LION CONSERVATION IN WEST AND CENTRAL AFRICA

Integrating Social and Natural Science for Wildlife Conflict Resolution around Waza National Park, Cameroon

Hans Bauer

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Dissertation defended at Leiden University,

The Netherlands, on 17 September 2003.

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ISBN 90-9017184-3
Cover photo: Barbara Meihuizen
Photos: Hans Bauer, Paul Scholte, Paul Loth

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Acknowledgements

The unofficial keyword of this thesis is serendipity. The idea started in 1995, but the research proposal was not funded then. Instead, I set out to become an expatriate bureaucrat in Cameroon, with a part-time research assignment. As contracts were extended over and again, the volume of fieldwork grew steadily, to the several man-years required for a thesis. Students also continued to request topics to work on, and overall fifteen students worked under my supervision, adding another six man-years. Back in Holland, my intention of dropping raw data into a dusty drawer and leaving for another expatriate job was blocked by personal circumstances. Staying at Leiden University allowed me to drain brains around the world with the wonderful instrument called e-mail, and after two more years of plodding dutifully through the data at Leiden University, this thesis emerged. All through this process, many people were essential in giving information, motivation, guidance, support or just fruitful frustration. Mentioning all names would fill many pages; I will mention a few names, but those that do not find their names here are not forgotten! Chapters that were published as articles were largely reprinted as published and contain separate acknowledgements.

I am grateful to all my colleagues at the Centre of Environmental Science (CML), especially Hans de Iongh, Helias Udo de Haes, Wouter de Groot, Mariska de Jong, Paul Scholte, Ruth Noorduyn, Natascha Zwaal, Marieke Hobbes, Diny van Est, Gerard Persoon, Annelies Oskam, Jose van Santen, Paul Loth, Merlijn van Weerd, Paul Langeveld, Huub Peters, Ingvild Harkes, Edith de Roos, Maarten ‘t Zelfde, Ludmilla van der Meer, Erik Kien, Jakkus van der Salm, Astrid Kreischer and Roswitha Adelaar. Furthermore, I acknowledge the insightful remarks of Herbert Prins of Wageningen University, both as regular visitor and as referee.

I am grateful to all staff of the Centre for Environemt and Development studies in Cameroon (CEDC), especially Madi Ali, Martin Tchamba, Ismailou Adama, Hanson Njiforti, Francis Tarla, Eric Fotsing, Arabi Mouhaman, Jean Pierre Mvondo and Theodore Mayaka (MT and HN also in their current capacity at WWF Cameroon). I’m also grateful to all CEDC support personnel: drivers, secretaries, garage and maintenance personnel and my research assistants Sylvain Tiawoun and Ngomena Vincent. A special word or remembrance for Hamidou Hamadou, the driver who was killed by poachers in Waza NP.

I acknowledge the collaboration of the Ministry for Environment and Forests, in particular the permission to do research and the assistance of Denis Koulagna, Mahamat Habibou, Saleh Adam, Badama Paul, Hamadou Paul and the guards and guides of Waza NP. Furthermore, I acknowlegde the support of the Ministry for Higher Education and the University of Dschang, especially Prof. Tchuente, Prof. Bouelet, Prof. Mpoame and Prof. Tchala Abina. I'm also grateful to the Garoua Wildlife College, especially Jean Ngog, Ibrahim Njoya and staff.

Several organisations contributed to the work. First, the Waza Logone Project, executed by the World Conservation Union (IUCN), CML and the Netherlands Development Organisation (SNV), with Daniel Ngantou, Maureen Roell, Tineke Ceelen, Roger Kouokam, Saidou Kari and Serge Bobo Kadiri. Secondly the IUCN African Lion Working Group with Sarel van der Merwe, Johan Naude, Petri Viljoen, Graham Hemson, Iliara Di Silvestre and Gus Mills. Thirdly, the IUCN Cat Specialist Group and Conservation Breeding Specialist Group with Peter Jackson and Ulie Seal. Fourthly the Dutch Foundation Zoos Help, especially Frank Princée, and World Wide Fund for Nature Netherlands (WNF), especially

Gerhard van den Top and Miriam van Gool. Fifthly, the Elephant Camp, especially Per Aarhaug, Jeerima Djibrila, Magali Jacquier, Christiaan van der Hoeven and Patricia Bekhuis. Finally, I'm grateful to the members of the West and Central African Lion Network, especially Aristide Tehou and Etotepe Sogbohossou.

I also acknowledge the assistance of the following students: Norbert Sonne, Youssoufa Maty, Boubakary Bello, Christiaan van der Hoeven, Hanneke van Ormondt, Calijn de Nieuwenboer, Tessa Wiegman, Godelieve Kranendonk, Elisa Kroese, Ngomeni Arlende, Mittouang, Dominique Gammi, Daan Schoemaker, Margriet Pluymakers, Vivian Van Oosten and Simon Maes.

Furthermore, I'm grateful to Hubert Planton, Guillaume Chapron, Thierry Lode, Therese 'Bamenda' Forteke, Sjaak Kaandorp and Stephany Kersten for valuable discussions and Barbara Meihuizen for the cover photograph. I'm grateful to the people living around Waza NP for their patience and hospitality. This work was entirely funded by Leiden University and my salary was partially funded by the Netherlands Organisation for International Cooperation in Higher Education (NUFFIC), I wish to show my gratitude to the Dutch tax-payer through these institutions.

I thank family and friends for their continuous support, especially Iris, Max and Oscar. Finally, I gratefully acknowledge the assistance of Falama Soudi, without whose tracking skills, experience and hospitality fieldwork could not have succeeded.

PART I

BACKGROUND

Part I comprises three chapters (Chapters 1-3) and contains the research framework and background information. Chapter 1 introduces the research area, the research questions, and explains the structure of the thesis. Chapter 2 gives a review of visions on conservation in Africa and a description of conservation policies in Cameroon, with special reference to Waza NP (Chapter 2). Chapter 3 elaborates on the multitude of interactions between the park and the human population and the way this is dealt with in the management plan of Waza NP.

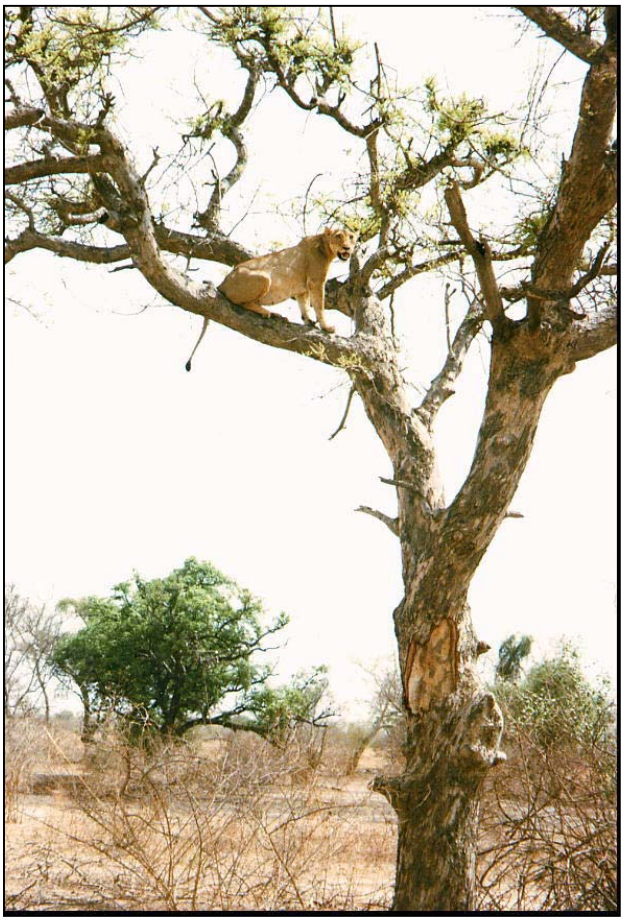

Photo 1: Lioness in the woodland zone of Waza NP.

Chapter 1:

Introduction

Photo 2: Flat Sahel landscape with inselberg.

1.1 General introduction

Biodiversity loss due to species extinction is a major environmental problem (Myers, 1979; Hammond, 1995; Hilton-Taylor, 2000; Pimm *et al*. 2000). Even sceptics of environmental degradation agree that the global ecosystem is undergoing biological impoverishment, although they may differ from mainstream environmentalists as to how serious that is (Simon *et al*., 1996; Lomborg, 2001). Critics object to the subjectivity of speculations on extinction rates, but most authors agree that humankind accelerates the extinction of species at a rate of between 1000 and 10.000 times the rate of 'background' extinction, thereby losing for ever the ecological, economic and spiritual functions of those species (May *et al*., 1995).

Protected areas alone will not be sufficient to conserve biodiversity (Burkey, 1995; Soule & Sanjayan, 1998), but they are an important instrument especially if their location is well chosen (Myers *et al*, 2000; Balmford *et al*., 2001). In 1992, about 10% of Sub-Sahara Africa was set aside for conservation of biodiversity in different types of protected areas, which was exactly the target agreed upon internationally (McNeely *et al*., 1994). But gazetting a protected area is not the same as protecting it, and conservation in protected areas is all but secure (Bruner *et al*., 2001; Inamdar *et al*., 1999). This thesis aims to contribute to the discussion on conservation effectiveness in protected areas, especially for species with large dispersal areas and a high potential for conflict with human land use, such as the African lion (*Panthera leo*, Linnaeus 1758).

This thesis describes the status of the African lion in general and in West and Central Africa in particular. The regional status is illustrated in detail by the case of Waza National Park (NP) in the Far North province of Cameroon. Waza NP is a classical 'hard edged park', a park with high biodiversity inside and high human densities outside, with little space in-between. Notwithstanding this hard edge, many interactions exist between the park and the people around it. Interactions are bi-directional: people enter the park illegally to use the rich natural resources and animals go out – either pushed by resource degradation inside the park or pulled by local people's crops or livestock to feed. These interactions will be described in several chapters, but Figure 1.1 already gives a good first impression: elephant destroying crops, lion killing livestock, birds preying on cereals and conflict between local people and park authorities.

Two species of Waza NP are important in terms of both tourist attractiveness and human wildlife conflict: elephant (*Loxodonta africana*, Blumenbach 1797) and lion. The human-elephant conflict was elaborately described by Tchamba (1996); this thesis focuses on the human-lion conflict. During the research period, knowledge on lion populations in the West and Central African region was compiled, showing that the lion may be regionally endangered. Waza NP was shown to be representative of problems and trends in the entire region, which increases the relevance of this thesis to lion conservation beyond the local level.

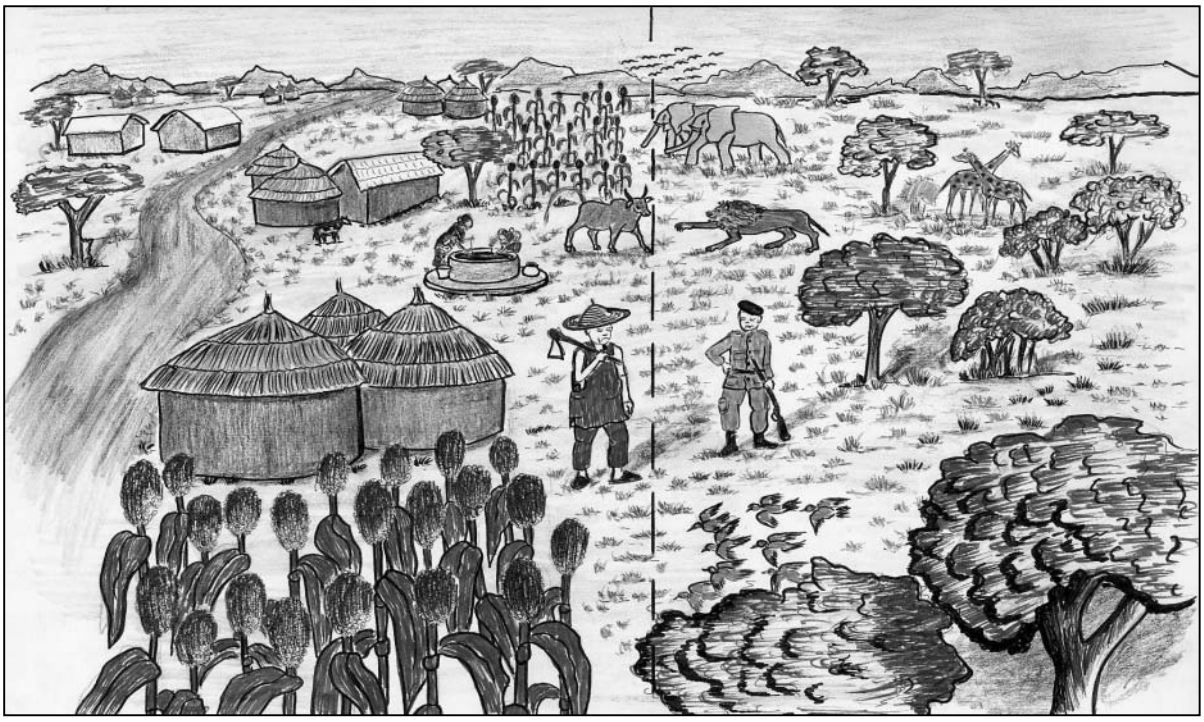

Figure 1.1: An impression of human wildlife conflicts by a local artist (Pierre Cafor).

1.2 Research questions

This thesis aims to answer the following research questions:

1. What is the conservation status of the African lion:
    a. how many lions live in Africa and how are they distributed;
    b. what are the trends in population sizes;
    c. what is the species' status in international conventions and national legislation;
    d. and which factors cause the decline of lion populations in West and Central Africa?
2. How may human-lion conflict around Waza National Park be described:
    a. which methods can be used to describe predator damage;
    b. what is the economic impact of depredation around Waza NP;
    c. and is there differentiation among individual lions with regard to livestock depredation?
3. Which conservation strategies are most appropriate for lion conservation in general and for the context of Waza National Park in particular:
    a. what are the current conservation strategies and how have they evolved;
    b. and which strategies are likely to enhance lion population viability?

1.3 Study area

1.3.1 Abiotic environment

Waza NP is a biosphere reserve of approximately 1600 km^2, located between 10º50' and 11º40' latitude and 14º20' and 15º00' longitude (Fig. 1.2). Waza NP is very flat at 320 m. above sea level in the West and 300 m. above sea level in the East. Undulations in the Western half can be up to a few metres, but the Eastern half generally has gradients of only a

few centimetres per kilometre. Exceptions to this relief are three granite inselbergs around the village of Waza near the main park entrance and one near the village of Mokoche. Soils of Waza NP can be divided into sandy soils in the West and clay in the East (Anonymus, 1997).

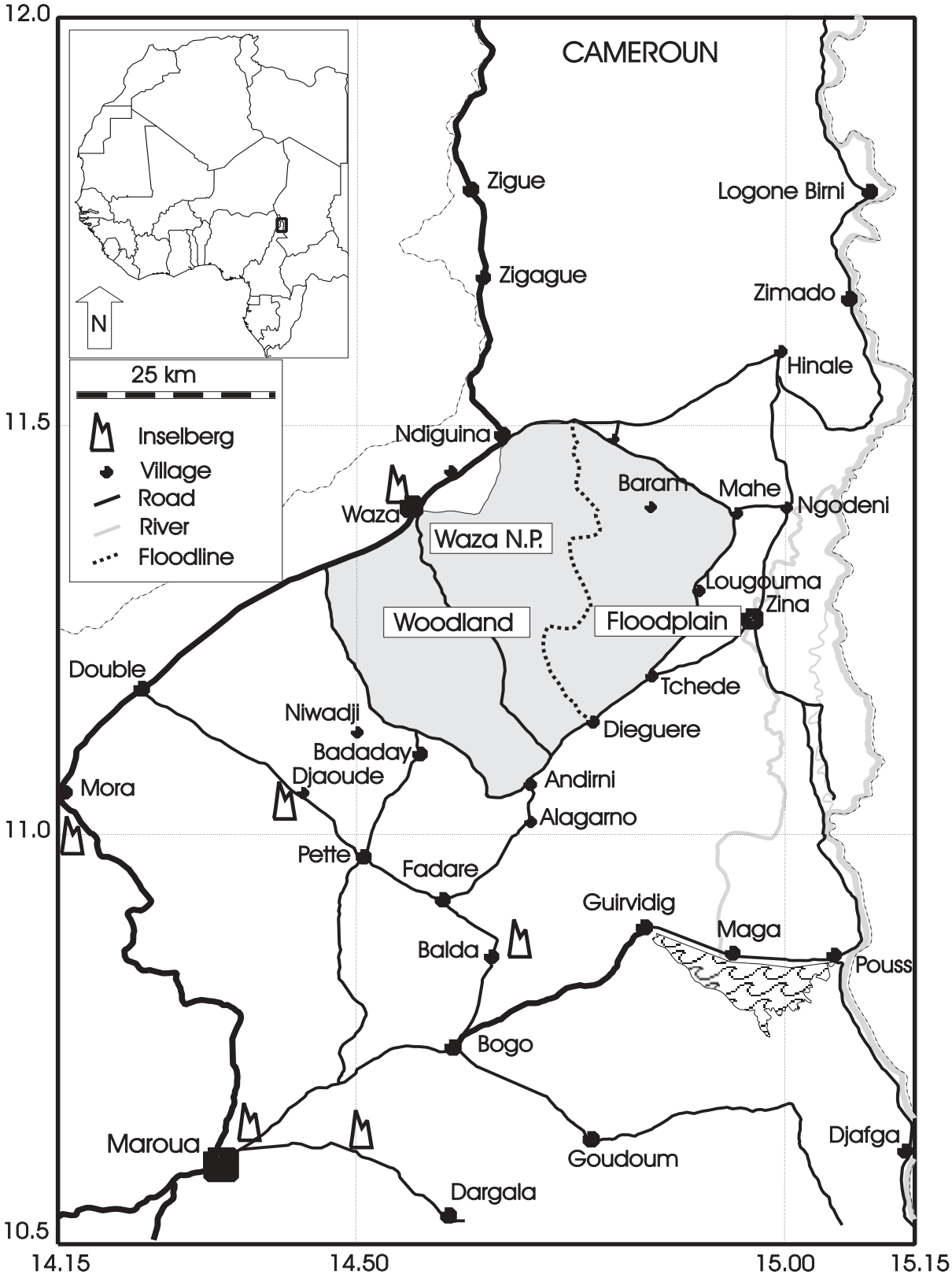

Figure 1.2: Study area.

