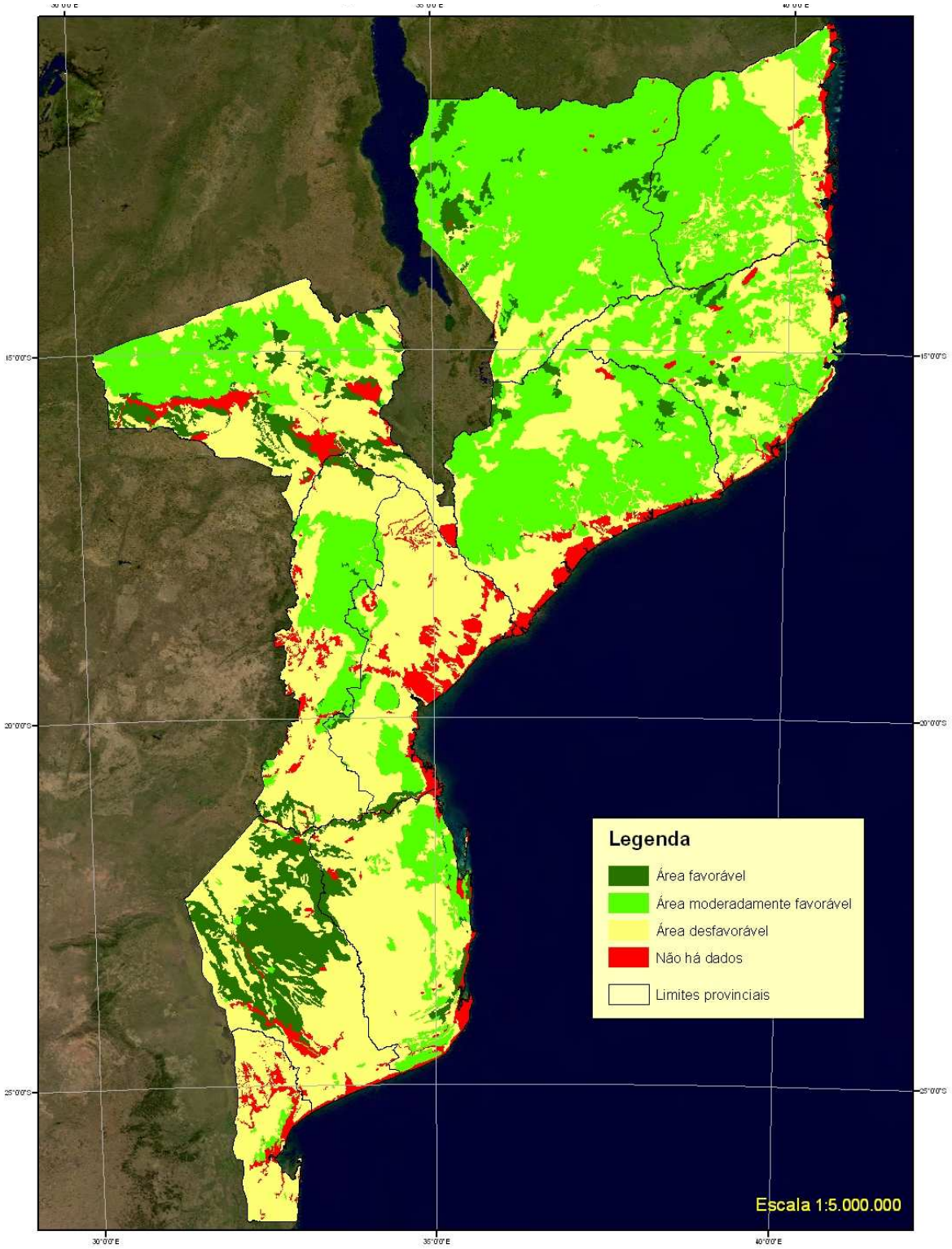
The prey basis is considered as a very important ecological topic to take into account when addressing the conservation prospects of the lion. For example, the on-going Niassa Carnivore Project shows the prime importance by far of wild suids (bushpig first, then warthog) as preys for lions (Begg & Begg, 2009). Since these particular prey species are widespread and abundant in the whole country even outside gazetted areas, it may be assumed that some lions could be able to sustain themselves in non-gazetted areas where larger prey species are scarce or even absent. Moreover lions tend to feed mainly in areas with high prey catchability rather than high prey density (Hopcraft *et al*., 2005).

- **Lion PAC**

The number of lions reported as killed as PAC operations is quite high and has escalated during the last 15 years. According to the MINAG Provincial Services for Forestry and Wildlife, the number of PAC would have doubled between 2007 and 2008.

Surprisingly, the number of lions killed as PAC appears much higher than the number of lions hunted as trophy animals: twice in 2007 and 2.4 times in 2008.

Moreover, PAC operations indiscriminately eliminate any lion, whatever sex and age, either male, female, young or cubs, while lion hunting only targets adult male lions.



Map 10: Environmental suitability model for lion in Mozambique (Courtesy of Ghiurghi & Urbano, 2007)

The data show some confusion between lions eliminated as PAC and lions hunted as trophy animals.

Similarly, some discrepancies are noticed between sources of information (Table XII). Lion PAC operations would be considerably improved with a clear logical framework, well defined decision-making process and implementation procedures, as well as proper data analysis and reporting.

Table XII: Discrepancies between sources regarding the number of lions eliminated as PAC in the last two years

Year	Sources	
	MINAG Provincial Services for Forestry and Wildlife	**Range of other sources used in this survey (MINAG HQ, safari operators, DPT…)**
2007	17	21
2008	34	20

- **Lion hunting**

  - **Hunting data collection and processing**

The monitoring system to evaluate the offtake of lions (the level of lion quota utilization) as well as for other species is not well developed and needs to be improved. With a few local exceptions, it remains quite difficult today to determine precisely the level of lion offtake in the country.
The reporting system as well as the data collection need also to be improved. Currently there is no standard format for the safari operators' annual reports. And only a percentage of safari operators are used to submit their annual reports to the wildlife authorities.

  - **Quota setting**

Quota setting for lion as well as for other game species is done through a procedure of data analysis and consultation: it is essentially based on information received from safari operators, provincial directorates for tourism, forestry and wildlife services, previous years quota offtake as well as the safari operator requirement.

With the exception of the study conducted in Niassa National Reserve by the "Sociedade de Gestão e Desenvolvimento da Reserva do Niassa", very few surveys of the lion population are carried out in other regions. In the absence of specific lion surveys, a set of indirect criteria can be efficiently used for monitoring the lion conservation status and trend in hunting areas, and for setting quotas, e.g. lion trophy size and trend, lion hunting effort parameters, direct and indirect lion signs and their indices. Participatory methods for setting quotas have been designed and are well known in Southern Africa (WWF, 1997; WWF, 2000).

Recent advances suggest that hunting quotas might be replaced by targeted harvests selected upon biological criteria as it is sometimes done for elephants with minimum tusks length and weights or with leopards with minimum length. For lion, Whitman *et al.* (2004) developed a

model showing that trophy hunting is likely to have minimal impact on the whole lion populations if the offtake is restricted to males older than 6 years of age, regardless of the level of offtake. The rational is to let enough time for pride males to produce cubs old enough to become independent (*i.e*. to escape infanticide) when incoming male coalitions take over the prides. The Niassa National Reserve is already combining the usual quota system with the new method of the minimum age threshold (Begg & Begg, 2009). It may be hypothesized that Mozambican lions have their own ecological and biological features according to their respective ecosystems and regions, as suggested by the difference between the evaluation of maximal pride sizes conducted during this survey (Table XIII) and the value observed in Northern Tanzania (nearly 30; Nowell & Jackson, 1996) where the Whitman *et al.* model was developed.

Table XIII: Maximal pride size for each of the documented Province (Source: inquiries carried out during phase II). The number of sources is mentioned in brackets.

Province	Maximal pride size		
	Mean	Min	Max
Cabo Delgado (2)	-	5	6
Inhambane (1)	-	-	3
Manica (1)	-	-	3
Niassa (7)	8	4	19
Sofala (4)	7	3	15
Tete (17)	5	2	14

Accurate ageing of live lions is critical for properly applying the minimum age threshold method. Five lion ageing criteria are used by Whitman *et al*. (2004): facial markings, mane development, nose pad pigmentation, leg markings and teeth. Whether the visual standards used in Northern Tanzania to assess the age of live lions at a distance are accurate when applied to other lion populations elsewhere remains questionable. Preliminary results from the Zambia Lion Project provide growing evidence that neither mane development nor nose pigmentation in Zambia provide reliable ageing criteria in the same way as in Tanzania (Paula White, *pers. com*.). According to Colleen Begg (*pers. com.*), the Tanzanian lion ageing criteria seem to apply to the Niassa situation.