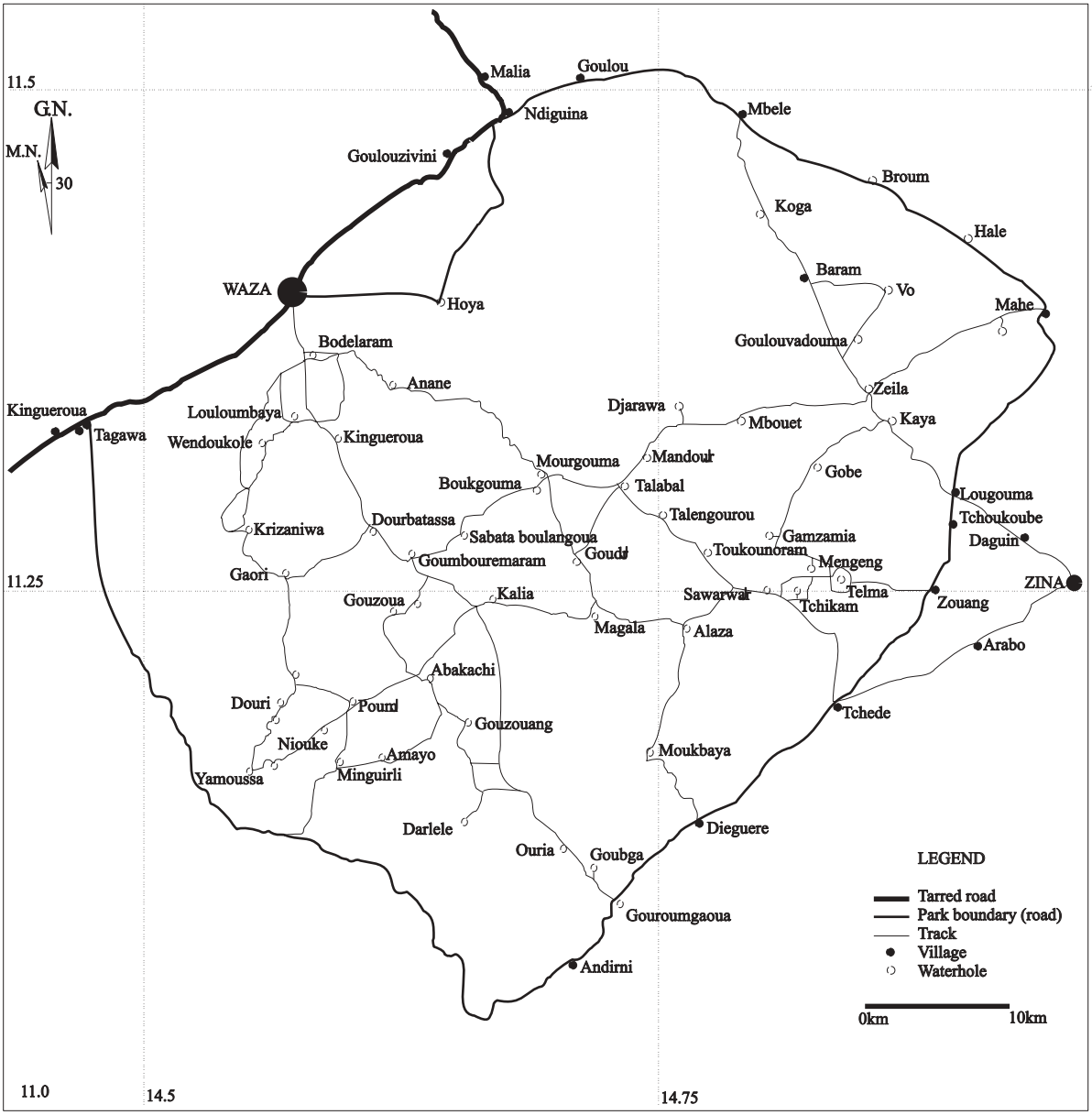

Figure 1.3: Waza National Park.

The climate of Waza NP is Soudano-Sahelian, semi-arid tropical with three seasons: rainy season (June – October), cold dry season (November – February) and hot dry season (March – May). Temperatures range from 15°C (January mean minimum) to 48°C (April mean maximum). Rainfall is irregular between years, with an annual mean of 600 mm in one rainy season (Beauvillain, 1995).

Waza NP does not have a permanent river and only a small number of permanent waterholes. The Western half has many natural and artificial waterholes that fill up during the rainy season. All except three artificial waterholes dry up during the dry season in most years. In the Eastern half, a large part is inundated during the rainy season and flooded by excess water from the Logone river, close to the park, but here too only a few waterholes contain water until the end of the dry season. To the East of Waza NP are the river Logone and its branches Logomatya and Lorome Mazra. These rivers carry water to Lake Chad in the North and used to inundate a very large floodplain from October to February, including the Eastern half of Waza NP. The creation of the artificial Lake Maga by a dam from Guirvidig via Maga

to Pouss in 1979, combined with decreased rainfall, reduced this inundation considerably (Drijver & Marchand, 1985).

A map of Waza NP was made in 1975, indicating soils, vegetation, waterholes and roads (Wit, 1975). Since then, some roads have been abandoned, newly created or diverted and the coordinates of landmarks such as waterholes have been determined more precisely with the use of new technology. A new topographic map was made (Fig. 1.3) by driving along all known roads and marking all landmarks, using a Global Positioning System receiver to feed coordinates into a Geographical Information System (IDRISI).

1.3.2 Biotic environment

The vegetation of Waza NP is divided into three categories: floodplain vegetation, *Acacia* savannah and woodland; the latter two are sometimes combined and described as the 'forest zone'. The floodplain is periodically inundated and dominated by grasses like *Sorghum arundinaceum, Pennisetum ramosum, Echinochloa pyramidalis, Oriza longistaminata, Hyparrhenia rufa* and *Vetiveria nigritana*. The *Acacia* savannah is a zone with clay soils between the floodplain and the woodland and is dominated by *Acacia seyal* trees interspersed with *Balanites aegyptiaca, Piliostigma reticulata* and *Sorghum arundinaceum*. The woodland zone is on sandy soils and is dominated by *Sclerocarya birrea, Anogeissus leiocarpus* and *Lannea humilis* (Wit, 1975; Scholte *et al*., 2000)

Waza NP has an important animal diversity, especially avifauna with 379 species including ostrich (*Struthio camelus*, Linnaeus 1758) and crowned crane (*Balearica pavonina*, Linnaeus 1758) (Scholte *et al.*, 1999). There are at least 30 species of mammals, including elephant, lion, giraffe (*Giraffa camelopardalis*, Linnaeus 1758), spotted hyena (*Crocuta crocuta,* Erxleben 1777), striped hyena (*Hyaena hyaena*, Linnaeus 1758), kob (*Kobus kob*, Erxleben 1777), topi (*Damaliscus korrigum,* Burchell 1823), roan antilope (*Hippotragus equinus*, Desmarest 1804), gazelle (*Gazella rufifrons*, Gray 1846), warthog (*Phacochoerus africanus*, Pallas 1676), reedbuck (*Redunca redunca*, Pallas 1767) and Grimm's duiker (*Sylvicarpa grimmia*, Linnaeus 1758) in addition to smaller or less abundant species (Tchamba & Elkan, 1996; Anonymus, 1997). The latter two species have become extremely rare and might join the list of species that have become locally extinct over the last few decades: leopard (*Panthera pardus*, Linnaeus 1758), cheetah (*Acinonyx jubatus*, Schreber 1775), waterbuck (*Kobus ellipsiprymnus*, Ogilby 1833), bushbuck (*Tragelaphus scriptus*, Pallas 1776) and red flanked duiker (*Cephalophus rufilatus*, Gray 1846) (Anonymus, 1997; Bauer & Kari, 2001).

Number and distribution of most large species in Waza NP is known, a variety of census methods has been used at regular intervals for over 30 years (Tchamba & Elkan, 1996; Anonymus, 1997). An exception is the lion, for which conventional census methods do not provide reliable results and which therefore requires specific census methods (see Chapter 4). At the time of our fieldwork, the working figure for the population size was 60 lions (excluding cubs), based on educated guesses and taking prey census data into account (see Chapter 5). The validity of this figure could not be confirmed within the framework of this study, but was later confirmed by a calling station survey (Schultz & Turk, 2002).

1.3.3 Human environment

As in most rural areas in West and Central Africa, several 'ethnic groups' co-exist in the area. Use of the term 'ethnic group' is not without problems (Barth, 1969; Banks, 1996); we use it

for 'groups with a self-ascribed cultural identity', a definition that recognises the dynamic nature of the term. The research area is a rural area where lifestyles are largely based on tradition, and where ethnic groups each have their own language and cultural identity. Over the time span of our research, the stability of these groups was such that categorisation along locally determined ethnic boundaries was justifiable. Moreover, the concept is widely used and recognised as important for natural resource management studies (Rambo *et al.*, 1988; Van Den Breemer & Venema, 1995; Seignobos & Iyébi-Mandjek, 2000). Many decisions are taken at household level and are influenced by an array of individual parameters ('within-group variability'), but in our research area decisions on land use have also traditionally varied between ethnic groups ('between-group variability'). For example, individuals within an ethnic group are mostly involved in the same production system. Thus, use of the term ethnic group in our context is relevant and useful, although we realise that any categorisation is a generalisation.

The main production systems around Waza NP are fisheries, animal husbandry and agriculture. Among the pastoralists, the largest ethnic group are the Fulbé, followed by the Arab Choa. An ethnic group in the floodplain mainly involved in fisheries are the Kotoko. Another major ethnic group, the Mousgoum, is involved in agriculture, fisheries and small-scale animal husbandry. Originally, there were several villages inside what is now Waza NP. When the area was given National Park status in 1968, these villages were forced to move. Some received limited compensation, others were forced out without any compensation. One village resisted and is still inside the park, now illegally. Most other villages resettled on the borders.

Both Waza and Zina are sub-district capitals or '*sous-prefectures*' with a permanent administrative unit and basic education and extension services. There are a few primary schools in the other villages, but generally state intervention is perceived as absent or dysfunctional. The park management structure is the most prominent interface between local people and the state. Administratively, the park warden or '*conservateur*' is responsible for the management of the park and his operational unit (10 rangers, 1 mechanic, 2 cars, 1 shovel, basic equipment). He is accountable to the Provincial Delegate for Environment and Forests in Maroua, capital of the Far North province, who in turn is accountable to the central government services, c.q. the Direction of Wildlife and Protected Areas of the Ministry of Environment and Forests in the national capital, Yaounde.

An Integrated Conservation and Development Project (ICDP) has been working in the area since 1993, the Waza Logone Project (WLP). This project has been funded by the Netherlands and executed by the World Conservation Union (IUCN), the Centre of Environmental Science of Leiden University (CML) and the Netherlands Organisation for International Cooperation (SNV). A major task of the WLP was ecological restoration and mitigation of the hydrological changes in the Logone floodplain. These activities are beyond the scope of this thesis; they are elaborately described by Scholte (*in prep*.) and Loth (*in prep.*). In the present study, we will focus on the WLP activities related to the management of Waza NP.

1.4 Outline of this thesis

This thesis aims to contribute to the disciplines of environmental science and conservation science, both multi-disciplinary and problem oriented sciences. The aim of theory

development in either social or natural science was subservient to the aim of integration of the two. This thesis is divided into three parts as follows.

Part I (Chapters 1-3) starts with a review of visions on conservation in Africa and a description of conservation policies in Cameroon, with special reference to Waza NP (Chapter 2). Chapter 3 elaborates on the multitude of interactions between the park and the human population and the way this is dealt with in the management plan of Waza NP. Together, they contain the background information and the research framework.

Part II of this thesis (Chapters 4-8) focuses on the human-lion conflict. Chapter 4 presents an inventory of lions in Africa, which suggests that the species may be classified as regionally endangered in West and Central Africa. Chapter 5 presents regional trends and causes of decline of lion populations in West and Central Africa. These chapters show that the case of Waza NP is representative for an urgent regional problem. Chapter 6 presents detailed information on human conflict with predators as assessed with participatory research techniques. Chapter 7 presents information on lion ecology and shows differentiation between individual lions with regard to the damage they inflict on livestock. An appendix describes an observation on behaviour of one of those lions that lies outside the story line of this thesis but is too unique to ignore: the use of a tool. Chapter 8 describes the differences between lion social organisation in two regions of Africa and offers explanatory hypotheses.

Part III (Chapters 9-11) focuses on conservation aspects by discussing the findings of part II in relation to the context as described in part I. It starts with a comparison of different research methods as different angles to look at human-lion conflict (Chapter 9). It continues with an examination of various conservation strategies and proposes a new strategy which addresses the specific difficulties of carnivore conservation (Chapter 10). Chapter 11 offers an overall discussion and concludes how the findings relate to the management of Waza National Park and formulates recommendations. Then follow the summaries in English, French and Dutch.

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Chapter 2:

Participation in Protected Areas

Photo 3: Herd of cattle on the border of Waza NP.

2.1 Description of terms

Many terms commonly used in literature on participation in protected area management are ambiguously described and are used differently between authors. This is especially true for the term 'co-management', which needs to be defined for use in the present dissertation. In order to define co-management, we need to describe the context, consisting of several related terms that are relevant for the African situation in general and the Cameroonian situation in particular. These terms are different but related dimensions of power relations between governments and communities: participation, ownership and sovereignty.

The most relevant dimension is participation. Participation is defined as 'taking part in something'. Participation is usually presented as a continuum of power sharing between two parties, in our case a government and a community (Pimbert & Pretty, 1997). This continuum is presented as Line B in Fig. 2.1; variations of this figure can be found in various other publications (e.g. Anonymus, 1994; Berkes, 1994a;). This continuum can be divided into categories that are described as follows. 'Instructive participation' implies that local people undertake action based on instructions by a government. 'Consultative participation' means that local people are consulted, their input is used but the responsibility for analysis, decision making and evaluation rests with their government. In 'cooperative participation', local people and government strive for synergy, consensus or compromise and sharing of responsibility. In 'advisory participation', a government advises a local community, whereas that community has the prerogative of decision making. In 'informative participation', a community is autonomous and informs the government. The extremes on both sides are no participation, in the case of communities this is also called 'self mobilisation'.

Participation can be applied to different things. Applied to protected area management, it gives Line A in Fig. 2.1. Line A is also a continuum that can be divided into categories as proposed by Barrow & Murphree (2001), that are described as follows. 'Fortress conservation' means that a government controls an area and fences it off from local communities, either physically or by legal and/or economic regulations. 'Park outreach' means that a government controls an area while addressing some of the problems and needs of populations living around protected areas, for example through benefit sharing, local employment, wildlife damage compensation etc. Park outreach implies that local people get rights to some benefits but acknowledges paramount responsibility and discretion of a government over park resources. In contrast, 'co-management' means that communities and governments actively manage a protected area together under shared responsibility. 'community-based conservation' can be described as conservation by and for the local community: responsibility and benefits of biological resources rest with the local community while the government gives advice and maintains an enabling policy framework. Finally, we discern a category that was not included by Barrow & Murphree (2001) and for which we will use the term 'Cultural protection'. This category includes conservation of species or ecosystems based on local culture, without government interference (e.g. 'sacred forests', 'totem species', etc.) (Laird, 1999, Posey, 1999). UNESCO labels areas with cultural protection 'Cultural landscapes'; this is an example of the category implied here. For the management categories of Line A in Fig. 2.1, the category of Line B exactly below it usually best describes the concomitant type of participation. The three categories in the middle if Line A are sometimes referred to as 'participatory management'.

Our description of co-management is compatible with the definition proposed by Borrini-Fayerabend (1997): the sharing of rights and responsibilities between government and citizens. The term ‘co-management’ is used for several types of management arrangements, the essential common elements are sharing of responsibility and institutionalised collaboration in management. Note that management refers to 'being responsible for controlling or organising something' (Cambridge dictionary). Here, co-management implies institutionalised and factual collaboration in the control over a natural area and the organisation of its exploitation. Institutionalisation can be in the form of boards with statutes and formal contracts regulating specific issues, or in the form of verbal agreements and customary law, parallel to the styles of management discerned by Evans (1996) and labelled 'complementarity' and 'embeddedness', respectively. The important criteria are that collaboration is not just occasional and is about real management issues. Specific aspects of management may deviate and may even be more characteristic of other categories as long both parties collaborate on a majority of aspects. For example, an area may be described as co-managed if all management decisions are jointly taken except e.g. the digging or maintenance of waterholes, or the setting of hunting quota being done unilaterally.

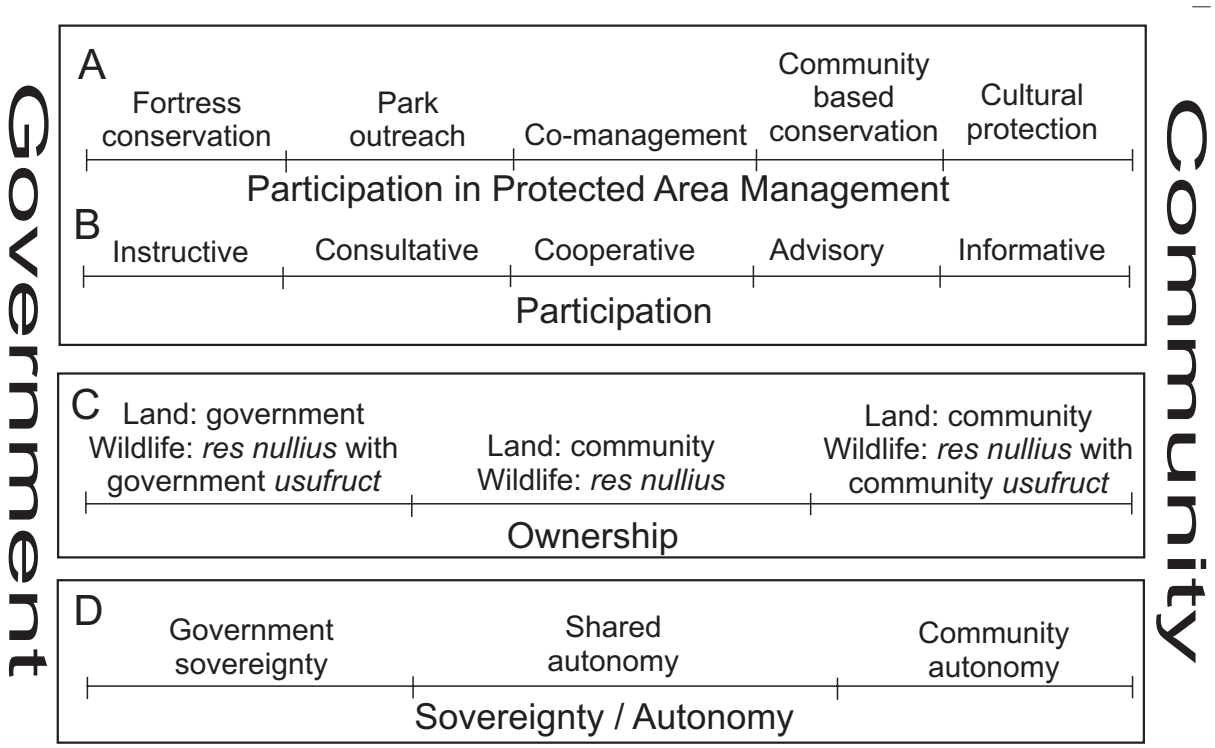

Figure 2.1: Three different but related dimensions of power relations between governments and communities; participation in general (B) and applied to protected area management (A), ownership (C) and sovereignty (D). N.B. dimensions have independent scales.

A different dimension of power relations is ownership, represented by Line C in Fig. 2.1. This dimension has been elaborately described by Child & Chitsike (2000). Here we only discuss the most relevant categories. Land can be private property of a natural or legal person under statutory or customary law, common property, or state property. Wildlife can only be owned if it is domesticated or fenced, otherwise it is called a 'fugitive resource', i.e. not restricted by

land property boundaries (Child & Chitsike, 2000). Therefore, wildlife ownership is less easily defined and not necessarily linked to land. In many countries, including Cameroon, free ranging wildlife has the status of *res nullius*; no one's property irrespective of land ownership, for which the state claims management responsibility without assuming liability for wildlife damage. In practice, states usually only manage and use wildlife in protected areas. On common land, however, state management is only nominal and local utilisation has the characteristics of common property (*res communes*) with its associated management problems and opportunities (Hardin, 1968; Ostrom, 1990; Berkes, 1994b). Only a few African countries (e.g. Namibia, Zimbabwe) have adopted legislation to give landowners in certain areas the right to manage, use and benefit from wildlife as long as it is on their land, thereby giving it the characteristics of private property (Hitchcock, 2000). In Cameroon, however, this right can only be obtained in small state-designated hunting zones that are managed by individuals, communities or municipalities, but no such zones have been defined in our research area (Mayaka, 2003).

The last dimension of power relations considered here is sovereignty, or 'the power of a country to control its own government (Cambridge dictionary); this is line D in Fig. 2.1. In the post-colonial era and with the exception of Antarctica, the world has been divided into sovereign nation-states ('government sovereignty' in Fig. 2.1). However, some states recognise a restriction of their sovereignty and the right to self-determination and autonomy of certain communities, often 'indigenous peoples', in their own territory ('community autonomy' in Fig. 2.1) (Bilderbeek, 1992; Stevens, 1997; Gray, 1999; Posey, 1999). This can be based on either legislation (e.g. Aboriginals under the Aboriginal Land Rights Act, 1976) (De Lacy & Lawson, 1997), or provisions of a treaty signed during colonisation (e.g. Maori, Treaty of Waitangi, 1840) (Anonymus, 2000). In many cases, national governments and autonomous community leaders have negotiated classification of community land as a protected area under both their own and the national jurisdiction ('shared autonomy' in Fig. 2.1). In some cases, autonomous communities gave up use rights in exchange for the benefits of a lease contract with the national government (e.g. Uluru-Kata Tjuta National Park, also known as Ayers Rock, Australia) (De Lacy & Lawson, 1997). In other cases, the national protected area classification system was adapted to accommodate human resource use and/or residency (e.g. Korea, Australia and Brazil) (West & Brechin, 1991).

In Africa, several countries recognise the rights and customary law of indigenous peoples (e.g. Chardonnet, 1995; Hitchcock, 2000). To our knowledge, there are no known cases of restricted government sovereignty as a result of a treaty during colonisation. There are cases, however, of community autonomy granted by law in southern Africa (Koch, 1997). The most famous case of shared autonomy is the Pafuri section of Kruger National Park, restored to the Makulele people in December 1998, on the condition that it remains part of the Kruger NP and that mining, farming and permanent habitation will not be allowed (Ramutsindela, 2002).

The relation between the three dimensions of power relations, participation, ownership and sovereignty, is as follows. Community-based conservation or co-management are likely management arrangements for protected areas under community autonomy or shared autonomy; national governments cannot refuse community participation even if they would want to. However, the relationship is not exclusive: not all autonomous communities exercise their right, and non-autonomous communities can be granted the same right. Likewise, community property or usufruct rights are an important factor, but not a necessary condition,

for community participation in protected area management (Child & Chitsike, 2000; Child, 2000b; Adams & Hulme, 2002).

There are many definitions of co-management, some wider and some narrower. Some restrict use of the term to areas with shared autonomy (H.H.T. Prins, pers. comm.). Others use it for any arrangement that is not strictly state or community management (e.g. Pinkerton, 1994). Our description is somewhere in the middle and is supported by many scholars, for example Brechin *et al*. (1991): "Co-management refers to the substantial sharing of protected area management responsibilities and authority among government officials and local people". It is important to note, however, that conservation professionals mostly use it very lightly. An often cited article -actually an editorial- by Berkes (1994) describes it as any form of participatory management and states: "it would be pointless to define the term co-mangement more precisely because of the variety of arrangements possible". He recognises the risk of abuse as "a politically correct label for business as usual" and "a mechanism for co-optation", risks that we try to avoid by giving an explicit interpretation: Co-management is defined here as factual and balanced sharing of responsibility for and institutionalised collaboration in the control of a natural area by the government on one hand and local people on the other.

Co-management arrangements have been developed and are typically implemented on common land or in protected areas with multiple objectives such as community hunting zones or resource management areas. NP's, however, are the highest category of protection in many countries, and there co-management is more paradoxical (see Box 2.1). Logically and usually, the maximum degree of participation in NP's is 'consultative participation' and 'park outreach'.

With regard to Waza NP, the park belongs to the state and the area around it to the local people. More precisely, in terms of Fig. 2.1, the park management can be labelled as park outreach and consultative participation, land and wildlife are government property and the government has sovereignty. In contrast, the peripheral zone around Waza NP can be labelled as community conservation and advisory participation, land is community property while wildlife is *res nullius* and the government has sovereignty. Both are outside and on opposite sides of co-management as defined here. However, communities in a ring around the park agreed on calling their territory 'peripheral zone'. Representatives of these communities sit on a board, together with the park's managers, in which many issues relating to both the park and the peripheral zone are discussed and in which contracts are prepared to exchange rights and responsibilities (e.g. consumptive use of park thatch in exchange for denouncement of poaching). This will be discussed in more detail below, here it is important to note that the peripheral zone and the park are managed by different parties while the interactions between them are co-managed by these parties.

2.2 Recent history of participation in protected area management

Conservation in the 19th and early 20th century had relatively simple objectives and management principles. The ideal was preservation of wilderness, which was defined as 'not influenced by humans' and which led to the management principle of exclusion of human activity; in terms of Fig. 2.1: fortress conservation (Adams & McShane, 1992; Adams & Hulme, 2001a).

Especially in developing countries, ideas about the role of humans in conservation changed during the second half of the 20th century. Participation became a new key notion. Adams & Hulme (2001a) identified six reasons for this change:

1. the popularity of 'sustainable development' and the idea that development and nature should not be viewed as opposite interests;
2. the concern about 'indigenous peoples' and the need to conserve 'traditional' rural lifestyles as well as wildlife;
3. the popularity of participation in development aid in general, moving from blueprint projects to bottom-up programmes;
4. the popularity of market-oriented mechanisms in general, especially the idea that liberalisation could be good for conservation and development if perverse subsidies were abolished;
5. the positive side effect that community organisation for conservation contributes to democratisation and political emancipation in general;
6. and finally the realisation that wildlife islands are not viable in the long term as fragments of nature surrounded by degraded land.

Persoon (2000) mentions a seventh reason, the growing importance and lobbying capacities of civil society in general and Non-Governmental Organisations (NGOs) in particular. Oates (1999) adds that conservation organisations also embraced this new style because it offered a possibility to tap into development funds which increased their funding sources and potential budgets manifold.

Participatory conservation has become a mainstream strategy in conservation in developing countries, promoted by both conservation multinationals like IUCN and WWF and development multinationals like Oxfam, UNDP and many national departments for international co-operation (Inamdar *et al*., 1999). Projects in this category are often referred to as Integrated Conservation and Development Projects (ICDP). They always have both conservation and development objectives, they assume that these interests are not mutually exclusive. Generally, their activities create conditions for a better relationship between local people and authorities (training of authorities in participatory techniques, facilitating participation of local people in meetings, etc.), facilitate sustainable use of resources, improve welfare conditions around the conservation area in compensation for not using the core area, etc. The idea is that by negotiating 'package deals' (e.g. a water pump in exchange for desired behaviour), by fostering positive attitudes and by giving people an interest in conservation of a resource, people will be motivated to end unsustainable practices and even collaborate in protection of the resource against outsiders. This is sometimes called 'social fencing' (Gillingham & Lee, 1999; Archabald & Naughton Treves, 2001; Mehta & Heinen, 2001).

Politically, participatory management also has a growing importance. This is illustrated by the three objectives of the United Nations Convention on Biological Diversity: conservation, sustainable use and equitable benefit sharing. These objectives imply that biological resources must be conserved, that they can be used sustainably, and that various groups have rights to the benefits. This does not automatically imply that local people should be involved in biodiversity management, but rights often come with responsibilities and in some cases the last objective can also read 'equitable sharing of responsibility'. In any case, these objectives demonstrate a vision of nature conservation with strong links to economy and society; until now, 186 nations have endorsed that vision by signing up to the convention (www.biodiv.org accessed on 30 October 2002).

In Africa, the first experiment away from 'fortress conservation' was the WINDFALL project launched in 1978 in Zimbabwe (Anonymus 1994). This was a top-down program for the distribution of some of the benefits of elephant culling, the first case of recognition of local rights and the idea that conservation must do 'something' with the population. In terms of Fig. 2.1, this is a typical example of Park Outreach. Before then, local people were just seen as an impediment to conservation, an alien element in the ecosystem and one of the most important causes of resource depletion. Since then, many programs for participatory management have been developed all over Africa.

The best known program of co-management in Africa is the CAMPFIRE (Martin, 1986) program in Zimbabwe which started in 1986 as a follow-up to WINDFALL. This program gives the wildlife department mandate to promote safari hunting and other wildlife-based income generating activities on communal lands by private enterprises, with a large part of the income going to the communities living in the area. In this program, decision making power on local issues are on district or community level, while issues on spatially or administratively higher levels (such as quota setting) are dealt with by politically higher levels. It was inspired by the economic success of safari hunting on private land after adoption of the 1975 Parks and Wildlife Act, granting landholders the right to use their wildlife commercially; CAMPFIRE aimed to extend this success to communal land (Child, 2000a). The three most important principles of CAMPFIRE are *sustainable development, wildlife utilisation* and *community empowerment* (Peterson, 1994).

The program's principle of sustainable development has a biological and a social dimension. The program sets quotas, controls animals and gives advice on land-use. It also assists in the realisation of community development projects such as schools, grinding mills and credit schemes, if a community decides to use a part of the revenues for such projects. In respect of the third principle, decision making power on how to spend the revenues is with the community, and they can choose simply to get cash ("wildlife dividends").

The program's principle of wildlife utilisation refers to the choice of wildlife exploitation following an economic rationale, with little attention for intrinsic values of nature: 'if it pays, it stays'. This choice is sometimes condemned by Western public opinion, influenced by animal rights organisations that use various media to publish pictures of butchered elephants, accompanied by statements arguing for a hunting ban. Wildlife utilisation has become widely accepted, however, and has become a mainstream activity in southern Africa (Grootenhuis & Prins, 2000).

The program's principle of community empowerment implies full participation by what is called in CAMPFIRE jargon 'producer communities'. Under the program, *appropriate authority* status with wildlife ownership is devolved to Rural District Councils, which should channel revenues from wildlife to the population with specific attention to equity (gender, social groups, damage compensation). These councils are mid-level authorities, faced with their own problems and varying interpretations of the non-binding guidelines on the shares of each group (Bond, 2001) This has led to cases of abuse and some authors criticise the program for failing to adopt further devolution to local communities (Olthof, 1995; Murombedzi, 2001). Child (2000a) describes several principles for the improvement of devolution and revenue sharing. Since then, however, the political situation in Zimbabwe has become unstable, and institutional progress in response to these critiques is not expected soon.

CAMPFIRE and its three principles are illustrative of all sorts of initiatives across Africa, although there are always local specific variations. Some continental and regional tendencies in the evolution of co-management programs are of interest. Southern Africa has the most promising and advanced programs, followed by East Africa (Child, 2000b). West and Central Africa, especially former French colonies, made a late start and have a common legacy of colonial legislation and administration which is very centralised and often an impediment to participation by the population. Burkina Faso features the Nazinga Game Ranch which includes a damage compensation scheme and which is almost two decades old, but it has always remained a top-down initiative (Anonymus, 1994).

2.3 Consumptive use in National Parks

Basically, every country (or in some countries lower levels of administration) has its own rules and regulations in relation to protected areas. In most countries, the highest category is a National Park (NP), with a definition that is usually compatible with the definition of the World Conservation Union (IUCN):

> *National Park*: Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible (IUCN, 1994).

The exact definitions differ between countries, a more useful concept for comparison are 'management objectives'. Most countries' protected areas can thus be compared and classified; Box 2.1 gives different categories as described by IUCN (1994) together with their management objectives. This classification was adopted at the 4th World Congress on National Parks and Protected Areas held in Caracas in 1994, and succeeded a classification published in 1978, in which the objective of NP's was defined as: 'to protect natural and scenic areas of national or international significance for scientific, educational, and recreational use'. Before 1994 the objectives of NP's were protection and recreation, after 1994 the word 'mainly' was added; before 1984 the definition excluded exploitation, after 1994 it excluded 'exploitation inimical to the purposes of designation of the area'. The difference is that the new definition cautiously accommodated community participation.

Box 2.1:Management objectives of categories of protected areas (IUCN, 1994):

I. Strict Nature Reserve/Wilderness Area: protected area managed mainly for science of wilderness protection.

II. National Park: protected area managed mainly for ecosystem protection and recreation

III. Natural Monument: protected area managed mainly for conservation of specific natural features.

IV. Habitat/Species Management Area: protected area managed mainly for conservation through management intervention.

V. Protected Landscape/Seascape: protected area managed mainly for landscape/seascape protection and recreation.

VI. Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems.

Co-management arrangements have been developed and are typically implemented on common land or in protected areas with multiple objectives such as community hunting zones or resource management areas. NP's, however, are the highest category of protection in many countries, and there co-management is more paradoxical. NP's are almost universally primarily owned and managed by the state, with limited community participation. Thus, the common degree of participation in NP's is 'consultative participation' and 'park outreach', with the exception of NP's under shared autonomy (see section 2.1). Still, equitable and sustainable arrangements may be reached for the use of such areas, including consumptive use, depending on local circumstances and national legislation.

In the IUCN definition, the tension between use and conservation has been solved by defining conservation as the priority while not ruling out forms of sustainable use, according to the definition cited above: "….exclude exploitation or occupation inimical to the purposes of designation of the area". The spirit of this definition is that exploitation of NP's must be avoided, but can be accommodated if it is necessary and if it is compatible with or conducive to conservation. It is generally accepted that any form of wildlife hunting is by definition incompatible, but there is a margin for sustainable use of other resources. Below are some cases of natural resource use in NP's.

In South Africa, the focus is currently on a case in the Kruger NP. The Pafuri section of this NP had long been claimed by the Makulele people, and this claim was settled in December 1998 by restoring the land to the community on the condition that it remains part of the Kruger NP and that mining, farming and permanent habitation will not be allowed (Ramutsindela, 2002). Other types of land-use are currently being discussed. This case is a test case and will create a precedent for the country. It is not yet clear what the outcome will be. In any case, hunting will certainly not be allowed, since a Makulele scheme to lease hunting contracts was ruled incompatible with the Kruger NP management plan (Fabricius, Koch & Magome, 2001).

In Zimbabwe, Namibia, Botswana and Tanzania, consumptive use in NP's is strictly illegal, although some CAMPFIRE proponents recently argued for usufruct rights in protected areas (Bond, 2001). In Madagascar, use of NP's is forbidden but policing is hard because of the mountainous terrain and resource extraction is in fact common (Shyamsundar, 1996). In Kenya, consumptive use is illegal, but as a form of compensation 25% of NP gate fees is offered to local communities (Barrow, Gichohi & Infield, 2001). The strict Kenyan standpoint is compromised in practice, since authorities publicly admit that they condone grazing by the Masai cattle in Tsavo West NP and use of water sources in Amboseli NP (Anonymus, 1994). In Mozambique, use is formally illegal but during a famine the warden of Gorongosa NP authorised fishing inside the park (Anstey, 2001).

Two countries are described as allowing consumptive use of NP's: Malawi and Uganda. In Malawi, people are allowed to collect honey inside Nyika NP on the condition that they do not hunt or collect firewood (Anonymus, 1994). Honey collection has been made possible through the 1992 Wildlife Conservation and National Park Act which encourages sustainable consumptive use of NP's (IUCN, 1997). In Uganda, consumptive use of resources in NP's is formally allowed and regulated. In Lake Mburu NP, cattle has access to water sources inside the park, fishing is allowed under certain conditions and people may harvest papyrus, medicinal plants and firewood (Hulme & Infield, 2001). In addition, emergency access to grazing and water sources in cases of drought or disease outbreak have been arranged (Infield & Namara, 2001). Another example from Uganda is Mgahinga NP, where a

multiple use zone has been identified within the limits of the park and especially bamboo is harvested by local people (Adams & Infield, 2001).