Research studies are needed in Mozambique to improve the knowledge in lion ecology and lion ageing, assuming possible regional differences given the size and shape of the country.

- **Lion offtake**

The national lion offtake, *i.e*. the percentage of the national lion quota which is utilized, is surprisingly low (17% in 2007 and 12.6% in 2008). There is one exception in the country with the Niassa National Reserve producing reliable data and decent figures. Some questions may be raised to look for explanations:

- Is the national lion offtake well evaluated? Is the data collection and reporting dysfunctional?
- Is the national lion quota really appropriate? Is it properly set?
- Is there any problem to harvest lions in some areas and to fulfill the quota? Did former overharvesting occur in some areas?

- **Trophy fees**

Trophy fees for fixed quotas are paid regardless of whether the animals are hunted or not. This system of fixed fees does not provide any incentive for hunting operators to avoid male lions that are less than 5 year old or that are in breeding prides (with lion cubs less than one year old). This untargeted hunting could result in unsustainable harvest with potential detrimental effect on population genetic and dynamic (Loveridge *et al.*, 2006). Placing lions on optional quota, with fees only paid if animals are shot, would help ensuring sustainable offtake.

- **Lion hunting by national citizens**

Official lion hunting by national citizens remains marginal and insignificant. From 2007 to 2008 no lion hunting licence was issued for national hunters to hunt in the Multiple Use Areas which are reserved to Mozambicans only. Most national hunters hunt for meat, some as a recreational activity, very few for trophy. The national hunter is looking more at plain's game (antelopes, wild suids and game birds). Also, a number of them are scared to hunt dangerous game such as lion. Finally, the cost of hunting big game is much higher than medium or small size game.

- **Overall lion mortality**

Overall, killing of lion by people in Mozambique is by far mostly due to poaching, either unintentional in the quest of bushmeat or intentional in retaliation. The second cause responsible for lion killing by humans is lion PAC operations. Lastly, tourism hunting is harvesting a few adult male lions every year. The question remains whether diseases are responsible for lion mortality in the country, to what extant and if human activities play a role.

2. THREATS TO LIONS

- **Threats to lions in Southern Africa**

Threats to lions are the main drivers for the classification of *Panthera leo* in CITES Appendix II, and of the African lion in the IUCN Redlist category Vulnerable (IUCN Redlist website, accessed on 2/02/2009).

In the regional conservation strategy for the lion in Eastern and Southern Africa, the top threats to the lion in the region include, by order of importance (IUCN SSC Cat Specialist Group, 2006):

- Low prey availability;
- Indiscriminate killing of lions (e.g. inadvertent snaring);
- Reduced size and extent of the lion population;
- Low amount of wild habitat available;
- Inefficacy of management for lion conservation.

- **Threats to lions in Mozambique**

Similarly to the regional conservation strategy for the lion in Eastern and Southern Africa, the national action plan for the conservation of the lion in Mozambique is expected to identify and prioritize the threats to lions in this particular country. This exercise will be conducted by the forthcoming national workshop through a participative approach. Without precluding the results expected from that meeting, the current survey has attempted to collect the opinion of informants thoughout Mozambique (Table XIV).

All the threats mentioned by the informants are of anthropogenic origin. Their impacts are either direct (lions removed) or indirect (lions weakened).

Table XIV: Perception of threats to lion survival in Mozambique (Source: inquiries carried out during phase II)

Threats	Percentage of informants (N=44)
Unintentional snaring/trapping	75
Loss of habitat	57
Inefficient management	55
Uncontrolled fire	36
Intentional poaching	34
Lack of prey	30
Human settlement	25
Prey poaching	20
Livestock occurrence	18
Retaliation	11
Official hunting	5

- **Direct threats**

Threats with direct impact on lions are perceived as the most detrimental for lion conservation. According to our informants, the main threat to lion survival in Mozambique by far is the indiscriminate killing of lions through the extensive use of snaring and trapping techniques by poachers, which is mentioned by 75% of informants. Because lions are responsible for livestock losses (mainly in western Tete Province and around Limpopo National Park) and human killings (mainly in Cabo Delgado and Niassa Provinces, cf. §III.3.1), they are persecuted intensively in areas where conflicts occur. Little actual information exist on the number of lions killed in retaliation (or prevention) by local people, even though this is considered as a major threat to their survival. The behaviour of the lion (scavenger, possible diurnal hunter, etc.) makes him particularly vulnerable to retaliation (Kissui, 2008). Implementation of appropriate livestock management measures, coupled with problem animal control measures and mechanisms for compensating livestock losses, are some of the primary responses to resolve human-lion conflicts (Frank *et al.*, 2006; Chardonnet *et al.*, 2008a).

Trophy hunting of lion has been considered by the regional conservation strategy for the lion in Eastern and Southern Africa as an important management and conservation tool outside National Parks for providing financial resources for lion conservation to both governments and local communities. Some authors consider that, if not properly conducted on a sustainable way, lion trophy hunting might contribute to declining a given lion population (Creel & Creel, 1997; Loveridge *et al.*, 2007). Whitman *et al.* (2004) identified the critical drivers for conducting sustainable trophy hunting of African lions. Lion trophy hunting was regarded by our informants as the smallest of the risks mentioned for Mozambique.

- **Indirect threats**

Threats with indirect impact on lions include habitat loss and inefficient lion management: they were considered as threats by more than 50% of informants. According to the informants, inefficient management of lions mainly means lack of knowledge about lions, insufficient training of rangers and anti-poaching units, and inappropriate quota setting process. About one third of informants mentioned the lack of prey and uncontrolled fire as threats, while one fourth or one fifth or informants mentioned human settlement, prey poaching and livestock occurrence.

- **Non-mentioned threats**

It may be noticed that very few informants in our inquiry mentioned diseases as potential causes of demographic catastrophes threatening large carnivores, especially the species with developed social ways of life such as lion (*e.g.* Berry, 1993; Hofmann-Lehmann *et al.*, 1996; Keet *et al.*, 1998; Gaydos & Corn, 2001). Although the impact of bovine tuberculosis is currently considered by some authors as negligible for the survival of the lion in Kruger National Park (Ferreira & Funston, *submitted*), this particular disease remains of great concern for the adjacent Limpopo National Park and surrounding areas in Mozambique. Because all the Protected Areas in Mozambique (with the exception of Gilé National Reserve) do contain human settlements with some domestic animals, the risk is real for lions to be affected by diseases of domestic animals and human origins. Dogs of poachers as well represent a risk of contaminating lions with several diseases including rabies and canine distemper. The Niassa lion population is known to be FIV positive (Colleen Begg, *pers. com.*).

Also to be noticed, only a single informant regarded as a risk an eventual low genetic diversity in small and isolated populations, even though it is sometimes considered as a possible factor responsible for the decline of carnivores (O'Brien *et al.*, 1985; Wildt *et al.*, 1987). Since the Niassa leopard population appears genetically quite different to other southern African populations, it is speculated that the Niassa lion population might be genetically distant as well (Colleen Begg, *pers.com.*).

- **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).

Several projects involving lion relocations are currently planned in Mozambique. If not properly designed and implemented, these projects may be a matter of concern. A chart has been specifically drawn on purpose for helping decision-makers to adopt the right attitude towards this kind of projects (Figure 2).

- **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 ZAWA now opposes any translocation 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 yet in Mozambique, similar measures could be applied to Mozambique as a precautionary principle to preserve the genuine biodiversity of the Mozambican lions. Reintroduction should not be considered when a genuine lion population exist nearby and can eventually be reached by the reintroduced lions.

  - Sanitary risks

Lions are susceptible to a number of diseases. In Kruger National Park, tuberculosis at least is raising concerns in respect to the now free movements of lions to Limpopo National Park and also in regards to translocations further else. In South Africa, outside Kruger National Park, most 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 have 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, 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 South Africa, thousands of lions are bred in captivity for multipurpose reasons including hunting. The issue of so-called “caned lions” is a matter of serious problem for the South African Government, 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.