Very little information on conservation in West and Central Africa been published in scientific books and journals. East (1998) gives a short description of the most important conservation areas, showing that human encroachment and poaching have seriously depleted biodiversity throughout the region and that the majority of the important areas persist largely due to support of international organisations. These support programmes almost invariably include at least a community support component but moreover promote participation and sustainable use by local people. Chardonnet & Lamarque (1996) conclude on the basis of anecdotal information that all projects now established in the region close to protected areas are based on the ICDP philosophy. In the Sahel and Sudan savannah belt, important NP's are the Niokolo Badiar transfrontier complex in Senegal and Guinea, the Comoe NP in Ivory Coast, the 'W' NP complex in Niger, Benin and Burkina Faso and Waza NP and the Benoue complex in Cameroon. The websites of the international donor agencies that support these parks refer to participatory natural resource management as their strategy for long-term conservation, but they do not specify whether they promote consumptive use of NP's.

2.4 Cameroonian legislation and policy

In Cameroon, the government and more specifically the Ministry of Environment and Forests (MINEF) changed the environmental legislation over the last decade. This started in 1994 with the adoption of the law n°94/01 of 20 January 1994 on forests, wildlife and fisheries and the concomitant application decrees. In 1996, this was followed by a new article in the constitution which gives all citizens the constitutional right to a healthy environment and the right to information and participation in environmental issues (n°96/06 of 18 January 1996). Subsequently, a framework law was adopted which defines the orientation for future environmental legislation to operationalise these rights (n°96/12 of 5/8/96).

The 1994 forestry law has a number of elements to promote people's participation in conservation. One of them is article 26 which has not often been used yet, as it is unconventional. This article states that the "social environment" of "local communities" must be respected when creating protected areas; they maintain the right to "normal use" of the area if this does not compromise the objectives of the area. They have a right to compensation if activities must be stopped or moved. This article contains many undefined terms, which makes its operationalisation difficult. In addition, it is only applicable to newly created protected areas. In theory, this article gives local people access to new NP's, but there is no precedent, and at this moment subsistence activities by the local people inside NP's are still considered illegal.

Article 29 of the 1994 forestry law states that NP's must have a management plan in which, among others, details of usufruct rights by local populations may be defined. Most parks do not have a management plan yet, but for Waza NP a management plan was adopted in 1997 (Anonymus, 1997). Section 2.5 will elaborate on this management plan and on the inclusion of resource use by local people.

The 1994 forestry law and especially the concomitant 1995 enactment decree define procedures for community involvement in commercial hunting and/or wildlife related revenue sharing as reviewed by Egbe (2001) and Mayaka (*2003*). These are important on communal land, but they do not apply to NP's. Hunting is always illegal in NP's, except for the

theoretical possibility to include it in a management plan as defined in article 29. However, a management plan can only allow 'traditional hunting' on non-threatened animals ("class C" animals in Cameroonian legislation). Traditional hunting is defined as any action aimed at tracking, killing or capturing an animal for subsistence consumption using material of plant origin. Article 80 of the 1994 forestry law specifically forbids the use of fire, poison, torchlight, dane guns (home made muzzle loaders), etc. Most local hunters do use these and their hunting is thus not traditional by law. In practice, it is therefore unlikely that hunting can be legally regulated, meaning that usufruct rights under article 29 cannot include wildlife.

Another important article in the 1994 law is article 83, the right of self-defence. It says that anyone having killed a wild animal cannot be sanctioned if he or she was motivated by defence of himself, his livestock or his crops. A claim for self-defence must be reported to the appropriate authorities within three days. This article is also not operational and local MINEF representatives avoid informing the population of the possibility. They feel that they are the only institution capable of managing wildlife, including problem animals.

The last legal provision relevant in this context is the definition of the term 'bufferzone'. In Cameroon, this is defined as private property of the state in which hunting is forbidden and other activities may be allowed after obtaining permission of the Ministry of Environment and Forests. The ministry may or may not allow the participation of the population who basically have no rights at all. A bufferzone is created by the act of gazettment of the protected area it belongs to, it falls under the jurisdiction of the authority in charge of that protected area and its management plan. Basically, a bufferzone is an extension of the protected area, not a transition zone between the inside and the outside. Until now, bufferzones in this sense have not been implemented in Cameroon. Most protected areas do have a transition zone, however, albeit without specific legal status, which may be called 'peripheral zone' (Waza NP), 'support zone' (Korup NP) or 'multiple use zone' (Dja reserve).

Before the 1994 forestry law, no human activity other than tourism was allowed in NP's, and management was oriented towards elimination of interaction between the park and the surroundings. Under favourable economic conditions and repressive leadership, this was fairly effective: few villagers entered NP's. In the 90's, the new environmental legislation coincided with a severe economic crisis, which was an extra argument for new policies. Park management budgets plummeted, leading to a degradation of infrastructure and logistical services. MINEF personnel was considerably reduced, and those remaining saw their salary reduced by 50%. They were not trained in new styles of management and were no exception to the general rise of corruption, desertion and neglect of responsibilities in the civil service. The economic crisis made co-management an extra attractive option: in theory devolution of responsibilities implies a reduction of workload, high investment costs could be borne by international donors who were eager to finance fashionable ICDPs.

Nowadays, most important protected areas in Cameroon host an ICDP, funded by different donors (Dja by the European Union, Mount Cameroon by the Department For International Development in the United Kingdom, Korup and Lobeke by World Wide Fund for Nature, Campo and Benoue by the Global Environmental Facility, Waza by the Dutch department for development and through IUCN). Co-management is thus being implemented by NGO's and the international community, while the state does little more than create the legal framework. There are few examples of MINEF staff autonomously implementing new policy, and in areas hosting an ICDP they are usually only active in anti-poaching activities.

Conservation areas without donor support (Mozogo-Goroko NP, Kalamaloué NP and several Reserves) have no management plan and have not started implementing any new policy.

2.5 The management plan

In 1995, the Waza Logone Project organised participatory rural appraisals in all villages around the park. The results showed the difficulty of the process ahead: people not only mentioned all familiar problems (e.g., crop damage by elephants and antelopes, depredation by lion and hyena, lost fishing rights) but they also mentioned the park management as a problem *per se* (Scholte *et al*., 1999). People complained about intimidation, corruption, unlawful arrests, unregistered fines, cruelty and contempt by the park authorities. The task ahead was thus to turn a situation of war (literally: a warden, a ranger and a driver of our research institute have been killed by poachers) into cooperative management. Even before the start of the project, this situation was known to exist, and the process started with a change of personnel, especially the park warden. The new warden was trained in and accepted the new style of management.

The project staff originally wanted the creation of a buffer zone around the park, even though they were aware of the implications of that status as described in the previous section. They had discussed this at length with representatives of the ministry and finally made a 'gentlemen's agreement' to 'stretch the law' and implement the buffer zone as if legislation devoluted some responsibility to local people. During one of the meetings, the group of NGO's, research institutes, and other resource persons, unaware of this agreement and not convinced of the good intentions of the ministry, informed the population that there is legally little difference between a bufferzone and an NP, causing much turmoil. The debate ended in chaos, and a few weeks later it was decided that the zone around the park would be called 'peripheral zone', not defined by law and a compromise acceptable to everyone.

The WLP was asked to draft a park management plan for Waza NP which included the proposal about the peripheral zone. This document was accepted by the ministry and received the status of policy document for the management of the area for the period 1997-2002 (Anonymus, 1997). The management plan process was described by Scholte (2000), the most important points are as follows:

1. The village inside the park will be ignored, roads leading to it will not be maintained, no action must be favourable to the population. Thus, the villagers are expected to find voluntary resettlement in the peripheral zone more profitable.
2. The park warden gets more personnel (staff, rangers) and materials (firearms, maintenance budget).
3. A peripheral zone is defined, a ring of varying width but maximum 5 km around the park. All villages in this ring and all nomadic groups known to pass through the area are included.
4. The people in the peripheral zone maintain exclusive right to use of the peripheral zone and any type of exploitation inside the park that might be permitted in the future. They can refuse immigrants, which is always possible under traditional land tenure regulations, village chiefs were requested to comply with this policy in their decisions on new installations.
5. Inside the peripheral zone, there will be no damage compensation or problem animal control.

6. Consumptive use is an option that can be included in annual activity plans to regulate the use of some vegetative resources and fish. Hunting, grazing and agriculture inside the park are specifically excluded from this provision.
7. Local people's involvement in park protection will be encouraged, possibly through the creation of a network of 'village scouts'.
8. The people in the peripheral zone have priority in the sharing of tourism related benefits and employment opportunities.
9. A forum for information, discussion and decision-making will be installed.

One of the principles applied to the peripheral zone was described in section III.3.2.4 of the management plan, which stated that costs incurred by local people are considered as being more or less compensated by the benefits. This section further stated that particularly damage by elephants, lions and granivorous birds should be prevented by management interventions, but killing problem animals is only an option outside the limits of the peripheral zone.

This management plan has not fully been implemented. The least progress was made in park management capacity building. The emphasis has been on the implementation of participatory structures, especially the 'Committee for management and consultation of Waza NP and the peripheral zone'. The ambiguous name is a consequence of the dual legal status: the management of the park is the sole responsibility of the government, the periphery is governed by customary law of the population, but the two parties intend to consult each other on management issues. The president of the committee was elected from the local people and assisted by the park warden as vice-president. All villages and nomadic groups held elections and appointed two representatives (male and female) for each of the geographic divisions of the periphery as members. Other members of the committee are local traditional chiefs, mayors, provincial MINEF staff and a representative of the Minister. The committee held several assemblies and a sense of consultation and participation does seem to evolve.

The measures for the promotion of participation have facilitated cooperation and helped mediate the serious conflict between the population and park authorities as only a third party could do (Lewis, 1996). However, people not only expect to be heard, they also expect benefits. Those benefits related to tourism or employment opportunities were confirmed by the management plan, but they already existed. Tourist guides and local shops, restaurants and hotels have always been beneficial to the local people. The creation of a visitors' centre and several other structures increased the opportunities only marginally. More important changes occurred in a different category of benefits, namely the consumptive use of vegetative resources inside Waza NP. The last two sections of this chapter focus on this issue. The next section describes the observed resource use by local people inside Waza NP. The last section of this chapter will then conclude on the comparison of the existing *de facto* and *de jure* situation.

2.6 Resource use in Waza NP

Since the creation of Waza NP in 1968, law enforcement had been strict until 1993, and consumptive use of natural resources was more or less effectively combated. Since 1993, however, several changes have reduced the law enforcement capacity, leading to increased illegal activities by local people inside Waza NP. These factors were: firstly, the appointment of a new warden in 1994 to replace the feared warden who had punished many people

severely over more than a decade, secondly the reduction in park staff from 30 to 10 rangers, thirdly the rise in corruption and neglect of duties by many civil servants after 50% salary reductions, and finally the degradation of park management equipment and logistics. These factors reduced the law enforcement capacity which led to an increase in illegal use of the park.

All local stakeholders are aware of the fact that there is much human activity in Waza NP. The management plan states that "if the park would really be closed to all forms of exploitation, the economic situation of the surrounding villages would not allow their presence where they are now" (Anonymus, 1997). Exploitation of important resources can be qualified and characterised based on our field experiences and participant observation. Below, a description is given for the main resources. Quantitative data are not available for most of them. A summary is provided in Table 2.1.

Bushmeat. Poaching for bushmeat is less widespread than in most areas in Cameroon. The nearest commercial market for bushmeat is 400 km. south of Waza, but meat poached in Waza NP is hardly ever exported to that market. Meat is primarily for local consumption. Kobs and guineafowl are probably among the species most often poached by the local population and are the third most preferred bushmeat species in the area (Njiforti, 1996). Our impression that poaching has a limited importance is supported by three objective arguments: firstly the elephant population has been steadily increasing since the creation of the NP (Tchamba, 1996); secondly the kob density is highest near two villages (Mahe and Zina, *ibid.*); and thirdly wildlife numbers have increased since the flooding regime was partially restored (Anonymus, 1997), suggesting that populations were limited by food availability rather than poaching. For some species, however, poaching pressure is significant, e.g. collection of eggs of ostrich and crowned crane (Van der Giessen & Raspe, 1997).

Fish. There are rich fishing grounds inside the park, some villages hold ancestral claims to some of them. The highest fish offtake occurs in the floodplain at the end of the wet season, when the area is hardly accessible to outsiders. There is no external control, therefore, and exploitation is common. Saleh (1995) calculated that an average fisherman catches 3,000 kg of fish in the two months with inundation, which represents a net income of $300. But even in the dry season, when control is easier, fishing gear can easily be observed at many waterholes. It may be estimated that current fish offtake has the highest total monetary value of all current forms of consumptive use in Waza NP (Scholte, pers. comm.; pers. obs.)

Pastures and waterholes. Cattle is led into the park for grazing and drinking. Apart from scarcity of these resources elsewhere, this is motivated by the tendency to keep cows near the village for milk consumption. Livestock was even encountered in the centre of the park, despite regular arrests and impoundments by the warden (pers. obs.). Livestock using the relatively abundant resources of the park reaches high levels of productivity, more than enough to compensate for the heads lost in penalties (Scholte, pers. comm.).

Firewood. Firewood-driven deforestation is becoming an important regional problem, but people around the park have no trouble finding firewood except in the floodplain. The park warden can give some permits for the collection of dead wood for local use, but most firewood collection is uncontrolled. In some villages, men take up firewood collection for

commercial purposes, selling it to traders who transport it to town. However, the quantity of firewood in village depots is much smaller than in villages closer to urban centres like Maroua.

Construction wood. People more or less depend on tall straight trees in the park for the construction of roofing support in houses and stables. This resource is hardly commercialised or exported from the area: mechanically produced logs imported from the rainforest zone in south Cameroon are preferred in town.

Thatch, grass, leaves. Thatch, grass and leaves are used for roofing, for mats to sit on and to fence off enclosures, for ropes, brooms, harness and saddles of horses and donkeys and other locally produced utilities.

Fruits. All sorts of fruits are collected and locally consumed. Modest quantities of *Balanites aegyptiaca* and *Tamarindus indica* fruits are sold in various markets.

Resin. Especially "gum arabic", a resin produced by *Acacia* spp. trees, is collected and sold to traders on local markets at between $0.23 and $0.33 per kg. Women and children are most involved in this sector. Annual production in the Far North Province is approximately 1.500.000 kg, Waza NP is one of the areas with the highest productivity (Balarabe, 2000). Mean gum production in the *Acacia* habitat of Waza NP is 2 kg/ha in the dry season. Women collect over 0.4 kg/hour, this rate is significantly higher inside than outside the park (Van Brederode, 2001). A small quantity is used locally in food or utilities, the bulk is sold to middlemen in Cameroon or Nigeria. It ends up at the world market for raw materials, where pharmaceutical and industrial companies pay roughly $1 per kg and use it as an emulsifier.

Table 2.1: Natural resource exploitation in Waza NP, presently all illegal.

Resource used	End-users	Gender	Exploitation zone	Commercial value	Remarks
Bushmeat	village	men	all zones	medium	rarely exported
Fish	town	both	floodplain	high	not controlled
Firewood domestic	households	women	forest	medium	no alternatives
Firewood commercial	town	men	forest	medium	near main road
Construction wood	household	men	forest	low	rarely exported
Resin	industry	women	forest	medium	world market
Thatch, grass, leaves	households	women	all zones	low	roof, rope, mat
Fruits	households	both	all zones	low	seasonal
Pasture and waterholes	herders	men	all zones	high	esp. dry season

2.7 The managers' dilemma of consumptive use

Section 2.4 described the possibility of regulation of consumptive use in National Parks; section 2.5 described the management plan of Waza NP and the prospect of legalising the harvest of wood, resin, thatch and fish; and section 2.6 described the diversity of resource use of Waza NP by the surrounding population. Together, these sections present a case in which the *de facto* and the *de jure* situation can be partially reconciled by allowing consumptive use of natural resources in Waza NP. Implementation of the management plan has been slow and until now only collection of thatch has been regulated, but other resources may follow.

This evolution creates a dilemma for the future of Waza NP. Two opposite views are possible. The first is that this the beginning of a progressive downgrading of the protection status leading to ecological degradation of the park, which could eventually lead to declassification. The second is that it marks the evolution towards participatory park management. In this view it would not be fully co-managed, since Waza NP will legally remain private property of the state. Some issues will remain non-negotiable, like hunting inside the park or compromising current rights of people in the peripheral zone. Rights and responsibilities on many other issues would be shared, however, like the organisation of tourism, patrolling and resource extraction. Advocates of this view hope that this does not lead to degradation but to improved conservation through positive attitudes, local support, package deals, increased patrolling and social fencing (i.e. local communities protecting the resource from outsiders to maintain exclusive usufruct rights). In the concluding chapter of this dissertation, we will assess this dilemma based on our analysis of people-park interactions.

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Chapter 3:

Local Perceptions of Waza National Park

Bauer, H. (2003) Local perceptions of Waza National Park, northern Cameroon. *Environmental Conservation* **30**, 175-181.

Photo 4: Interview setting in a local community.

Summary

Waza National Park, Cameroon, is representative of trends towards more participatory Protected Area management in Africa. It has no transition zone and interactions with the surrounding human population are complex. A recently adopted management plan allows experiments with limited consumptive use of natural resources, in exchange for people's collaboration. In order to determine which resources are desired and which resources are a liability, people in the Park's vicinity were interviewed. Respondents' attitudes towards conservation were positive, motivated by both use and intrinsic values, and with reference to future generations. Attitudes were significantly related to locally perceived benefits. Respondents found most of the Park's resources useful but differences between user groups were significant. User groups also differed in their complaints about human-wildlife conflicts, but overall they considered the animals most important for tourism as main nuisance. This case shows that local aspirations cannot all be met, but indicates that limited outreach can improve the existing public support for conservation measures.

3.1 Introduction

With decreasing budgets for and increasing criticism on 'Fortress Conservation', Protected Areas are increasingly moving towards 'Community Based Conservation' (Adams & McShane, 1992; Adams & Hulme, 2001). In the case of National Parks this is controversial; as the highest category in most countries' Protected Area system, they are considered outstanding set-asides of supra-local value with no obligation to contribute to the livelihoods of those living nearest to it (Oates, 1999; Straede & Helles, 2000; Spinage, 2002). In practice, however, National Park managers throughout Africa are trying to collaborate with local people in order to improve their effectiveness, with approaches ranging from Park Outreach to Co-management (Barrow & Murphree, 2001). This is illustrated by the case of one of the best conserved Sahel ecosystems; Waza National Park, Northern Cameroon.

Waza National Park (hereafter called 'the Park') is situated in the Far North Province of Cameroon, with a Soudano-sahelian climate and vegetation. The Park is a biosphere reserve of approximately 1600 km^2, the Eastern half is part of the Logone floodplain, the Western half is savanna woodland partially dominated by *Acacia seyal*. It is not fenced but contained by a peripheral road with signboards at four crossroads. It contains, *inter alia*, various antelope and monkey species, giraffe (*Giraffa camelopardalis*), elephant (*Loxodonta africana*), lion (*Panthera leo*), hyena (*Crocuta crocuta*) and a diverse avifauna (Tchamba & Elkan, 1995; Scholte *et al.*, 1999b). The population around the Park may be divided into several ethnic groups, each with a specific main livelihood activity: Fulbe and Arab Choa (animal husbandry), Kotoko (fisheries), Mousgoum (agriculture combined with fisheries and small scale animal husbandry) and Kanuri or Bornouan (agriculture, sometimes hunting/gathering).

The Park was gazetted as a protected area in 1934 and became a biosphere reserve in 1988. Most villages inside the Park were evicted and nomadic pastoralists were denied access to the Park without consultation or compensation, leading to conflict and tension (Scholte *et al.,* 1999a). People resettled close to the boundary of the Park, thus creating a 'hard edge' (no transition zone). On the interface, human wildlife conflict is an important problem; examples are elephants raiding crops, carnivores killing livestock, granivorous birds using the Park as a

safe haven for reproduction and grazers and diggers destroying crops (Tchamba, 1996, Scholte *et al*., 1999a; Bauer & Kari, 2001). There is no compensation system for wildlife damage. Since the early 1990s, staff capacity to enforce Park protection has decreased substantially, and illegal use of the Park's resources has increased (Bauer, unpubl. data).

The Park is situated on the border of a much larger wetland ecosystem, the Waza Logone floodplain. This floodplain was negatively affected by the construction of a dam in the Logone river in 1979. In 1993, the World Conservation Union (IUCN) initiated an Integrated Conservation and Development Projects (ICDP) in this area (Waza Logone Project, hereafter called 'the project'). This project featured development assistance to the population, support to Park management and hydrological and ecological restoration. Restoration activities only had a marginal impact on most villages around the Park since they were outside the re-flooded area, people in these villages primarily knew the project through its special 'Park programme'. Examples of project activities within this programme were the construction of tourist accommodations in three villages and support to local associations to manage them, the improvement of basic health facilities and drinking water availability, and the facilitation of dialogue with Park management. Project and Park teams usually operated independently in the field and local people clearly distinguished between project and Park activities.

The project also assisted in drafting a management plan for the Park which was adopted by the Ministry of Environment and Forests in 1997. This management plan is in line with trends towards more participatory management in Cameroon's policies and legislation over the last decade. It endorsed a multi-stakeholder management committee for the Park and the surrounding area. The project disseminated information on this committee and organised elections for village representatives. The management plan also allows for experiments with consumptive use of resources, notably limited and regulated harvesting of vegetative resources and fish by local people inside the Park. These experiments must determine which forms of consumptive use do not have a negative effect on the Park's ecology, which is a legal imperative. To prevent controversy or conflict of interests, the Park management plan recognises the ultimate entitlement of the state inside and the population outside the Park, respectively. Within those limits, practical opportunities for future collaboration both in- and outside the Park are being identified.

In local fora, the focus is not on general, political or moral discussions about resource harvesting in national parks, which is a policy choice made by the government. Rather, the focus is on modalities of resource use with minimum ecological impact that may contribute to local human development and lead to attitudes and behaviour favourable for conservation. At the time of fieldwork in 1999, legal harvesting was discussed but not yet implemented. In 2002, experiments with grass cutting permits have started. The present chapter also adopts this focus on practical solutions, rather than on principled theory. Interviews were undertaken to assess (1) public support for conservation, (2) attitudes towards the Park and the project, (3) the preferences for resources by various social groups and (4) the perception of wildlife damage.

3.2 Methods

The above assessments were made by means of a questionnaire which was designed and tested in a village outside the study area. The questionnaire was composed of questions about

background variables of the respondent and his/her village, followed by 10 open and 6 multiple choice questions on his/her perception of the Park and its resources (Table 3.1). Questions on natural resource preference and wildlife damage were open questions, to which the answers were categorised afterwards. This ensured that respondents were not limited in the range of possible answers.

Table 3.1: Summary of the questionnaire and the variety of answers.

Questions	Answers
Age, sex, ethnic group?	10-20/20-40/40-60/60+.
Do you know the Park boundary?	Yes, no.
Opinion on the size of the Park; why?	Too big, too small, right size; various reasons.
Opinion on the Park's presence; why?	Good, bad, no opinion; various reasons.
Opinion on the game guards; why?	Good, bad, no opinion; various reasons.
Top-two resources wanted?	Fish, thatch, pastures, fields, wood, resin, other
Top-two conflict species?	Lion, hyena, birds, elephant, locust, other.
Top-two resources used?	Fish, thatch, gathering, cattle-dip, wood, resin, other.
Number of game guards; why?	Too few, too many, right number; various reasons.
Opinion on the project; why?	Good, bad, no opinion; various reasons.
Why was the Park created?	Conservation, tourism, no opinion.
Why was the project created?	Development, conservation, both, no opinion.

Based on previous research (Scholte *et al*., 1999a; Bauer & Kari, 2001), extensive field experience and unpublished data of the district officer, villages within 10 km. of the Park were categorised by ethnic group, interaction with the Park and number of inhabitants. Ten of the 25 villages were selected, with a total population of approximately 2000. Random samples of approximately 10% per village were selected by visiting every tenth household on a round through the village. The interviews were administered to a total of 236 respondents, of whom 191 lived within 1 km of the boundary of the park, 184 benefited from the Park and/or the project and 157 were male; all other background variables were almost equally represented.

Interviews were conducted by two students of the regional agricultural college in March and April 1999, the best time of year for interviewing since few people work in the field during the dry season. Questionnaires and answers were written in French, but the interviews were entirely conducted in one of the local languages.

Data were analysed in SPSS 10.0 by crosstabulation, i.e. a chi-square test (notation: χ^2_{df}) applied to all combinations of independent and dependent variables. Independent variables were age group, ethnic group, gender and categories we defined as 'distance' (groups living more or less than 1 km from the boundary of the Park), 'non-use benefits' (groups benefiting from the Park and/or the project through e.g. employment), and 'occupation' (main livelihood activity categorised as agriculture, cattle raising, fisheries or agriculture combined with cattle). Ethnic group and occupation were strongly correlated as described in the introduction. Dependent variables were the answers to multiple choice questions and the categorised answers to some open questions. Answers to other open questions were used for qualitative interpretation.

3.3 Results

3.3.1 The existence of the Park

The question 'do you find the presence of the park good, bad or do you have no opinion?' was answered 'good' by a large majority of respondents: 82% appreciated the Park's existence.

The question 'do you find the work of the game guards good, bad or do you have no opinion?' showed that 52% of the respondents appreciated the work of the game guards. Appreciation varied significantly with the level of non-use benefits; of respondents with non-use benefits, 89% appreciated the Park and 60% appreciated the work of guards against 58% and 20% of respondents without non-use benefits (χ^2_1=25.0, p<0.001; χ^2_2=27.0, p<0.001). Appreciation was also significantly lower among Fulbe respondents; while percentages varied little among other ethnic groups, only 58% and 33% of the Fulbe appreciated the Park and the work of guards, respectively (χ^2_4=32.3, p<0.001; χ^2_4=25.9, p<0.001).

Half of the respondents who appreciated the existence of the Park did so because of the possibility to use natural resources or other advantages, but 16% mentioned non-utilitarian motives. Examples were: "we discover many animals which we normally never see", "one discovers wild animals of all kinds" and "the Park is a reflection of nature, which is unknown to many". Three women gave this reason for liking the Park: "because the children that we bear will also discover many animals". One woman liked the Park for the tourists it brought: "for the honour of receiving strangers, the mutual knowledge of our cultures, the openness of mind – and their money".

Of the 18% of respondents who did not appreciate the existence of the Park, none found nature intrinsically bad and only two respondents referred to ancestral claims to resources. Their motives were mostly the spatial restriction, damage to possessions and frustrations with Park management: "space for our activities is now too restricted", "the Park contains ferocious animals, the enemies of our crops" and "game scouts don't do their duty honestly, they just want to eat out of our pockets".

The question 'do you know the boundary of the Park' was answered 'yes' by 73% of the respondents. The question was followed by a question to describe its location, which showed that positive answers were correct in all cases. This knowledge varied significantly with sex and age, however, men (86%) and the two older age groups (82 & 84%) answered more often that they knew the boundaries (χ^2_1=41.0, p<0.001; χ^2_3=4.3, p<0.05, respectively). Almost all respondents (99.5%) found the Park too large. Answers to the question why the Park was created could be categorised as 'for conservation' (39%), 'for tourism' (7%), and 'don't know' (54%). Sex and age had no significant influence; the only significant variation was caused by non-use benefits accruing from the Park and/or the project (χ^2_3=11.5, p<0.01); all those that answered 'for tourism' belonged to the group with non-use benefits.

3.3.2 The existence of the project

The question 'the project is good / bad / no opinion?' was answered with 'good' by 50% of the respondents, while 25% did not appreciate the project and 25% had no opinion. Opinions were significantly more positive among the respondents living further from the Park's boundaries like the project (χ^2_1=10.2, p<0.01). Surprisingly, there was no influence of the level of non-use benefits from the Park and/or the project on the perception of the project (χ^2_1=1.1, n.s.). Answers to the question 'why?' showed that appreciation of the project was motivated by actual or expected positive effects on respondents' livelihoods. Respondents who did not appreciate the project were mostly motivated by frustration about unfulfilled promises of development actions: "the project is all words, it breaks my ears" and "the project did not do what it promised".

When asked why the project was created, answers could be categorised as 'for the development of the local population' (37%), 'for conservation of biodiversity and for the

promotion of tourism' (16%), 'for integrated conservation and development' (4%) and 'don't know' (43%). The perceived reason for the creation of the project varied significantly with distance, non-use benefits and sex. Respondents living close to the Park, those with non-use benefits and male respondents answered more often that the project was created for the development of the local population (42% ,44% and 45%, respectively; χ^2_3=11.5, p<0.01; χ^2_3=48.4, p<0.001 and χ^2_3=15.4, p<0.01, respectively).

3.3.3 The natural resources of the Park

When asked for the two most appreciated resources currently used illegally in the Park, answers could be put into seven categories (Fig. 3.1). Arab and Fulbe, both involved in cattle raising, considered waterholes inside the Park as a useful resource. Mousgoum and Kotoko, the fishermen in the floodplain, appreciated mainly the fishing grounds inside the Park. Kanuri, agriculturalists with a tradition of hunting and gathering, collected non-timber forest products and especially Arabic gum (resin of *Acacia* spp. trees). Appreciated resource was significantly related to both ethnic group and occupation (χ^2_{24}=303.6, p<0.001; χ^2_{18}=304.4, p<0.001), but not to sex (χ^2_6=6.7, n.s.).

When asked for the two most desired resources of the Park, i.e. resources they most want authorisation to use, the answers were divided into seven categories. Variation in requested resource was significantly related to ethnic group and occupation in the same way as described above for appreciated resource (χ^2_{24}=261.3, p<0.001; χ^2_{18}=263.2, p<0.001). It was also significantly related to sex (χ^2_6=22.8, p<0.01): men mainly requested the resource related to their main activity (pastures, fishing grounds or fields, depending on occupation) whereas women were more interested in a variety of forest products like fruits, resin and thatch (Fig. 3.2).

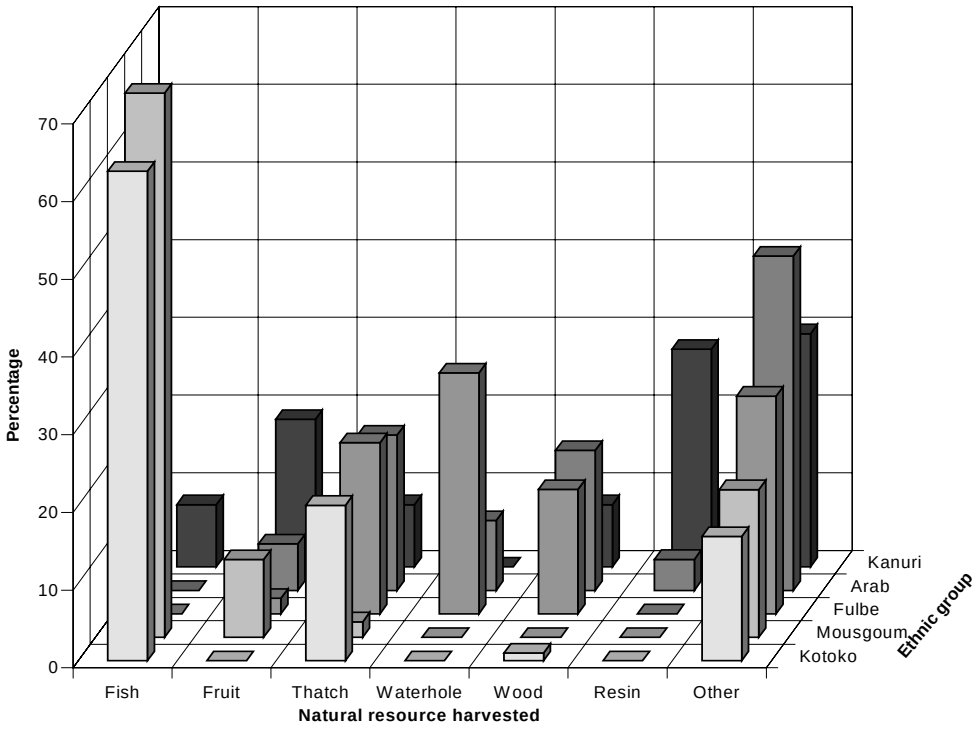

Figure 3.1: Answers of different ethnic groups to the question which of the natural resources harvested illegally in Waza National Park are most important (percentage respondents per ethnic group).

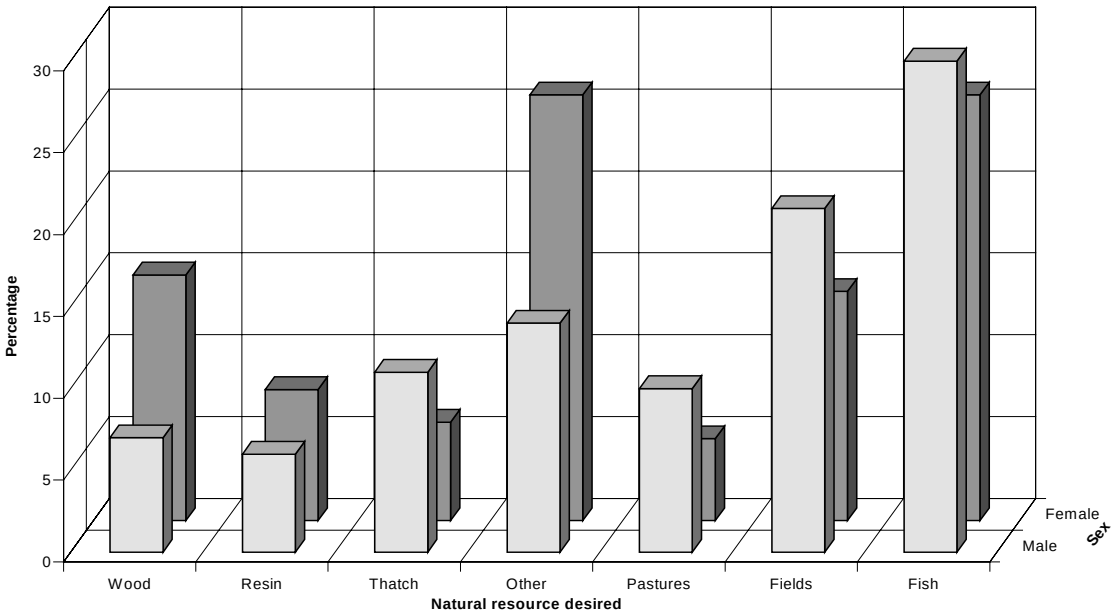

Figure 3.2: Answers of different sexes to the question which natural resources in Waza National Park are most desired (percentage respondents per sex).

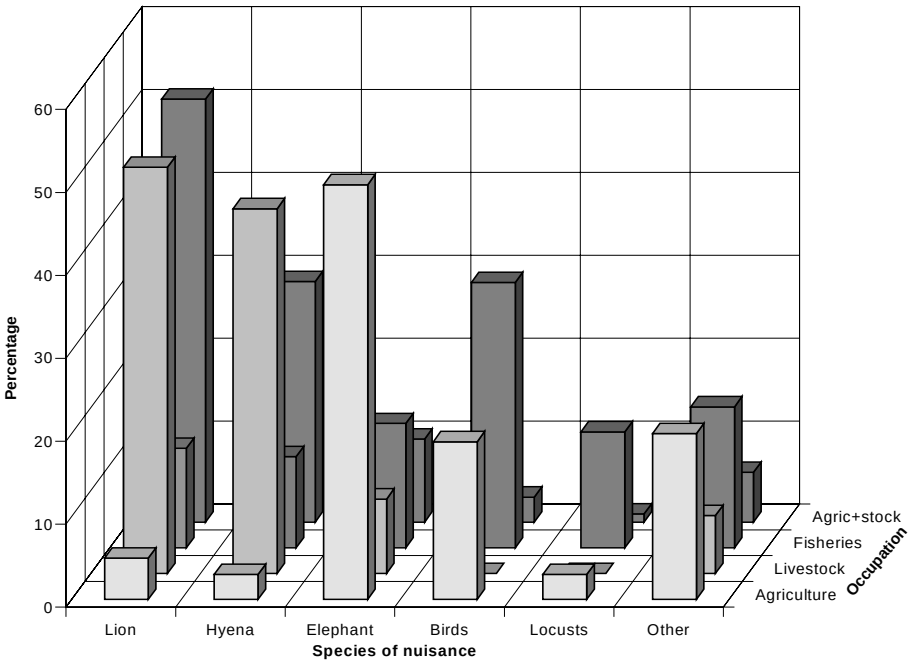

Figure 3.3: Answers of people with different main livelihood activities or 'occupations' to the question which species in Waza National Park are of main nuisance (percentage respondents per occupation).