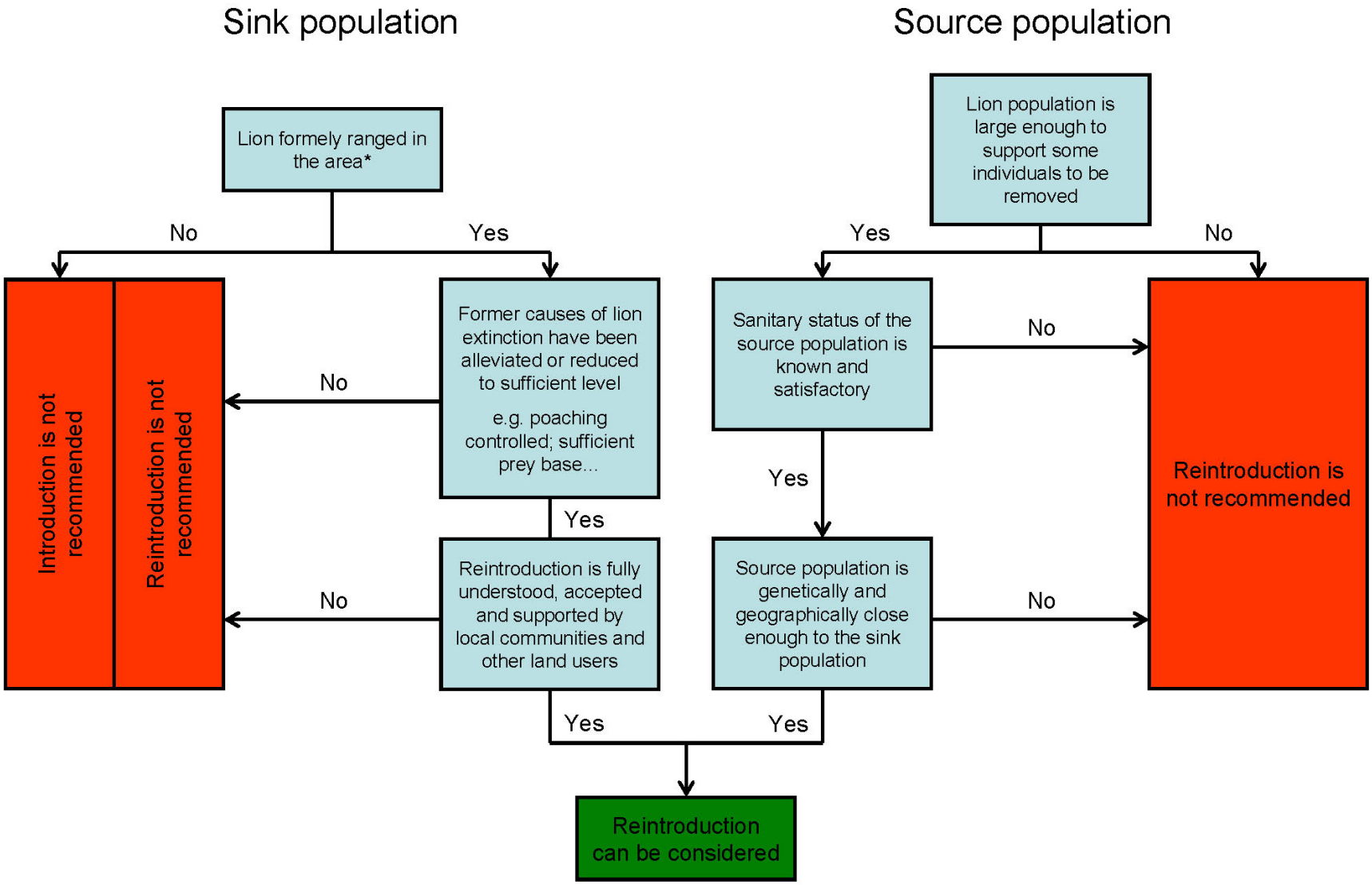


Figure 2: Decision making process for implementing a lion population translocation (*also valid in case of population re-enforcement, where lions still occur in low number)

- **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. 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 1), *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. 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 envisaged when conditions supporting the decision making process are positively met (Figure 2), 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 Mozambique**

If a lion reintroduction project is to be envisaged in Mozambique, 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 35/43 (Tete Province) or 25/26/42 (Niassa and Cabo Delgado Provinces) should be given the preference, avoiding lions from LCU 49. Foreign lions should be avoided and Mozambican lions 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 genetic, 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 where the translocation takes place must be properly investigated in terms of prey basis, poaching, proximity of livestock and people and sanitary status (notably tse tse fly occurrence if the source population comes from a tse tse free area).

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APPENDICES

APPENDIX I: Relevant lion range maps published in literature

- **Map A**: African lion range according to Bauer & Van Der Merwe (2004);
- **Map B**: Southern African lion range according to Chardonnet (2002);
- **Map C**: African lion range according to African mammal databank (1999);
- **Map D**: Eastern and Southern African lion range according to IUCN SSC Cat Specialist Group (2006);
- **Map E**: Mozambican lion occurrence according to Galvão (1943);
- **Map F**: Mozambican lion range according to Smithers & Tello (1976);
- **Map G**: Proposed habitat suitability for lions in Mozambique (Ghiurghi & Urbano, 2007);
- **Map H**: Mozambican lion records in Ghiurghi & Urbano (2007).

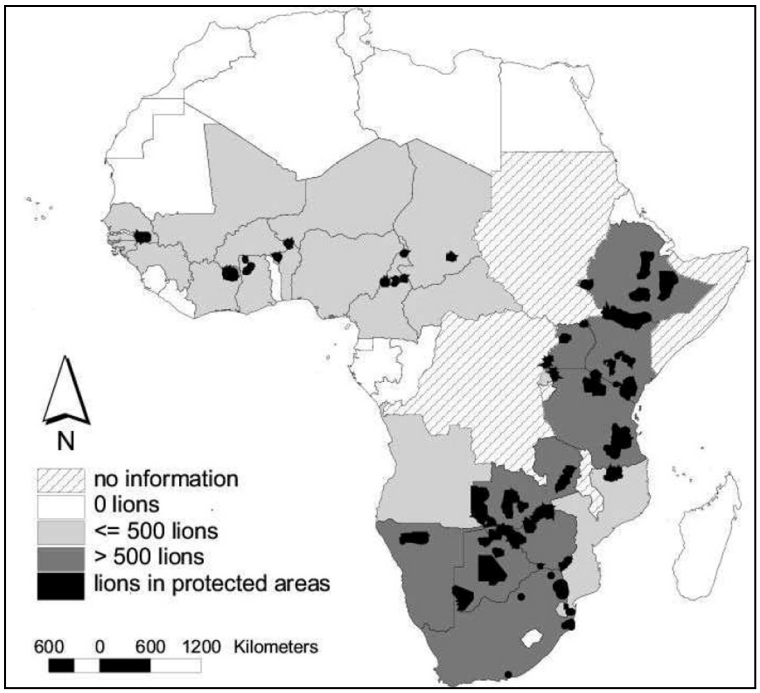
APPENDIX II: Inquiry forms

- DPT & DPA inquiries (Phase I);
- Safari operator inquiry (Phase I);
- Extra material used for DPA inquiries (Phase I and II);
- DPT & DPA inquiries (Phase II);
- Safari operator inquiry (Phase II).

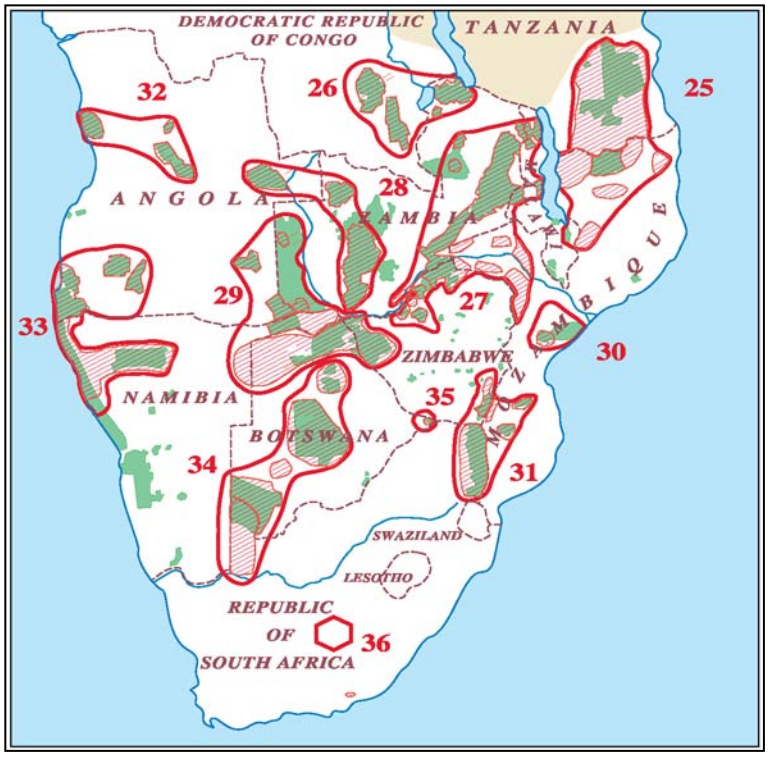
APPENDIX III:

- Survey's synthetic database

APPENDIX I

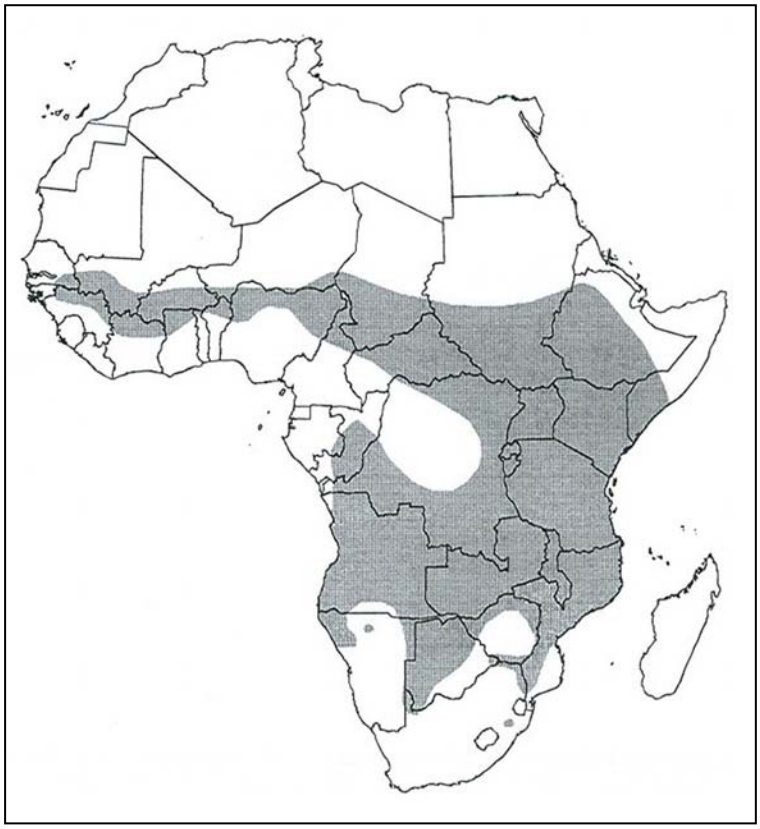


Map A: African lion range according to Bauer & Van Der Merwe (2004)

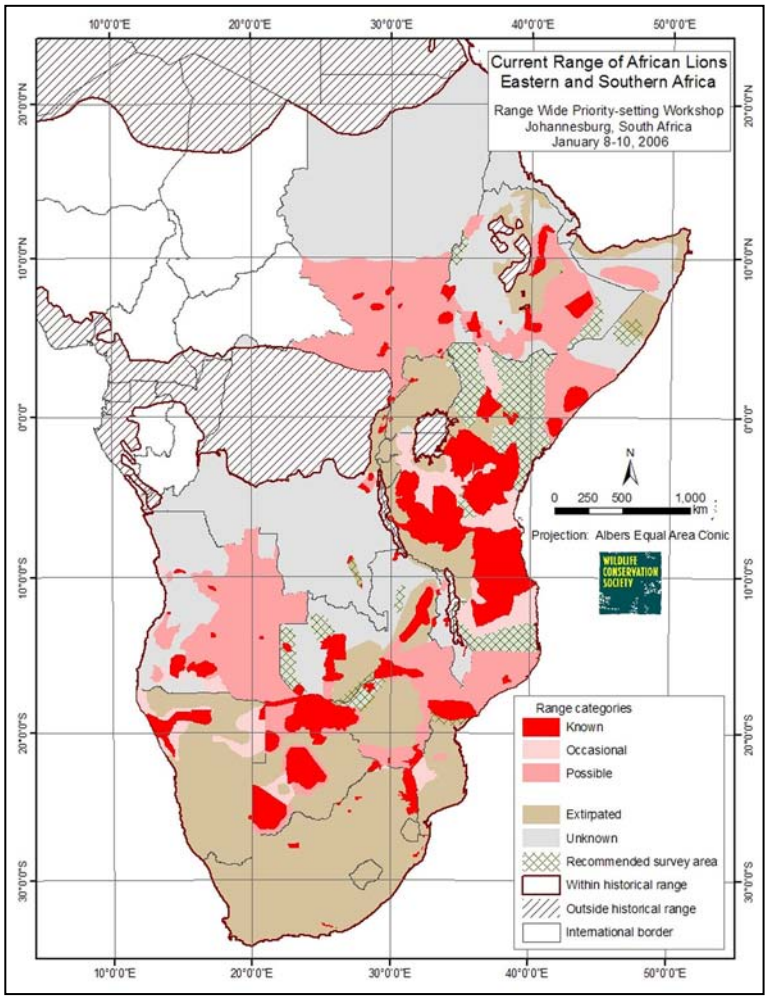


Map B: Southern African lion range according to Chardonnet (2002)

APPENDIX I

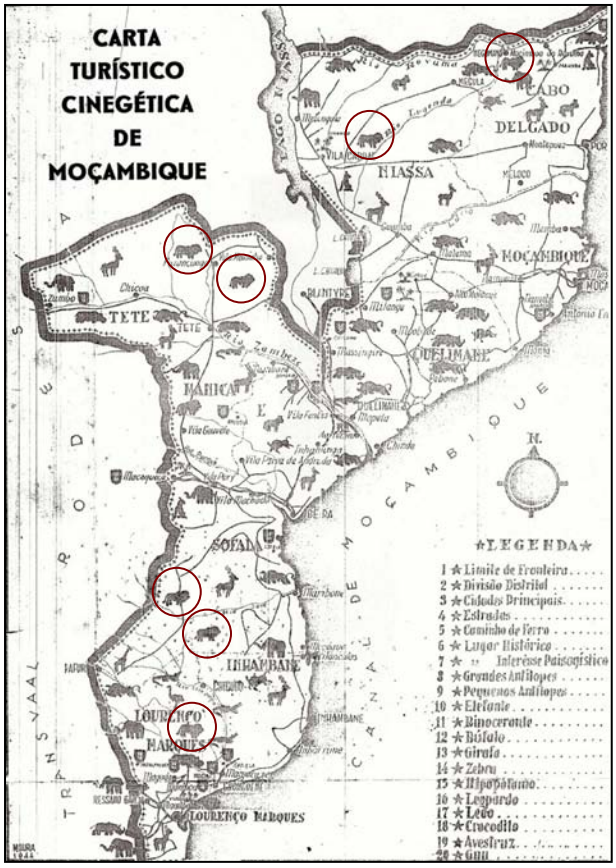


Map C: African lion range according to African mammal databank (1999)

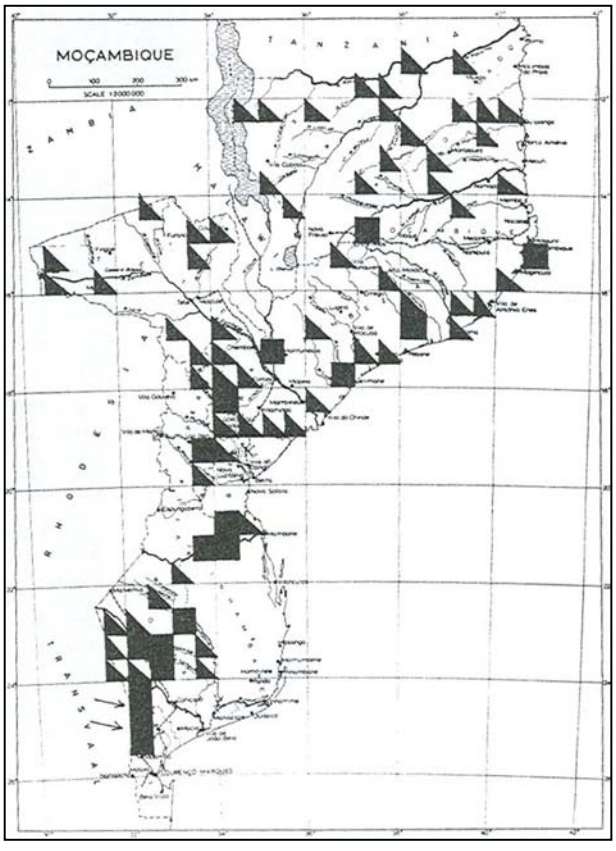


Map D: Eastern and Southern African lion range according to IUCN SSC Cat Specialist Group (2006)