When asked for the two species of major nuisance, there were six categories of answers. Responses varied significantly with occupation: cattle raisers disliked lion and hyena, farmers disliked elephant, locust and granivorous birds, and fishermen disliked piscivorous birds (Fig. 3.3; $\chi^2_{15}=277.9$, $p<0.001$). Since occupation and ethnic group were linked, variation among ethnic groups were similarly significant ($\chi^2_{20}=278.2$, $p<0.001$). Male and female respondents had the same opinion on badly perceived species ($\chi^2_5=6.9$, n.s.).

3.4 Discussion

The results show that respondents felt free to make both negative and positive statements about both the Park and the project. An important reason is that people clearly distinguished between Park, project and our own university staff. All three institutions had been active for many years prior to the interviews, and large stickers with different symbols on each of their cars made identification instantly possible upon arrival. Added to the fact that the interviews were conducted by students from the same province in the local language, this reduced the bias towards socially desirable answers. Total sample size and sample size of various social groups were sufficient for statistical testing and gave significant results. However, to achieve sufficient sample size, interviews were necessarily short and the questions only covered a specific domain.

A large majority of all respondents knew about the Park and appreciated its existence, and appreciation was significantly higher among respondents benefiting from the Park and/or project. The minority that disliked the Park was primarily frustrated with management practices and promises; no one objected to the Park *per se*. Almost all respondents found the Park too large. This all suggests that people perceive the park positively, provided it does not limit their activities. These results corroborate surveys around Parks in Ecuador and Nigeria, where people agreed on the necessity to protect forest for future generations, but showed negative attitudes towards the daily manifestations and consequences of conservation (Fiallo & Jacobson, 1995; Ite, 1996). This underscores the importance of good communication between Park, project and local communities with regard to rights and responsibilities in natural resource management.

Our findings suggest that benefits are an incentive for people to perceive conservation positively. Correlation between benefits and positive attitudes has been confirmed in many cases (de Boer & Baquete, 1998; Gillingham & Lee, 1999; Hamilton *et al*., 2000; Abbot *et al*., 2001; Mehta & Heinen, 2001). Further, literature based on empirical evidence indicates that three important refinements must be added to the statement that benefit sharing contributes to co-operative attitudes towards conservation. These can be summarised as (1) the importance of economic viability from a local perspective (Shyamsundar & Kramer, 1996), (2) an explicit link with long term conservation interests (Shyamsundar, 1996) and (3) the need for proper institutional arrangements (Archabald & Naughton-Treves, 2001). However, the available information in the present case is too limited to assess such influences on attitudes.

Around the Park, some people had non-use benefits in cash (tourism, employment, etc.), but all benefited from the use of natural resources inside the Park. Preference for types of resource use varied significantly between ethnic groups. This may be explained by the differences in natural resource management; ethnic groups constituted discrete user-groups. Sex explained variation in cases where the resource at hand was used differently by the two

sexes, again parallel to user-groups. This stresses the need to distinguish between various local groups and acknowledge the diversity of interests. Furthermore, the similarity of response between 'requested resource' and 'appreciated resource' confirms the impression that exploitation of the Park was not effectively controlled by the authorities; people got what they wanted.

There were also costs for the local people related to the Park in the form of animal damage to people's assets. Predators (lion and hyena killing livestock) and elephants (depredating and trampling crops) were perceived as the main culprit (Fig. 3.2). Hazard studies consistently show that damage is often disproportionately lamented if it is unpredictable, potentially catastrophic and beyond respondents' control (Naughton-Treves, 1997). Both elephants and lions are conspicuous species whose movements cannot easily be influenced by local people and whose raids can have a devastating impact on individuals' livelihoods. Damage perception can be different from real damage averaged over time and individuals, however. Damage by large mammals has been found to be of the same order of magnitude as damage by rodents and primates in savannahs in Uganda and Malawi (Naughton-Treves, 1997; Deodatus, 2000). In the present case, however, perceived classification of damage was probably close to real classification, since rodents and primates, particularly the most notorious species (baboon, *Papio cynocephalus*), occur at low densities (Bauer, unpubl. data). Damage by elephants and predators have both been described as serious human-wildlife conflicts in this area, but in both cases human death or injury is relatively rare (Tchamba, 1996; Bauer & Kari, 2001). In a comparable situation in Namibia, O'Connell-Rodwell *et al*. (2000) described elephant damage as the most frequent and lion damage as the most costly conflict.

An option often mentioned for mitigation of conflict without compromising conservation is a compensation system for wildlife damage, either in cash or in kind. Bruner *et al*. (2001) showed that various forms of compensation and benefit sharing contribute to park effectiveness. In the African context, however, compensation schemes for elephant damage are considered inefficient and ineffective, mainly due to practical problems related to damage assessment and the distribution of compensation (Tchamba, 1996; Hoare, 2001). These problems also apply to many other types of wildlife damage and compensation schemes. An additional argument against compensation is the attraction of immigrants which would exacerbate the conflict (Studsrød & Wegge, 1995). In the case of Waza, this is an already existing threat; measures of ecological rehabilitation by the project have led to immigration into the project area (Scholte, 2003).

Van den Born *et al*. (2001) highlighted the difference between attitudes towards conservation as such (which often are basically positive), and attitudes towards conservation management and managers; a similar patterns was found here. Moreover, they found a high appreciation of nature among Dutch respondents, not only based on utilitarian motives but with explicit reference to intrinsic values and next generations. In the case of Waza National Park, respondents also referred to such values, which suggests that here too the use of non-economic arguments to win people's support for conservation may be explored.

3.5 Conclusion

Park outreach includes a wide variety of activities which managers of protected areas can initiate or stimulate other organisations to initiate. Here, however, the focus was on resource-

based outreach. Based on the cumulated opinions of the different groups, I conclude that people aspired to harvest most of the Park's locally useful resources, while they considered as the main nuisance the same animals that happen to be most important for tourism. Legally, however, a National Park management plan in Cameroon must have biodiversity protection as primary objective. Therefore, reducing important animal populations and/or harvesting many resources is not an option. The Park is likely to constitute a net cost to local people now and in the near future, as for most African protected areas (Earnshaw & Emerton, 2000; Blom, 2001; Bond, 2001). In some areas, this can be compensated by sustainable wildlife use in surrounding multiple use areas, but Waza National Park is entirely surrounded by human settlements without a transition zone, meaning that resource-based mitigation measures can only involve the Park itself.

Park management currently envisages 'contracts', whereby every community commits itself to conservation of some of the resources (usually wildlife), in exchange for limited and regulated consumptive use of selected vegetative resources and possibly fish. Our results suggest that conditions are conducive to this policy, since people basically appreciate nature and attitudes towards conservation are related to benefits. In view of the reduced Park management capacities, co-operative attitudes among the population are an important asset. However, because of National Park status, 'contracts' must have a demonstrable net positive effect on conservation, which will limit the extent to which the large variety of aspirations can be met. The general appreciation of the Park, and the values it represents, indicate potential public support for such constraints.

Acknowledgements

We thank the Ministry of Environment and Forests (MINEF), especially the conservator of Waza National Park, and the Centre for Environment and Development studies in Cameroon (CEDC) for their support. Thanks are also due to Mittouang and Dominique Gammi for their help during fieldwork. We acknowledge comments on earlier versions by Mr. F.N. Tarla, Dr. D.M.E. Van Est, Dr. H.H. De Iongh, Prof. W.T. De Groot and Prof. H.A. Udo de Haes and three anonymous reviewers.

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PART II

HUMAN LION CONFLICT

Part II comprises four chapters (Chapters 4-8) and focuses on human-lion conflict. Chapter 4 presents an inventory of lions in Africa, which suggests that the species may be classified as regionally endangered in West and Central Africa. Chapter 5 presents regional trends and causes of decline of lion populations in West and Central Africa. These chapters show that the case of Waza NP is representative for an urgent regional problem. Chapter 6 presents detailed information on human conflict with predators as assessed with participatory research techniques. Chapter 7 presents information on lion ecology and shows differentiation between individual lions with regard to the damage they inflict on livestock. This is followed by appendix 7.1, a short note about an observation of lion behaviour that lies outside the story line of this thesis but is too unique to ignore: the use of a tool. Chapter 8 describes the differences between lion social organisation in two regions of Africa and offers explanatory hypotheses.

Photo 5: Anti-predator shelter for lambs in Amaheiri.

Chapter 4:

Inventory of Free Ranging Lions in Africa

Bauer, H. & S. Van Der Merwe (in press) Inventory of free ranging lions (*Panthera leo)* in Africa. *Oryx*.

Photo 6: Lioness with cubs in Waza NP.

Summary

The number of free ranging African lions (*Panthera leo*) has never been assessed. We present an inventory of available information, covering most protected areas and ranging in quality from educated guesses to individually known populations. This gives a conservative estimate of between 16,500 and 30,000 free ranging lions in Africa. The inventory shows that populations are small and fragmented in West and Central Africa, whereas the species still occurs widely in East and Southern Africa. The results concur with the current IUCN Red List classification of the lion as Vulnerable.

4.1 Introduction

Lions (*Panthera leo*, L. 1758) once roamed large parts of Africa, Europe, the Middle East and Asia. They disappeared from Europe during the first century AD and from North Africa, the Middle East and Asia between 1800 and 1950, except one population of the sub-species *P. l. persica* in India. Nowadays, lions are found in savannah habitats across sub-Sahara Africa (Nowell & Jackson, 1996).

The African lion is classified as Vulnerable on the Red List of Threatened Species of the World Conservation Union (IUCN); agriculture, human settlement and poisoning are mentioned as main threats (Hilton-Taylor, 2000). This classification was partly based on an educated guess of between 30,000 and 100,000 free ranging lions (Nowell & Jackson, 1996). The large margin was justified by lack of information and the notorious difficulty of lion censuses (Loveridge, Lynam & Macdonald, 2001; Mills, Juritz & Zuccini, 2001). The African Lion Working Group, affiliated with IUCN, took the initiative to gather available information for a more precise estimate.

4.2 Methods

Requests for information were sent to researchers, wildlife departments and conservationists. Also, an information sharing workshop was organised in Cameroon in 2001 for professionals from West and Central Africa (Bauer *et al.*, 2001). Information gaps were filled by specific requests targeted at resource persons or conservation networks. In total, nearly 100 persons provided information. In addition, some information was found in literature; data more than ten years old were not included. The inventory is thus based on existing information, except for Zambia which was surveyed especially for this inventory.

Resource persons indicated their method, an estimate of lion numbers (in 2001 or 2002, unless indicated otherwise) and an indication of minimum and maximum (min-max) numbers. In a few cases, these min-max values were 95% confidence limits, but most sources could only indicate the lowest and highest conceivable estimate. For a few areas we had two different estimates from equally authoritative sources; we included the mean estimate with the extreme min-max values and mentioned both sources.

Census methods were categorised; if no min-max values were provided, they were generated depending on method category using a percentage of the estimate as indicated below:

1. Total count, with all lions in an area individually identified by features such as whisker spots, scars, nose colour, etc. (Pennycuick & Rudnai, 1970). This is the most accurate

census method. Min-max: the estimate minus or plus 10%, respectively (short notation: min-max +/-10%).

2. Total or sample area inventory with the aid of calling stations, with or without bait, using hyena and/or prey sounds to attract lions. Calling station methods and precision vary between areas and researchers, confidence limits were reported to be 3% in the Masai Mara National Reserve (Ogutu & Dublin, 1998), but this figure is expected to be higher under most conditions, up to 90% depending on habitat (Mills *et al.*, 2001). Sources using this method were expected to give case-specific min-max values, otherwise we assumed min-max to be +/-20%.
3. A third category includes mark-recapture experiments, use of radio collars and tourist picture databases (Smuts, Whyte & Dearlove, 1977; Creel & Creel, 1997; Loveridge *et al.*, 2001). Spoor counts are included in this category, but the methodology has to be further developed to improve accuracy and precision (Stander, 1998). Most studies in this category combine several of these methods. Min-max: +/-30%.
4. Estimate based on fieldwork. An informed guess by a resident researcher with intimate knowledge of an area, preferably based on prey censuses. Min-max: +/-40%.
5. Guesstimate based on short visits and secondary data, such as prey or hyena numbers, area size, rainfall, etc. (East, 1984; Van Orsdol, Hanby & Bygott, 1985). Min-max: +/-50%.
6. Other methods or information obtained under special circumstances. Min-max specified by the source.

Counts based on aerial, dung and roaring surveys were considered inappropriate methods and were not included. We present (sub-) totals under 5000 rounded to the nearest 50 and over 5000 to the nearest 500.

4.3 Results

The results are listed in Appendix 4.1, a summary is provided in Table 4.1 and dispersion is shown in Fig. 4.1. The estimate for West and Central Africa together was 1,800, mostly based on guesstimates, since little research has been done in this part of the continent. They were all in small and fragmented populations scattered over the region. The Eastern African estimate was 11,000, with the continent's two currently largest populations in the Serengeti and Selous ecosystems (Tanzania). The Southern African estimate was 10,000, with the majority in Botswana and South Africa.

Table 4.1: Summary of available information on African lion population estimates.

Region	Estimate	Minimum	Maximum
West Africa	850	450	1,250
Central Africa	950	500	1,550
East Africa	11,000	8,000	15,000
Southern Africa	10,000	7,500	12,500
Total	23,000	16,500	30,000

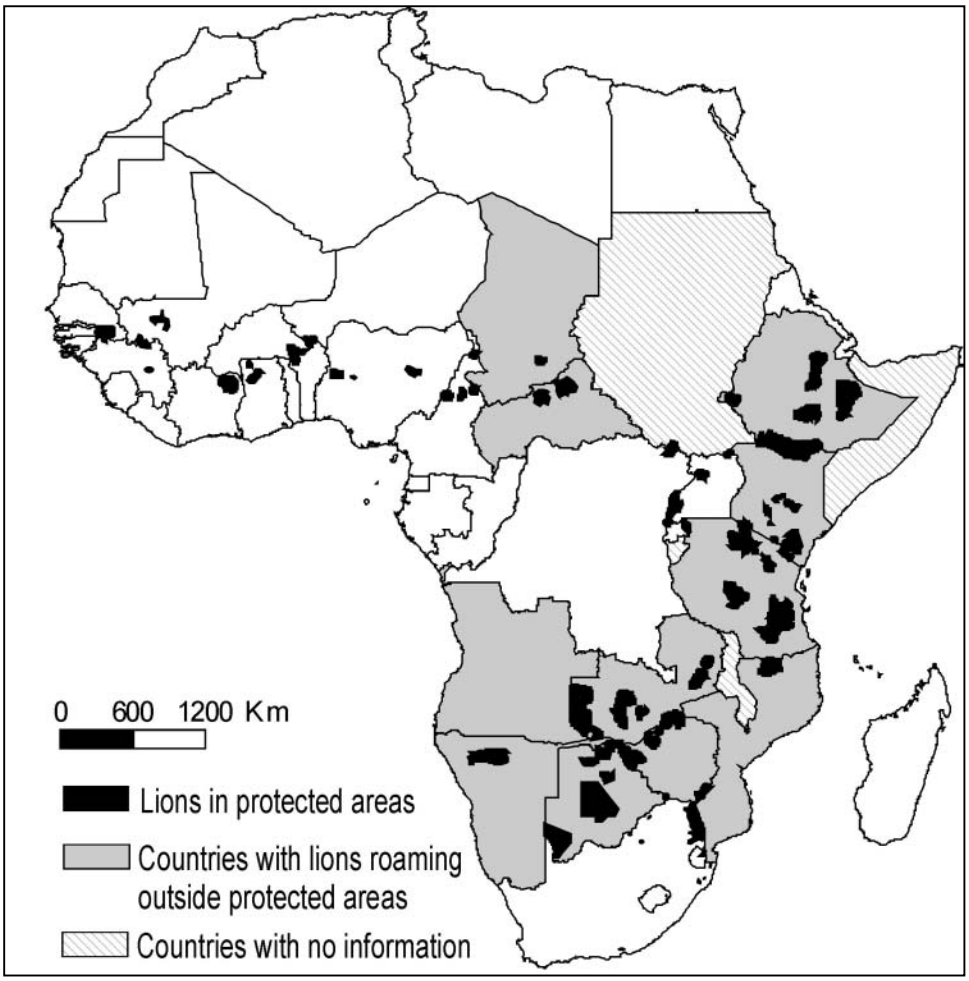

Fig. 4.1: Map of Africa showing lion dispersion. Protected areas with lions as listed in Appendix 4.1 in black, countries with substantial numbers of lions outside protected areas shaded, information in Appendix 4. 1 with no specific geographic denomination not displayed.

4.4 Discussion

Methods 1 to 3 accounted for approximately 30% of the total lion estimate, leading to relatively high accuracy (reliable estimate) and precision (objective min-max values). Seventy percent was established with methods 4 to 6, which give a rather accurate estimate of lion numbers, especially if they include calculations from basic parameters that were assessed objectively. In contrast, the min-max values are subjective, though not meaningless since an experienced researcher's min-max conceivable lion numbers will rarely be exceeded. Nevertheless, min-max values should not be confused with confidence intervals.

Some figures in Appendix 4. 1 were marked as disputed. In the case of Kruger NP, the source stated that min-max values were inappropriate for his research conditions (G. Mills, pers. comm.). S. Creel (pers. comm.) provided an estimate for the Selous population, despite the paucity of data; C. Packer and J. Scott (pers. comm.) questioned the figure but did not propose an alternative and agreed that the estimate reflected the true order of magnitude. For the Central Kalahari area, P. Funston (pers. comm.) estimated the lion population at 517, higher than the estimate of the Botswana Department of Wildlife and National Parks. J. Anderson (pers. comm.) stated that the last two lions in Odzilla NP were shot in 1994, but C. Aveling (pers. comm.) reported that there could still be up to 25 individuals. Nowell & Jackson (1996) stated that lions were extinct in Gabon whereas some sources suggested that there may be lions on the Bateke Plateau. A recent survey in that area found that the last lion

was shot in 1999. A few small savannah patches near Mpassa were not surveyed, these can theoretically contain 0-10 lions (P. Henschl, pers. comm.). For Niokolo Koba NP, the warden stated that the only figure ever published, 120 in 1977, should be listed (Dupuy & Verschuren, 1977; I. Diop, pers. comm.). Another source, however, estimates the population at 20, based on extensive travel and interviews in 2001 (O. Burnham, pers. comm.). A third source used several methods and estimated between 50 and 150 lions in 1996 (I. Di Silvestre, pers. comm.).