APPENDIX I

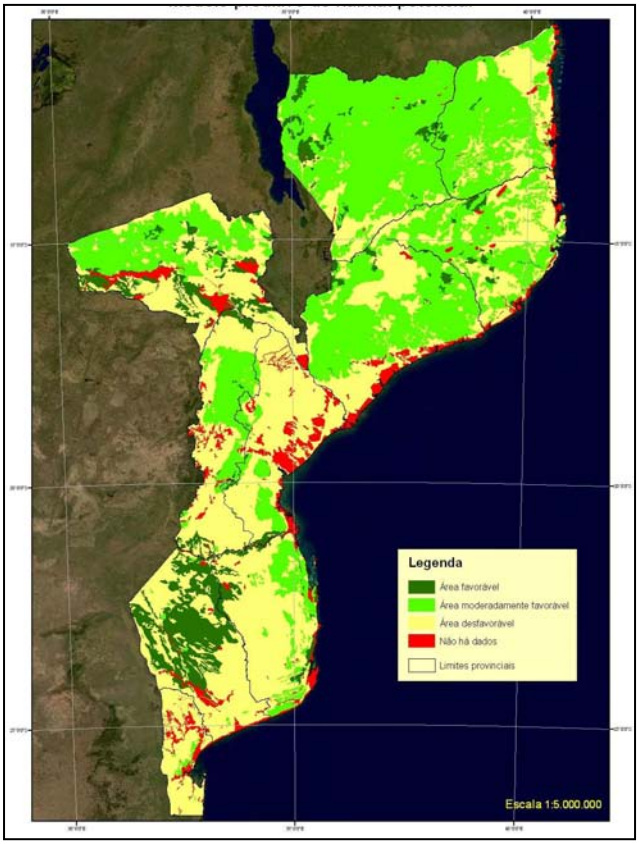


Map E: Mozambican lion occurrence according to Galvão (1943). Lion quotations inside red circle.

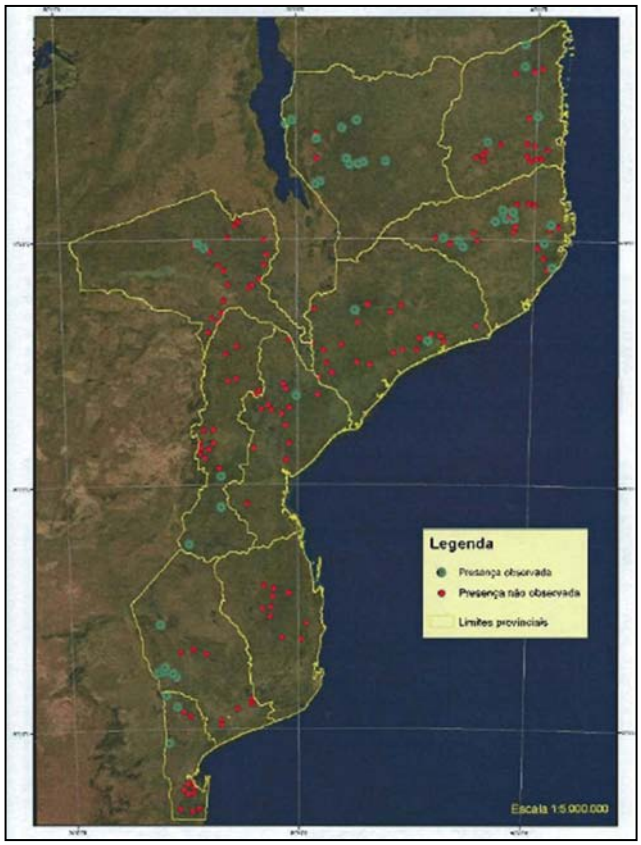


Map F: Mozambican lion range according to Smithers & Lobão Tello (1976)

APPENDIX I



Map G: Proposed habitat suitability for lions in Mozambique (Ghiurghi & Urbano, 2007)



Map H: Mozambican lion records in Ghiurghi & Urbano (2007)

APPENDIX II - DPT and DPA inquiries (Phase I)

Primeiro Censo Nacional do Leão
Questionário de levantamento de dados nas provincias

Provincia_____

1. Tem alguma informação de ocorrência de leões

	Sim	**Não**
Mês passado		
Ano passado		
Á 5 anos		
A mais de 5 anos		
Nunca		

2. Tem alguma informação de frequencia de leões ?

	Sim	**Não**
Cada semana		
Cada mês		
Cada 6 meses		
Cada ano		
Esporadicamente		

3. Em que zona da Provincia tem informação da ocorrência de Leões? (indicar distrito e/ou localidade). Favor colocar os distritos com mais leões em primeiro. Por favor, pode usar o mapa na pagina 3 para marcar os distritos.

Distrito	**Localidade**
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____

4. Tem alguma informação de ocorrência de conflitos entre leões e população:

	Sim	**Não**	**Numero de animais domésticos afectados (indicar o tipo de animal)**	**Número de pessoas afectadas**	**Distrito**
Mês passado					
Ano passado					
Á 5 anos					
A mais de 5 anos					
Nunca					

5. Tem alguma informação sobre o tipo de presa do leão na sua área:

Tipo de presa (espécie)	**Periodicidade**	
	Frequente	Ocasional

6. Contagens efectuadas

Ano	**N.º Observado**	**Local (coordenadas)**	**Data**

7. Observações

Preenchido por_____Data_____

APPENDIX II - Safari operator inquiry (Phase I)

Primeiro Censo Nacional do Leão
Questionário de levantamento de dados nas Áreas de caça

Área_____ Nome da Empresa_____

8. Tem alguma informação de ocorrência de leões

	Sim	**Não**
Mês passado		
Ano passado		
Á 5 anos		
A mais de 5 anos		
Nunca		

9. Em que zona da Coutada tem informação da ocorrência de Leões? (indicar Posto Administrativo e/ou Localidade)

Posto Administrativo	**Localidade**
9. _____	_____
10. _____	_____
11. _____	_____
12. _____	_____

10. Tem alguma informação de ocorrência de conflitos entre leões e população:

	Sim	**Não**	**Numero de animais domésticos afectados (indicar o tipo de animal)**	**Número de pessoas afectadas**
Mês passado				
Ano passado				
Á 5 anos				
A mais de 5 anos				
Nunca				

11. Tem alguma informação sobre o tipo de presa do leão na sua área:

Tipo de presa (espécie)	**Periodicidade**	
	Frequente	Ocasional

12. Informação sobre a quota de abate do leão e troféus

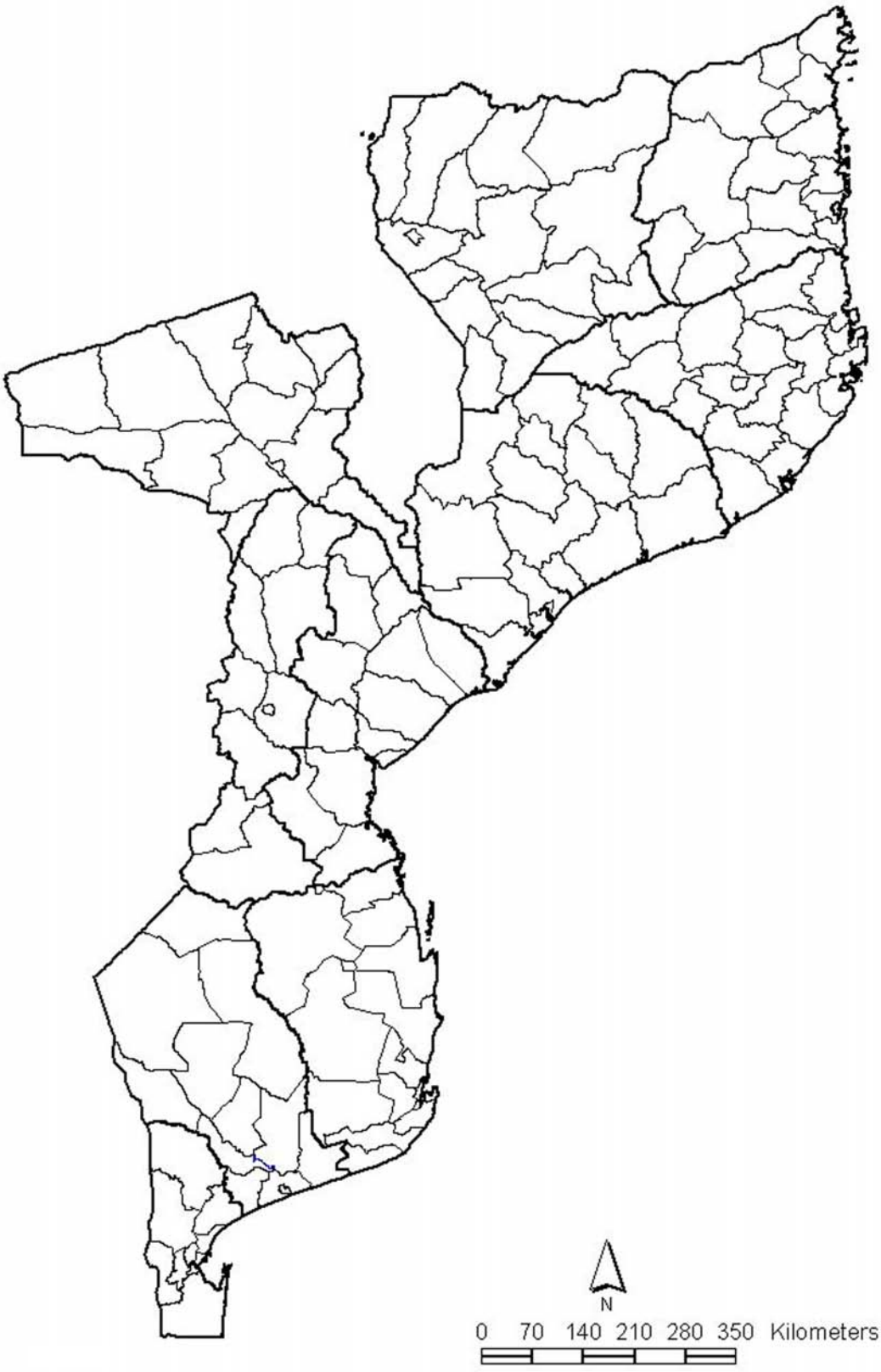
Ano	**Quota**	**Consumo**	**Peso do troféu**	**Dimensões do Troféu**		**Comprimento da pele**
				Comprimento	Circunferência da base	
2003						
2004						
2005						
2006						
2007						

13. Contagens efectuadas

Ano	N.º Observado	Local (coordenadas)	Data

Preenchido por_____Data_____

APPENDIX II – Extra material used for DPA inquiries (Phase I & II)



Mapa: nos distritos onde não tem leão põe **"0"**, onde tem pouco leões põe **"1"**, onde tem numero razoável de leões põe **"2"** e nos distritos com muito leões põe **"3"**

APPENDIX II - DPT and DPA inquiries (Phase II)

QUESTIONÁRIO « LEÃO » - DPT & DPA

Data : _____

Nome dos responsáveis do questionário: _____

Precisão da informação	Pontuação*
Identificação certa dos predadores [a]	
Informações erradas ou duvidosas	
Consistência da informação	
Atitude cooperativa	

* Sim = 1 / Não = 0 ; [a] Sobre apresentação de fotografias

DETALHES SOBRE O INFORMANTE

1. Nome: _____ 2. Função:

_____

3. Desde quando é que você está nesta região?

_____

4. Endereço:

_____

5. Número de telefone: _____ E.mail:

_____

DETALHES SOBRE A REGIÃO CONCERNIDA

- Província: _____

Distrito	Posto Administrativo	Localidade
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

OBSERVAÇÕES DE LEÕES

1. Os leões frequentam a sua região? Sim / Não / Não sabe

Se não, desde quando é que eles desapareceram? _____

2. Quantas vezes você viu leões em 2008? _____

Quantos leões você viu em 2008? _____

Número médio de leões vistos por ano durante os últimos 5 anos? _____

3. Detalhes das observações de leões:

Data	Tamanho do grupo	Composição do grupo			Localização
		Macho	Fêmea	Jovem	

4. Frequência de observação?

Semanal	Mensal	Anual	Raramente

5. Tem você uma ideia do número total de leões presentes na sua região (permanente e temporário)?

_____

6. Número máximo de leões observados juntos:

_____

7. Você pensa que o número de leões aumentou ou diminuiu desde 10 anos?

Aumento / Redução / Estável / Não sabe

8. Os seus colegas vêem leões? Sim / Não / Não sabe

CAÇA

1. Quota de caça e realização para o leão*:
2. Você foi testemunha de casos de caça furtiva de leão? Sim / Não
3. Número de casos de caça furtiva de leões desde Janeiro 2008? _____

   Em 2007? _____

   Durante os últimos 5 anos? _____

CONFLITOS ENTRE LEÕES E POPULAÇÃO

1. Os leões são responsáveis de depredação na sua zona? Sim / Não / Não sabe
2. Nível dos conflitos Homem/Leão:

	Homens matados	Homens machucados	Perda de animais domésticos (Número e espécie)	Batida administrativa oficial	Represálias não oficiais
2008					
2007					
2006					

3. Qual é o animal que causa mais problemas? _____
4. Qual é o predador que causa mais problemas? _____

AMEAÇAS SOBRE A SOBREVIVÊNCIA DOS LEÕES

Classifique as ameaças por ordem decrescente:

Falta de presas	Caça oficial	Caça furtiva intencional	Represálias	Caça com armadilhas não intencional	Desaparecimento de habitat favorável	Ineficácia da gestão dos leões	Presença de gado	Doença

Outros : _____

Na sua região, você estima o número de leões a _____ +/-_____%

APPENDIX II – Safari operator inquiry (Phase II)

QUESTIONÁRIO « LEÃO » - ZONAS DE CAÇA

Data : _____Nome do responsável do questionário:_____

Precisão da informação	Pontuação*
Identificação certa dos predadores	
Informações erradas ou duvidosas	
Consistência da informação	
Atitude cooperativa	

* Sim = 1 / Não = 0

DETALHES SOBRE O INFORMANTE

1. Nome: _____ 2. Função: _____

3. Desde quando é que você está nesta zona? _____

4. Endereço: _____

5. Número de telefone: _____ E.mail:_____

6. Presença na zona:

	2007/2008	2006/2007	2005/2006	2004/2005	2003/2004
Número de dias no mato na zona					

DETALHES SOBRE A ZONA DE CAÇA

Província: _____ Distrito: _____

Nome da Zona de Caça (localidade): _____

Nome da companhia: _____

Superfície (km²): _____ Ponto GPS do acampamento (LAT/LONG):_____

OBSERVAÇÕES DE LEÕES

1. Os leões frequentam a sua zona? Sim / Não / Não sabe

Se não, desde quando é que eles desapareceram? _____

2. Quantas vezes você observou leões durante a época venatória 2007/2008? _____

Quantos leões você viu durante a época venatória 2007/2008? _____

Número médio de leões vistos por época durante as últimas 5 épocas venatórias? _____

3. Com qual frequência você observa-os?

Semanal	Mensal	Anual	Raramente

4. Detalhes das observações de leões:

Data	Tamanho do grupo	Composição do grupo			Localização
		Macho	Fêmea	Jovem	

5. Sabe você quantas famílias de leões frequentam a sua zona (permanente e temporário)? _____

6. Tem você uma ideia do número total de leões presentes na sua zona (permanente e temporário)? _____

7. Superfície aproximativa ocupada pelos leões: _____

8. Número máximo de leões observados juntos: _____

9. Você observa regularmente os mesmos leões? Sim / Não / Não sabe

10. Você ouve os leões rugir ? Sim / Não

Com qual frequência ouve você os leões rugir? _____

Resposta ? Sim / Não

11. Você pensa que o número de leões aumentou ou diminuiu desde 10 anos?

Aumento / Redução / Estável / Não sabe

12. Os seus colegas vêem leões? Sim / Não / Não sabe

PRESAS DO LEÃO

Espécies	Ausente	Presente	Abundante	Presa do leão?
Facocero				
Porco bravo				
Cabritos				
Imbabala				
Chango				
Piva				
Gondonga				
Pala pala				
Cudo				
Elande				
Girafa				
Búfalo				
Macaco cão amarelo				
Vaca				
Ovelha/cabra				
Porco				
Burro				