The results are based on extensive enquiry, only a few areas are listed as 'no information available' or 'present, not estimated'. Of these areas, we expect the Ruaha and Tarangire ecosystems in Tanzania to contain substantial numbers of lions. The other areas were described as 'depleted' (East, 1999), therefore we expect their lion populations to have a marginal impact on the total estimate. Many rural non-protected areas in East and Southern Africa contain lions (G. Mills, *pers. comm.*), in contrast to West and Central Africa (Bauer *et al*., *2003*). Some of these areas were included, but others have never been surveyed although they may contain substantial numbers of lions (order of magnitude: thousands). We speculate that surveys of unknown lion populations will increase the current estimate and min-max to an unknown extent, but surely by less than 100%. More research on currently known lion populations will improve precision but is not expected to change the estimate substantially. We conclude that this inventory represents the best possible conservative estimate of lion numbers at this moment.

In West and Central Africa, lion populations are generally small and isolated; they are declining in some protected areas and have virtually disappeared from non-protected areas, except southern Chad and northern Central African Republic (Bauer *et al.*, 2003). A few populations exist in savannah patches in the Central African forests, but the majority is found in the Sahel savannah belt. This belt is also extensively used by livestock, which frequently leads to human lion conflict. Lion density is typically between 0.01 and 0.03 km^{-2} throughout the region, comparable to the low end of the range in East and Southern Africa. This is partly due to naturally low biomass (East, 1984), and partly due to human influence (Oates, 1999; Fischer & Linsenmair, 2001).

In East and Southern Africa, many large lion populations have been stable over the last three decades. Illustrative of their resilience is the Serengeti population, which has recovered from a canine distemper virus epidemic causing 30% mortality in 1994 (Roelke-Parker *et al*., 1996). Conservation is bolstered by safari hunting and tourism revenues, allowing for conservation in natural lands outside NP's. An important challenge for long term conservation in this region is political stability (Dudley *et al*., 2002). An example is the lion population in Akagera NP in Rwanda, currently estimated at 25, before the civil war estimated at 250 (Montfort, 1992).

This inventory supports the lion's Red List status of 'Vulnerable', based on criterion C2a-i (Hilton-Taylor, 2000; Anonymus, 2001). For West and Central Africa, our results suggest that classification as Regionally Endangered based on the same criterion should be investigated (Gärdenfors *et al*., 2001). Our estimate overlaps with the low end of the educated guess by Nowell & Jackson (1996), but their methodology was entirely different from ours, which precludes conclusions on time-trends. The present inventory aims to be the first step towards a regularly updated African Lion Database, in order to monitor population trends. To this end, it is recommended that areas with no or low quality information are surveyed in the near future and that other surveys are regularly updated.

Acknowledgements

The authors merely collated available information, credit for all surveys and censuses goes to the sources as listed in Appendix 4.1. We are grateful to the many people who put us into contact with these sources and to all members of the IUCN African Lion Working Group, especially Johan Naude. In addition, we acknowledge the assistance of (alphabetically) J. Blanc, A. Blom, G.H. Boakye, W.T. De Groot, J. Hangcock, H.H. de Iongh, P. Jackson, D. Ngantou, M.G.L. Mills, J.O. Ogutu, C. Packer, F.P.G. Princée, J.P. Scott, R. Slotow, C. and T. Stuart, H.A. Udo de Haes, U.S. Seal, and M. van 't Zelfde.

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Appendix 4.1: Lion population estimates in Africa

Lion population estimates in Africa, 2001/2002 unless indicated otherwise. Lions in conservation areas adjacent to NP's were included in the NP figure. Some contiguous protected areas were designated by the name of the most prominent area followed by 'ecosystem'. Methods are described in the text and numbered 1 – 6, they are followed by a reference or the source (personal communications).

Country	Ecosystem (area in km^2)	Est.	Min.	Max.	Method (Source)
North Africa	All ecosystems	0	0	0	6 (Nowell & Jackson, 1996)
Benin	Pendjari ecosystem (6.505)	45	39	52	2 (I. Di Silvestre, A. Tehou)
Benin	Remainder	20	12	28	4 (A. Tehou)
Burkina Faso	Arly-Singou ecosystem (6.388)	100	50	150	5 (P. Bouche, H. Bauer)
Cote d' Ivoire	Comoe NP (11.500)	30	15	45	5 (F. Fischer, H. Bauer)
Gambia	National	0	0	0	5 (H. Bauer)
Ghana	Gbele Reserve (1.226)	10	6	14	4 (Ghana Wildlife Society)
Ghana	Mole NP (4.921)	20	12	28	4 (Ghana Wildlife Society)
Guinea	Guinea-Mali Protected Area	120	60	180	5 (A. Oulare)
Guinea	Remainder	80	40	120	5 (A. Oulare)
Guinea-Bissau	Doulombi / Boe NP (1.500)	30	15	45	5 (D. Fai)
Liberia	National	0	0	0	5 (Garnett & Utas, 2000)
Mali	National	50	25	75	5 (Moriba)
Mauritania	National	0	0	0	6 (Nowell & Jackson, 1996)
Niger	"W" NP (2.977)	70	49	91	3 (Moussa & P. Gay)
Nigeria	National	200	100	300	5 (P. Jenkins)
Senegal	Niokola Koba ecosystem* (19.130)	60	20	150	6 (O. Burnham, I. Diop & I. Di Silvestre)
Sierra Leone	National	0	0	0	5 (Garnett & Utas, 2000)
Togo	National	0	0	0	6 (Nowell & Jackson, 1996)
Sub-total	**West Africa**	850	450	1250	
Cameroon	Benoue ecosystem (30.000)	200	100	400	6 (P. Aarhaug & H. Bauer)
Cameroon	Waza NP (1.700)	60	42	78	3 (H. Bauer)
Central African Republic	National	300	150	500	5 (P. Scholte)
Chad	Zakouma ecosystem (3.000)	50	25	75	5 (P. Scholte)
Chad	Remainder	100	50	150	5 (P. Scholte)
Congo	Odzilla NP* (2.848)	0	0	25	6 (J. Anderson & C. Aveling)
Democratic Rep. of Congo	Virunga NP (7.800)	90	60	125	5 (M. Languy)
Democratic Rep. of Congo	Garamba NP (12.477)	150	100	200	5 (F. Smith & M. Languy)
Equatorial Guinea	National	0	0	0	6 (Nowell & Jackson, 1996)
Gabon	National	0	0	0	6 (Nowell & Jackson, 1996)
Sub-total	**Central Africa**	950	500	1550	
Burundi	National	Not available			
Djibouti	National	0	0	0	6 (Nowell & Jackson, 1996)
Ethiopia	Babile, Darkata. Webe Shebelle	300	180	420	4 (S. Williams & C. Sillero-Zubiri)
Ethiopia	Bale, Sof Omar	50	30	70	4 (S. Williams & C. Sillero-Zubiri)
Ethiopia	Borana, L.Stephanie, L. Turkana	100	60	140	4 (S. Williams & C. Sillero-Zubiri)
Ethiopia	Gambella	150	90	210	4 (S. Williams & C. Sillero-Zubiri)
Ethiopia	North East	250	200	300	6 (S. Williams & C. Sillero-Zubiri)

Ethiopia	Omo NP, Mago NP	Present, not estimated			6 (S. Williams & C. Sillero-Zubiri)
Ethiopia	Remainder	150	75	225	5 (S. Williams & C. Sillero-Zubiri)
Kenya	Aberdares NP (1.966)	7	5	15	6, 2000 (B. Heath)
Kenya	Amboseli NP (392)	20	20	20	4 (C. Packer)
Kenya	East of Rift Valey to the East of the Matthews, Ndotos, Mt Nyiru	Present, not estimated			6 (S. Williams)
Kenya	Galana Game Ranch	150	75	150	5 (B. Heath)
Kenya	Isiolo, Barsalinga, Wamba, Shaba	100	75	125	4 (S. Willliams)
Kenya	Kora National Reserve	40	20	60	5 (M. Jenkins)
Kenya	Laikipia Plateau (10.000)	120	96	144	2 (L. Frank)
Kenya	Masai Mara NP (1.670)	558	502	614	2 (Ogutu & Dublin, 1998)
Kenya	Meru NP, Bisanadi Reserve (5.273)	80	40	120	5 (L. Frank)
Kenya	Nairobi NP (117)	22	22	22	2 (J. Cavanaugh & C. Packer)
Kenya	Nakuru NP (98)	28	17	39	4 (L. Hannah & J. Dawson)
Kenya	North of Tana, East of rift valley	650	325	1300	5 (S. Williams)
Kenya	Tsavo NP (40.000)	675	338	1350	5 (C. Packer & B. Heath)
Kenya	Remainder	Present, not estimated			6 (S. Williams)
Rwanda	Akagera NP (1.500)	25	15	35	4 (S. Williams)
Somalia	National	Not available			
Sudan	National	Present, not estimated			6 (G. Steehouwer)
Tanzania	Manyara NP (325)	20	20	20	4 (C. Packer)
Tanzania	Ngorongoro Crater (4.081)	53	53	53	1 (C. Packer)
Tanzania	Selous Game Reserve* (92.000)	3750	3000	4500	5 (S. Creel)
Tanzania	Buffer zone around Selous	750	500	1000	6 (S. Creel)
Tanzania	Serengeti Ecosystem (40.000)	2500	1750	3250	3 (C. Packer)
Tanzania	Tarangire and Ruaha ecosystem	Present, not estimated			6 (C. Packer)
Uganda	Kidepo Valley NP (1.340)	25	20	30	2 (L. Siefert & M. Dricuru)
Uganda	Murchison Falls ecosystem (5.198)	350	280	420	2 (L. Siefert & M. Dricuru)
Uganda	Queen Elizabeth ecosystem (3.233)	200	140	260	2 (L. Siefert & M. Dricuru)
Sub-total	**East Africa**	11,000	8,000	15,000	
Angola	National	450	270	630	4 (W. Van Hoven)
Botswana	Central Kalahari Game Reserve* (8.766)	312	166	458	6 (P. Funston & Department of Wildlife and National Parks)
Botswana	Kgalagadi Transfrontier Park (38.000)	458	428	478	6 (P. Funston)
Botswana	Southern Kgalagadi Wildlife Management Areas*	225	200	250	6 (P. Funston)
Botswana	Dry North	223	133	312	4, 2000 (C. Winterbach & L. Sechele)
Botswana	Kwando, Chobe River	213	149	277	3 (C. Winterbach & L. Sechele)
Botswana	Okavango Delta (80.000)	1438	1006	1869	3 (P Kat, C. Winterbach, H. Winterbach & L. Sechele)
Botswana	Makgadigadi Pans NP (2.836)	39	28	59	6 (G. Hemson)
Botswana	Nxai Pan (1.817)	Present, not estimated			6 (G. Hemson)
Botswana	Tuli Block	10	0	20	6 (C. Winterbach & H. Winterbach)
Lesotho	National	0	0	0	6 (J. Naude)
Malawi	National	Not available			
Mozambique	Manica Gaza	25	15	35	4 (J. Anderson)
Mozambique	Niassa, Cabo Delgado (15.000)	175	105	245	4 (J. Anderson)

Mozambique	Zambezi Valley	175	105	245	4 (J. Anderson)
Mozambique	Remainder	25	15	35	4 (J. Anderson)
Namibia	Etosha NP (22.270)	230	191	266	6 (P. Stander)
Namibia	Remainder	680	476	884	3 (P. Stander)
South Africa	Eastern Cape: Addo Elephant Park, Kwande, Shamwari	13	12	14	1 (R. Slotow & G. Van Dyk)
South Africa	Kruger ecosystem* (23.700)	2200	2200	2200	6 (G. Mills)
South Africa	Hluluwe-Umfolozi NP (965)	120	72	168	4 (R. Slotow)
South Africa	Phinda, St Lucia, Thembe, Ndumu	15	15	15	1 (R. Slotow & G. Van Dyk)
South Africa	Lowveld region	161	153	169	6 (S. Liversage, I. Sussens, T. Yule, L. van Losenoord, C. Jones, G. Thomson, R. Niemann, P. Owen, M. Pieterse)
South Africa	Venetia Limpopo Mine (400)	30	15	45	5 (J. Kruger)
South Africa	Ligwalagwala – near Malelane	13	13	13	1 (R. Slotow)
South Africa	Madikwe, Pilanesberg (550)	110	99	121	1 (G. Van Dyk)
South Africa	Kgalagadi Transfrontier Park	See Botswana			
South Africa	Tswalu	Not available			
South Africa	Waterberg Region	54	54	54	1 (R. Slotow & G. Van Dyk)
Swaziland	Hlane Royal NP (163)	15	15	15	1 (J. Naude)
Zambia	Kafue NP, Luangua Valley and Lower Zambezi NP	1500	1000	2000	6 (C. Stuart & T. Stuart)
Zimbabwe	Charara Safari Area (2.207)	40	24	56	4 (N. Monks)
Zimbabwe	Chete, Sijarira Safari Area	40	24	56	4 (N. Monks)
Zimbabwe	Chewore Safari Area (2.704)	100	60	140	4 (N. Monks)
Zimbabwe	Chirisa Safari Area (1.788)	40	24	56	4 (N. Monks)
Zimbabwe	Chizarira NP (1.878)	60	36	84	4 (N. Monks)
Zimbabwe	Dande Safari Area (988)	50	30	70	4 (N. Monks)
Zimbabwe	Doma Safari Area (1.933)	35	21	49	4 (N. Monks)
Zimbabwe	Gonarezhou, Save, Chiredzi, Malilangwe, Beit Bridge, Tuli (5.200)	130	91	169	3 (C. Wenham)
Zimbabwe	Hurungwe Safari Area (2.606)	80	48	112	4 (N. Monks)
Zimbabwe	Hwange ecosystem (25.000)	120	72	168	4 (N. Monks)
Zimbabwe	Mana Pools NP (14.000)	97	83	112	6 (N. Monks)
Zimbabwe	Matetsi Safari Area (1.343)	60	36	84	4 (N. Monks)
Zimbabwe	Matusadona NP (16.000)	120	72	168	4 (N. Monks)
Zimbabwe	Sapi Safari Area (1.526)	40	24	56	4 (N. Monks)
Zimbabwe	Zambezi NP (865)	25	15	35	4 (N. Monks)
Sub-total	**Southern Africa**	10,000	7,500	12,500	
TOTAL		23,000	16,500	30,000	

*=Disputed or questioned; n.b. area sizes as listed by East (1999) were given for approximate comparison, not for calculation of lion densities since most figures do not include adjacent lion habitat.

Chapter 5:

Research Needs for Lion Conservation in

West and Central Africa

Edited from: Bauer, H., H.H. de Iongh, F.P.G. Princée & D. Ngantou (2003) Research needs for lion conservation in West and Central Africa. *Comptes Rendus Biologies* **326**, S112-S118.

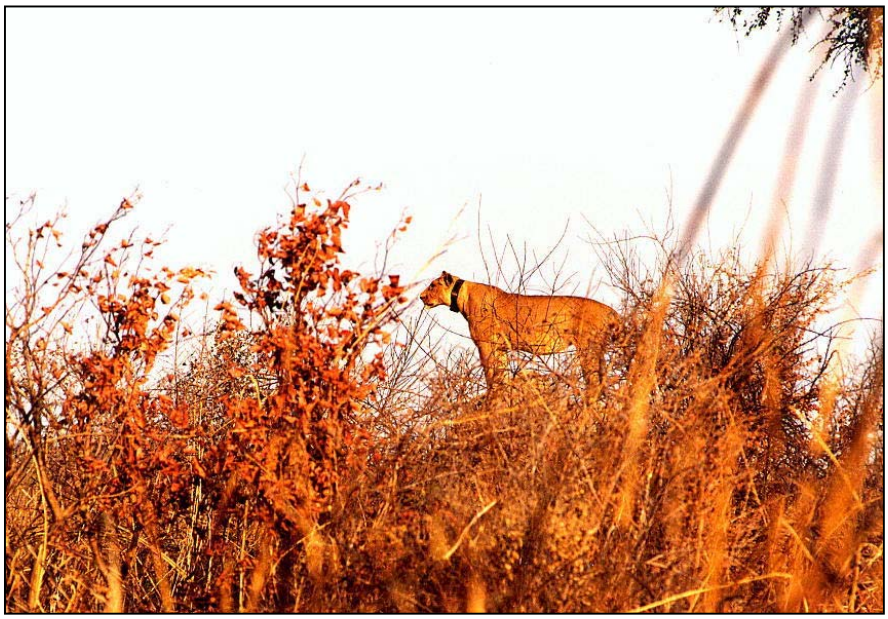

Photo 7 (by P. Scholte): Tagged lioness on the outlook at dawn.

Summary

The lion has historically probably been widespread at low densities in West and Central Africa, nowadays they are largely restricted to small isolated populations inside protected areas. The total number is probably between 1000 and 2850, the best possible guestimate would be 1800. Human factors form the main cause for the suspected decline of lion populations, both inside and outside protected areas. Very little research has been done on West and Central African lions, a few examples are summarised. The international community is slowly becoming aware of threats to lions in the region and some initiatives for lion conservation have started.

5.1 Introduction

The lion (*Panthera leo*, L. 1758) once roamed large parts of Africa, Europe, the Middle East and Asia. The species disappeared from Europe during the first century AD and from North Africa, the Middle East and Asia between 1800 and 1950, except one population in India, containing approximately 250 lions of the sub-species *P. l. persica*. The sub-species *P. l. africana* now lives in savanna habitats across sub-Sahara Africa (Nowell & Jackson, 1996).

The African lion is classified as vulnerable on the Red List of Threatened Species of the World Conservation Union (IUCN); agriculture, human settlement and poisoning are mentioned as main threats. The lion is a member of the family *Felidae* which is listed in appendix II of the Convention on International Trade in Endangered Species (CITES). Institutions involved in nature conservation do not generally focus on lions.