CAÇA

1. Quota de caça e realização para o leão:

	Zona A :		Zona B :		Zona C :	
	Quota	Realizações	Quota	Realizações	Quota	Realizações
2008						
2007						

2006						
2005						
2004						
2003						

2. Você foi testemunha de casos de caça furtiva de leão? Sim / Não

3. Número de casos de caça furtiva de leões desde Janeiro 2008? _____

Em 2007? _____

Durante os últimos 5 anos? _____

CONFLITOS ENTRE LEÕES E POPULAÇÃO

1. Os leões são responsáveis de depredação na sua zona? Sim / Não / Não sabe

2. Nível dos conflitos Homem/Leão:

	Homens matados	Homens machucados	Perda de animais domésticos (Número e espécie)	Batida administrativa oficial	Represálias não oficiais
2008					
2007					
2006					

3. Qual é o animal que causa mais problemas? _____

4. Qual é o predador que causa mais problemas? _____

AMEAÇAS SOBRE A SOBREVIVÊNCIA DOS LEÕES

Classifique as ameaças por ordem decrescente:

Falta de presas	Caça oficial	Caça furtiva intencional	Represálias	Caça com armadilhas não intencional	Desaparecimento de habitat favorável	Ineficácia da gestão dos leões	Presença de gado	Doença

Outros :

_____

Na sua zona, você estima o número de leões a _____ +/-_____%

APPENDIX III

Survey's synthetic database – District level (continued)

Province	District	Range		Frequency of observation	Frequency of conflict	Type of conflict	Level of knowledge	Gaps in knowledge	Source (N)
		Raw data	Refined data						
CABO DELGADO	ANCUABE	1	1	Yearly	None	None	Medium	Mild	7
	BALAMA	1	1	Yearly	None	None	Medium	Mild	7
	CHIURE	0	0	Absent	Absent	Absent	Poor	Mild	4
	MACOMIA	1	1	Weekly	High	Both	High	Mild	13
	MECUFI	1	1	Yearly	Low	Livestock	Medium	Mild	7
	MELUCO	1	1	Monthly	High	Both	High	Mild	13
	MOCIMBOA DA PRAIA	1	1	Weekly	Medium	Human	High	Mild	6
	MONTEPUEZ	1	1	Monthly	High	Human	High	Mild	15
	MUEDA	1	1	Weekly	High	Human	High	Mild	13
	MUIDUMBE	1	1	Weekly	High	Human	High	Mild	7
	NAMUNO	1	1	Yearly	None	None	Poor	Mild	6
	NANGADE	1	1	Weekly	Medium	Human	High	Mild	7
	PALMA	1	1	Weekly	High	Human	High	Mild	12
	PEMBA	1	1	Yearly	Low	Livestock	High	Minor	6
	QUISSANGA	1	1	Monthly	High	Both	High	Mild	10
GAZA	BILENE	1	1	Yearly	None	None	Questionable	Mild	3
	CHIBUTO	0	0	Absent	Absent	Absent	Poor	Mild	2
	CHICUALACUALA	1	1	Monthly	Medium	Livestock	High	Mild	13
	CHIGUBO	1	1	Yearly	None	None	Poor	Mild	4
	CHOKWE	1	0	Absent	Absent	Absent	Questionable	Mild	2
	GUIJA	1	0	Absent	Absent	Absent	Questionable	Mild	2
	MABALANE	1	1	Monthly	Medium	Livestock	High	Mild	6
	MANDLAKAZE	0	0	Absent	Absent	Absent	Poor	Mild	2
	MASSANGENA	1	1	Monthly	None	None	Medium	Mild	3
	MASSINGIR	1	1	Weekly	Medium	Livestock	High	Mild	9
	XAI-XAI	0	0	Absent	Absent	Absent	Poor	Mild	2
INHAMBANE	FUNHALOURO	0	0	Absent	Absent	Absent	Poor	Mild	4
	GOVURO	1	0	Absent	Absent	Absent	Questionable	Mild	3
	HOMOINE	0	0	Absent	Absent	Absent	Medium	Mild	3
	INHARRIME	0	0	Absent	Absent	Absent	Medium	Mild	3
	INHASSORO	0	0	Absent	Absent	Absent	Medium	Mild	4
	JANGAMO	0	0	Absent	Absent	Absent	Medium	Mild	3
	MABOTE	1	1	Yearly	None	None	Medium	Mild	5
	MASSINGA	0	0	Absent	Absent	Absent	Medium	Mild	4
	MORRUMBENE	0	0	Absent	Absent	Absent	Medium	Mild	3
	PANDA	1	0	Absent	Absent	Absent	Questionable	Mild	3
	VILANKULO	0	0	Absent	Absent	Absent	Medium	Mild	3
	ZAVALA	0	0	Absent	Absent	Absent	Medium	Mild	3
MANICA	BARUE	1	1	Yearly	Low	Both	Medium	Mild	6
	GONDOLA	0	0	Absent	Absent	Absent	Medium	Mild	3
	GURO	1	1	Yearly	None	None	Questionable	Mild	6
	MACHAZE	1	1	Yearly	None	None	Medium	Mild	6
	MACOSSA	1	1	Yearly	None	None	High	Minor	8
	MANICA	0	0	Absent	Absent	Absent	Medium	Mild	4
	MOSSURIZE	1	1	Yearly	Low	Livestock	Questionable	Mild	3
	SUSSUNDENGA	1	1	Yearly	Low	Livestock	Medium	Mild	8
	TAMBARA	1	0	Absent	Absent	Absent	Questionable	Mild	3
MAPUTO	BOANE	0	0	Absent	Absent	Absent	Poor	Mild	2
	MAGUDE	1	1	Monthly	Medium	Livestock	High	Mild	8
	MANHIÃA	0	0	Absent	Absent	Absent	Poor	Mild	2
	MARRACUENE	0	0	Absent	Absent	Absent	Poor	Mild	2
	MATUTUINE	0	0	Absent	Absent	Absent	Medium	Mild	3
	MOAMBA	1	1	Yearly	Medium	Livestock	Questionable	Mild	3
	NAMAACHA	0	0	Absent	Absent	Absent	Poor	Mild	2

APPENDIX III

Survey's synthetic database – District level (end)

Province	District	Range		Frequency of observation	Frequency of conflict	Type of conflict	Level of knowledge	Gaps in knowledge	Source (N)
		Raw data	Refined data						
NAMPULA	ANGOCHE	0	0	Absent	Absent	Absent	Poor	Mild	2
	ERATI	1	0	Absent	Absent	Absent	Questionable	Mild	2
	LALAUA	1	1	Yearly	Low	Both	Medium	Mild	4
	MALEMA	1	1	Yearly	Low	Livestock	Medium	Mild	3
	MECONTA	0	0	Absent	Absent	Absent	Poor	Mild	2
	MECUBURI	1	1	Yearly	Low	Livestock	High	Minor	7
	MEMBA	1	1	Yearly	Low	Livestock	Poor	Mild	2
	MOGINCUAL	1	0	Absent	Absent	Absent	Questionable	Mild	3
	MOGOVOLAS	0	0	Absent	Absent	Absent	Poor	Mild	2
	MOMA	1	1	Yearly	Low	Livestock	Questionable	Mild	3
	MONAPO	1	0	Absent	Absent	Absent	Questionable	Mild	3
	MOSSURIL	1	0	Absent	Absent	Absent	Questionable	Mild	3
	MUECATE	1	0	Absent	Absent	Absent	Questionable	Mild	3
	MURRUPULA	0	0	Absent	Absent	Absent	Poor	Mild	2
	NACALA A VELHA	0	0	Absent	Absent	Absent	Poor	Mild	2
	NACAROA	0	0	Absent	Absent	Absent	Poor	Mild	2
	NAMPULA	0	0	Absent	Absent	Absent	Poor	Mild	2
	RIBAUE	1	1	Yearly	None	None	Medium	Mild	5
NIASSA	CUAMBA	1	0	Absent	Absent	Absent	Questionable	Mild	5
	LAGO	1	1	Yearly	None	None	High	Minor	7
	LICHINGA	0	0	Absent	Absent	Absent	Medium	Mild	7
	MAJUNE	1	1	Yearly	Medium	Both	High	Minor	11
	MANDIMBA	1	1	Yearly	None	None	Questionable	Mild	4
	MARRUPA	1	1	Weekly	High	Both	High	Mild	16
	MAUA	1	1	Monthly	None	None	Poor	Major	6
	MAVAGO	1	1	Monthly	Medium	Both	High	Mild	11
	MECANHELAS	0	0	Absent	Absent	Absent	Poor	Mild	6
	MECULA	1	1	Weekly	High	Both	High	Mild	12
	METARICA	1	1	Yearly	None	None	Questionable	Mild	5
	MUEMBE	1	1	Yearly	None	None	High	Minor	8
	NGAUMA	1	0	Absent	Absent	Absent	Questionable	Mild	6
	NIPEPE	1	1	Yearly	None	None	Medium	Mild	7
	SANGA	1	1	Yearly	Medium	Livestock	High	Minor	12
SOFALA	BUZI	1	0	Absent	Absent	Absent	Questionable	Mild	7
	CAIA	1	0	Absent	Absent	Absent	Questionable	Mild	5
	CHEMBA	1	1	Yearly	None	None	Poor	Mild	6
	CHERINGOMA	1	1	Weekly	Medium	Human	High	Mild	16
	CHIBABAVA	1	1	Yearly	None	None	Questionable	Mild	6
	DONDO	0	0	Absent	Absent	Absent	Medium	Mild	5
	GORONGOSA	1	1	Weekly	Low	Livestock	High	Mild	13
	MACHANGA	1	1	Yearly	None	None	High	Minor	7
	MARINGUE	1	1	Yearly	None	None	Medium	Mild	8
	MARROMEU	1	1	Monthly	Medium	Both	High	Mild	16
	MUANZA	1	1	Monthly	None	None	High	Mild	11
	NHAMATANDA	1	0	Absent	Absent	Absent	Questionable	Mild	4
TETE	ANGONIA	0	0	Absent	Absent	Absent	High	Minor	7
	CAHORA BASSA	1	1	Monthly	Low	Livestock	High	Mild	18
	CHANGARA	1	1	Yearly	None	None	High	Minor	11
	CHIFUNDE	1	1	Monthly	None	None	High	Mild	13
	CHIUTA	1	1	Monthly	Low	Livestock	High	Mild	10
	LUENHA	1	1	Yearly	None	None	High	Minor	11
	MACANGA	1	1	Monthly	Low	Livestock	High	Mild	9
	MAGOE	1	1	Monthly	High	Livestock	High	Mild	18
	MARAVIA	1	1	Monthly	Medium	Both	High	Mild	21
	MOATIZE	1	1	Yearly	None	None	Poor	Mild	6
	MUTARARA	1	1	Yearly	None	None	Medium	Mild	5
	TSANGANO	0	0	Absent	Absent	Absent	Medium	Mild	7
	ZUMBU	1	1	Monthly	High	Livestock	High	Mild	13
ZAMBEZIA	ALTO MOLOCUE	0	0	Absent	Absent	Absent	Poor	Mild	2
	CHINDE	1	0	Absent	Absent	Absent	Questionable	Mild	4
	GILE	1	1	Yearly	None	None	Medium	Mild	4
	GURUE	0	0	Absent	Absent	Absent	Poor	Mild	2
	ILE	1	1	Yearly	None	None	Questionable	Mild	3
	INHASSUNGE	0	0	Absent	Absent	Absent	Poor	Mild	2
	LUGELA	0	0	Absent	Absent	Absent	Poor	Mild	2
	MAGANJA DA COSTA	1	1	Yearly	None	None	Questionable	Mild	4
	MILANGE	1	0	Absent	Absent	Absent	Questionable	Mild	3
	MOCUBA	0	0	Absent	Absent	Absent	Poor	Mild	2
	MOPEIA	0	0	Absent	Absent	Absent	Poor	Mild	4
	MORRUMBALA	0	0	Absent	Absent	Absent	Poor	Mild	2
	NAMACURRA	1	0	Absent	Absent	Absent	Questionable	Mild	2
	NAMARROI	0	0	Absent	Absent	Absent	Poor	Mild	2
	NICOADALA	1	0	Absent	Absent	Absent	Questionable	Mild	4
	PEBANE	1	1	Yearly	None	None	Medium	Mild	4

APPENDIX III
Survey's synthetic database – Conservation Area level

Conservation Area		Surface (km²)*	Range		Frequency of observation	Frequency of conflict	Type of conflict	Level of knowledge	Gaps in knowledge	Source (N)
Name	Nature		Raw data	Refined data						
Hunting block A	National Reserve	3022	1	1	Weekly	High	Human	High	Mild	8
Hunting block B	National Reserve	2215	1	1	Weekly	High	Human	High	Mild	8
Hunting block C	National Reserve	4649	1	1	Weekly	High	Human	High	Mild	9
Hunting block D1	National Reserve	2407	1	1	Weekly	High	Human	High	Mild	9
Hunting block D2	National Reserve	3620	1	1	Weekly	High	Human	High	Mild	8
Hunting block E	National Reserve	3660	1	1	Weekly	High	Human	High	Mild	9
Hunting block R2	National Reserve	2427	1	1	Weekly	High	Human	High	Mild	8
Hunting block R3	National Reserve	2834	1	1	Weekly	High	Human	High	Mild	7
Hunting block L3	National Reserve	2476	1	1	Weekly	High	Human	High	Mild	8
Niassa	National Reserve	44046	1	1	Weekly	High	Human	High	Mild	8
Coutada Nicage	Hunting Area	544	1	1	Weekly	High	Both	High	Mild	6
Quirimbas	National Park	9013	1	1	Weekly	High	Both	High	Mild	8
Chipenje Chetu	Community Program	6357	1	1	Weekly	None	None	High	Mild	6
Gile	National Reserve	2861	1	1	Yearly	None	None	Medium	Mild	4
Daque	Community Program	6370	1	1	Yearly	None	None	Medium	Mild	5
Chinthopo	Community Program	3030	1	1	Weekly	High	Livestock	High	Mild	8
Chifunde	Community Program	3770	1	1	Weekly	None	None	Medium	Major	4
Muze	Community Program	2475	1	1	Weekly	High	Livestock	Medium	Major	4
Chawalo	Community Program	3510	1	1	Weekly	High	Livestock	Medium	Major	4
Ntuvi	Community Program	2850	1	1	Yearly	None	None	Medium	Mild	3
Chiputu	Community Program	2920	1	1	Monthly	Low	Livestock	Medium	Mild	3
Nhenda	Community Program	2945	1	1	Weekly	Medium	Livestock	Medium	Major	4
Chipera	Community Program	3100	1	1	Monthly	None	None	Medium	Mild	4
Empty extension	Hunting Area	2477	1	1	Monthly	Medium	Livestock	Questionable	Major	1
Gorongosa	National Park	3750	1	1	Weekly	None	None	High	Mild	12
Marromeu	National Reserve	1561	1	1	Monthly	Medium	Both	High	Mild	10
Coutada 6	Hunting Area	3042	1	0	Absent	Absent	Absent	Questionable	Mild	6
Coutada 7	Hunting Area	4764	1	0	Absent	Absent	Absent	Questionable	Mild	5
Coutada 9	Hunting Area	3761	1	1	Monthly	None	None	High	Mild	7
Coutada 10	Hunting Area	2600	1	1	Monthly	None	None	High	Mild	9
Coutada 11	Hunting Area	1868	1	1	Weekly	None	None	High	Mild	8
Coutada 12	Hunting Area	2734	1	1	Monthly	None	None	High	Mild	9
Coutada 13	Hunting Area	5904	1	1	Monthly	None	None	High	Mild	7
Coutada 14	Hunting Area	646	1	1	Monthly	None	None	High	Mild	10
Limpopo	National Park	10781	1	1	Weekly	High	Livestock	High	Mild	9
Banhine	National Park	7047	1	1	Yearly	None	None	Medium	Mild	5
Zinave	National Park	4618	1	1	Yearly	None	None	Medium	Mild	4
Coutada 4	Hunting Area	3194	1	1	Yearly	None	None	Medium	Mild	4
Coutada 5	Hunting Area	5727	1	1	Yearly	None	None	High	Minor	7
Chimanimani	National Park	1740	1	0	Absent	Absent	Absent	Questionable	Mild	5
Pomene	National Reserve	150	0	0	Absent	Absent	Absent	Questionable	Mild	1
Maputo	National Reserve	778	0	0	Absent	Absent	Absent	Medium	Mild	3