Lion numbers were estimated at between 30,000 and 100,000 in 1996 (Nowell & Jackson, 1996). Populations in West and Central Africa were then described as largely unknown but probably declining. An inventory by the IUCN African Lion Working Group, the African Lion Database, shows that the number of lions in Africa is more likely between 16,500 and 30,000 (conservative estimate; Chapter 4). Here, we focus on the West and Central African part of that inventory and describe numbers, trends, threats and opportunities with regard to lion conservation in West and Central Africa.

5.2 Material and methods

The inventory was based on extensive inquiries, the fact that almost every single country was covered indicates that there are few gaps. More research on currently known lion populations will improve precision but is not expected to change the estimate substantially. Figures are presented as unrounded figures, except sub-totals and totals which are presented as rounded to the nearest 50. Only a few figures were found in literature, very few census data have been published, most are therefore based on guestimates by informants with knowledge of the area. Background information for the interpretation of the figures was obtained from literature and from personal communications of conservationists attending a workshop held in Cameroon, 2001 (Bauer *et al.*, 2001).

5.3 Results and discussion

The African Lion Database estimates the number of free ranging lions in West and Central Africa at 1800 (lowest and highest conceivable estimate or "min-max": 1000-2850; Appendix 4.1). Fig. 5.1 highlights that all populations are small and fragmented, scattered over the region.

Wildlife densities in any Central and West African ecosystem have always naturally been much lower than in eastern Africa, generally speaking, in the order of magnitude of 500 – 2500 kg/km^2. This means that lion densities have probably always been much lower than in other parts of the continent. Following the correlation between lean season biomass and lion density (Van Orsdol *et al.,* 1985), it probably varied between 1 and 20 lions per 100 km^2. With the increase in human pressure, lions have virtually disappeared from non-protected areas, and lion densities in most protected areas are now below 5 lions per 100 km^2.

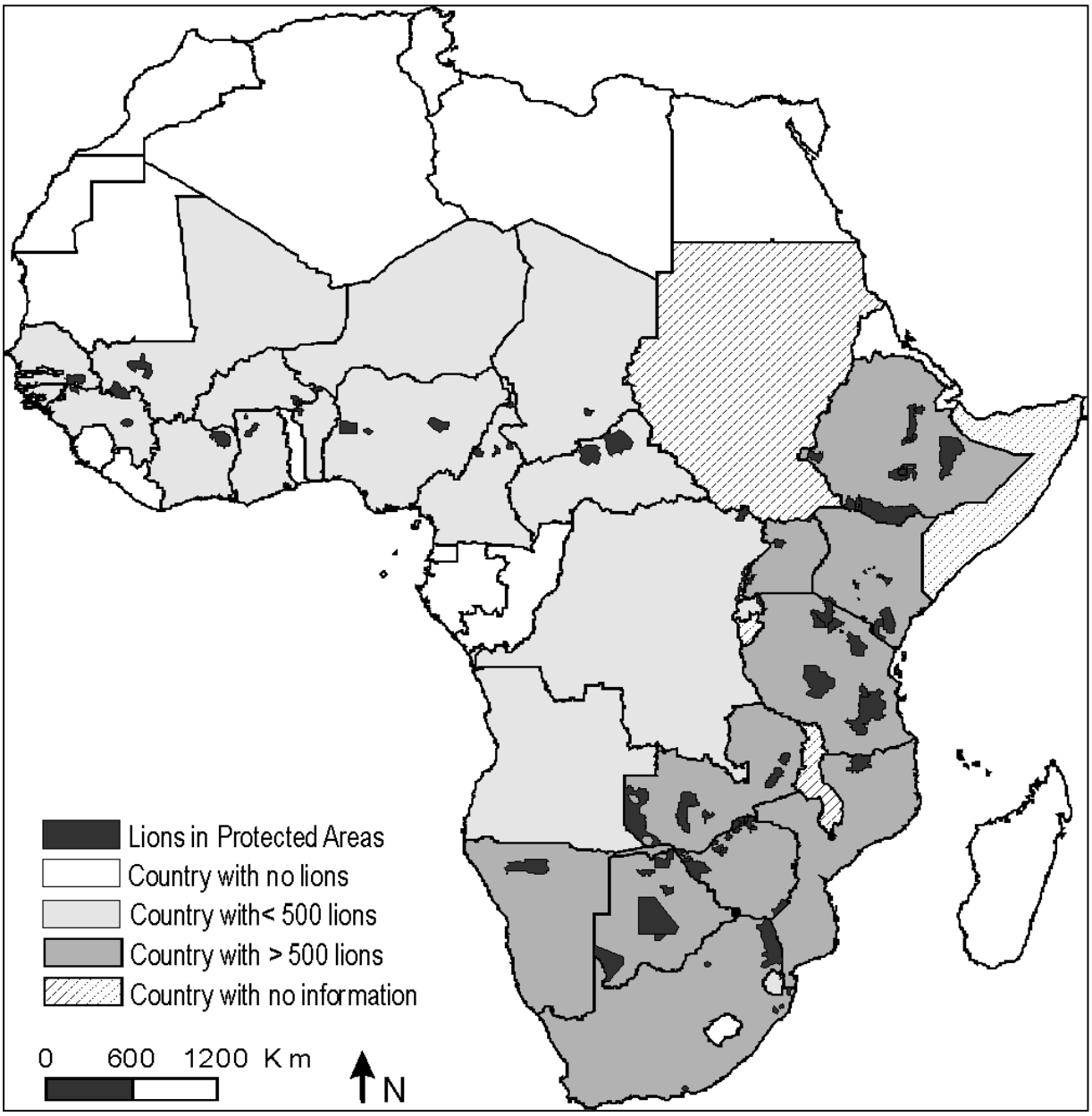

Figure 5.1: Lion distribution in Africa.

In West and Central Africa, lion populations appear to be small and isolated; they have virtually disappeared from non-protected areas. Scarce information suggests a decline over the last three decades in protected areas, illustrated by changes in four reputed National Parks (NP): Niokolo Koba NP in Senegal from 120 to 70 (Dupuy & Verschuren, 1977), Comoé NP in Ivory Coast from 100 to 30 (estimate based on a 70% reduction in prey availability (Fischer & Linsenmair, 2001), Pedjari conservation area in Benin from 80 to 50 (Geerling & Bokdam, 1973) and Waza NP in Cameroon from 100 to 50 lions (Flizot, 1962) (Fig. 5.2).

5.3.1 Causes of decline

Biodiversity loss is believed to be a general and ongoing regional trend, associated with human expansion because of demographic growth. In fact, most Protected Areas were originally created in areas with abundant wildlife due to the absence of man caused by river blindness and sleeping sickness, but pressure on those areas only started when the epidemics were controlled and humans expanded (McNeely *et al.,* 1994).

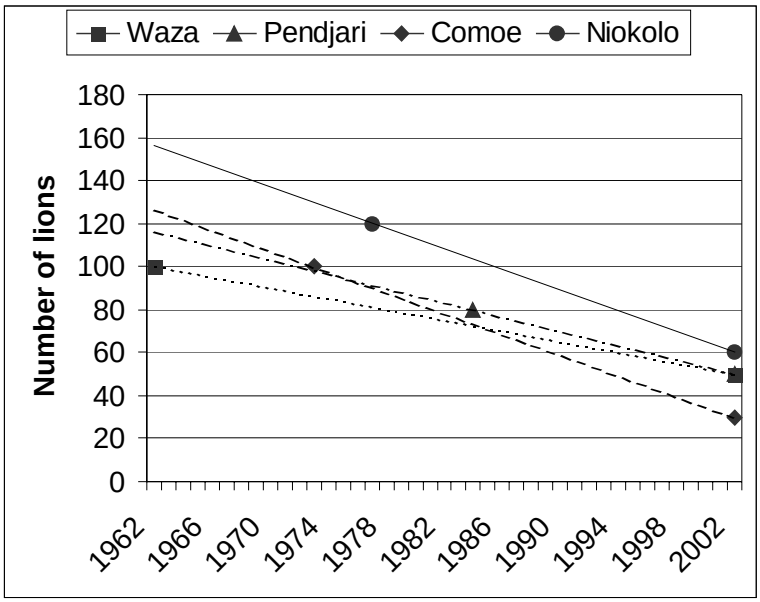

Figure 5.2: Lion population trends in four National Parks.

The main economic activity in the Sahel and Sudan vegetation belts, the largest part of the regional extent of occurrence, is extensive animal husbandry. This is mainly practised in a (semi-)nomadic way, over large ranges (Anonymus, 1996). Human lion conflict is therefore a widespread problem with a long history. Herdsmen generally accept livestock depredation up to a varying threshold, lion poaching or poisoning is not immediately practised (pers. obs.). Gradually, however, lions have progressively been restricted to protected areas and their surroundings only. Poaching and poisoning has probably been the main direct cause, but in a context indirect human impact (on prey and on habitat).

Lion populations inside protected areas also appear to be declining. One important cause could be the regional economic crisis. The number of civil servants and their salaries decreased substantially as a result of the Structural Adjustment Program that was adopted for economic recovery. The effects on the management of National Parks have been negative, the presence of guards has been considerably reduced, especially in the remote areas. The number of guards in Waza NP, for example, dropped from 19 in 1997 to 8 in 2001 (Saleh, pers. comm.). Road maintenance, surveillance, infrastructure maintenance and tourist

accommodations have all suffered from budget reductions. In many areas, authorities faced with a lack of capacity for 'repressive' management shifted towards 'participatory' management in various forms (Adams & McShane, 1992; Oates, 1999). Since the lion is a species with high propensity for conflict with local people, its conservation in protected areas in West and Central Africa under participatory management is not easy.

5.3.2 Current threats

The main direct threats mentioned during a regional workshop were (Bauer *et al.,* 2001):

- poaching / poisoning for livestock protection
- poaching / poisoning for commercial / traditional use of lion organs
- habitat destruction
- livestock encroachment
- risks inherent to small populations (inbreeding, stochasticity, etc.)

In addition, most countries allow safari hunting. This paper is not intended to contribute to any of the current debates on lion hunting. We observe, however, that the low figures presented suggest that sustainable offtake is hardly possible. It could therefore be mentioned as a threat.

Risks associated with small populations are probably an important theme for research and management in the near future. However, no systematic inventory of genetic diversity or veterinary survey has been published so far. Therefore, we cannot give any details, and the next section will focus on the other main threat.

5.3.3 Human lion conflict

Human lion conflict is generally recognised as a regional management problem, some information is available on the Guinea, Senegal and Benin (Bauer *et al.,* 2001), but the most detailed study was undertaken in Waza NP, Cameroon. Here, depredation on livestock is a serious phenomenon, especially to the south of the park. The situation was first assessed with the aid of Participatory Rural Appraisal techniques in 1995 (Bauer & Kari, 2001). More quantitative information was gathered with structured interviews in 1998. These showed that lions are responsible for more damage than any other carnivore, it is estimated that 700 cattle and over 1000 small stock are attacked annually (not necessarily killed and consumed), valued at approximately US$ 130.000. The number of domestic animals killed by all carnivores together equals the mortality due to animal disease, it is estimated that livestock is the main prey for between 20 and 30 lions (Sonne, 1998). These figures obviously suffer from bias (people may exaggerate), but whatever the 'real' figures are, they are impressive.

People in all settlements gave similar information about the locations and moments at which depredation occurred. Lions attack all species of domestic animals on the pastures at daytime. People know that lions also hunt at night, but livestock is then kept in enclosures inside the villages where lions hardly ever venture. Hyenas are exclusively nocturnal, they attack small stock in or near the settlements at night. They enter enclosures and even houses, but are easily chased away if the owner is awake. All forms of depredation were said to occur more often in the rainy season, because the grass is tall and the rain makes noise which makes stalking easier. This is contrary to experiences in east Africa (Butler, 2000).

Some management options for human lion conflict mitigation were described by Stander (1990). An instrument which has not been described in literature is to chase lions away with the use of repellents. To our knowledge, this technique is generally considered

effective in elephant damage mitigation but not used on lions, except in Guinea. The Guinean experience has not been described in any publication (Oulare, pers. comm.). The Haut Niger NP park (central Guinea) consists of a core area for strict conservation and a buffer zone which is managed jointly by the state and the local population. Lions were extinct, but an estimated seven individuals re-invaded the area in 1997 and attacked 168 cattle in 1997 and 1998 according to local authorities. The well organised traditional hunters' fraternity decided to apply an ancient technique, in collaboration with the authorities, aimed at chasing the lions into the park's core area. This is done by at least 40 traditional hunters who walk in parallel lines towards the park over approximately 30 km during three or four days, about 100 m. between them. While marching, they blow whistles and they each fire one or two blank shots a day, using a muzzle loader with a mixture of three powders: phosphorous nitrate and dried fibre of *Trema guineensis* and *Authonata crassifolia.* This produces a lot of noise and an irritating and pervasive smoke. This is repeated on several sides of the core area, whenever necessary. It has led to a reduction in cattle attacks to 6 cases between 1998 and 2000, according to local authorities. This experience is based on traditional knowledge and has not been verified, but it could inspire the development of new conflict mitigation techniques.

5.4 Conclusion

It is surprising that so much effort has been invested in lion research in Southern and Eastern Africa, while so little is known about lions in West and Central Africa. This is not justified by conservation priority: lions are certainly more threatened in West and Central Africa. At this moment, there are hardly any special research, training or conservation programs for lions, and large conservation organisations still do not give priority to carnivore conservation.

The African Lion Working Group was aware of this situation and defined information gathering on West and Central African populations as a priority (Wildt, 1999). So far, this has led to a process that gives a promising prospect. The publication of the workshop proceedings (Bauer *et al.,* 2001) was given much media attention, awareness is now much higher in conservation circles. In addition, a West and Central Lion Network was created, with the following vision: *to promote the long term conservation of lion populations across West and Central Africa and to promote management aimed at maintaining long term viability while reducing human-lion conflict and in a way that contributes to the sustainable development of the region.*

Based on the current threats as cited above, research needs and priorities can be defined as:

- systematic regional inventories of lion numbers, trends, genetic variability, health, prey base and human lion conflicts,
- biological research on small population viability,
- animal production research on systems to minimize predator damage to livestock,
- socio-economic research on the actors involved in poaching and the trade in lion organs,
- interdisciplinary research on Protected Area effectiveness.

This research agenda is somewhat different from the current East and Southern African agenda, currently focussing on two themes. These are epidemiological research into Tuberculosis, Canine Distemper and Feline Immunodeficiency Virus (FIV or 'cat-aids') and ecological research into the demographic and behavioural effects of selective off-take for safari hunting. Human lion conflict is also being investigated, but it does not appear to be the

main theme, which is exactly what we propose for the West and Central African lion research agenda.

Acknowledgements

The inventory is based on the kind cooperation of our sources as listed in Appendix 4.1. We acknowledge the assistance of (alphabetically) J. Blanc, G. H. Boakye, G. Chapron, W. T. De Groot, P. Jackson, S. Van Der Merwe, J. Naude, E. M. De Roos, H. A. Udo De Haes, U. S. Seal, and M. Van 't Zelfde. The following institutions contributed in various ways to the process of information gathering: Cameroon Ministry for Environment and Forests, African Lion Working Group, Conservation Breeding Specialist Group, Leiden University, Foundation Dutch Zoos Help, Dutch branch of WWF, Garoua Wildlife School and IUCN regional office for Central Africa.

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Chapter 6:

Assessment of Human - Predator Conflict

through Thematic PRA around Waza National Park

Bauer, H. & S. Kari (2001) Assessment of the people – predator conflict through thematic PRA in the surroundings of Waza National Park. *Participatory Learning and Action Notes* **41**, 9-13.

Photo 8: Evening group discussion during PRA.

6.1 Introduction

Exploratory PRA is generally used to get an overview of the way of life of community members, a qualitative assessment of their production methods, a descriptive assessment of their history and culture, an introductory dialogue on problems etc. A conservation and development project organised a series of these exploratory PRA's in communities living close to Waza National Park (Waza N.P.), Cameroon. Scholte *et al.* (1999a) reported on these PRA's and on the specificity of PRA in a situation of conflict between park management and surrounding communities. The authors of this article participated in most of the PRA's in key communities and had separate thematic sessions in additional communities with a specific objective: to assess the conflict between livestock and wild predators. This article presents the results and discusses the usefulness of thematic PRA.

6.2 The area

Waza N.P. is situated in the Far North Province of Cameroon, with a Soudano-sahelian climate and vegetation. Temperatures range from 15ºC (January) to 48ºC (April), rainfall is irregular between years, with an annual mean of 700 mm in one rainy season from June to October. Half the park is part of an 8000 km^2 floodplain ecosystem that retains water until December, the other half is on higher sandy soils. Waza N.P. is a biosphere reserve of approximately 1600 km^2.

Waza N.P. is one of the most valued parks of West and Central Africa, with large populations of elephant (*Loxodonta africana*), various species of antelopes and monkeys and an extremely diverse avifauna (Tchamba & Elkan, 1996; Scholte *et al.,* 1999b). There are populations of lion (*Panthera leo*) and both spotted and striped hyena (*Crocuta crocuta* and *Hyaena hyaena*, respectively), Ngog Nje (1986) and unpublished data of the park warden and the author indicate population estimates between 25 and 100 lions and between 100 and 800 hyena's. Reliable data of counts using appropriate methods are not available. There are populations of unknown size of smaller predators, such as common jackal (*Canis aureus*), honey badger (*Mellivora capensis*), small spotted genet (*Genetta genetta*), civet (*Viverra civetta*), serval (*Leptailurus serval*), caracal (*Caracal caracal*), pale fox (*Vulpes pallida*) and various species mongoose (family *Herpestinae*).

Several ethnic groups use the area around Waza N.P. Among the pastoralists the Fulbé are predominant, followed by Arab Choa. Both can be divided into three groups: resident, transhumant and nomadic. The resident are found mainly in the south of the research area, the number of animals they keep in the vicinity of the village during the dry season is limited by water and pasture availability, the rest is sent to the floodplain. Transhumants come to the area with their herds during the dry season, their villages can be anywhere in the province, but mostly in the area south of Maroua. Nomads do not have a permanent base, they move around but follow more or less the same pattern of movement as the transhumants. The word 'settlement' is used instead of 'village' throughout this article to express the inclusion of nomads' camps. An ethnic group in the floodplain mainly involved in fisheries is called Kotoko. Another major ethnic group, Mousgoum, is involved in agriculture, fisheries and small scale animal husbandry.

In the meantime, a management plan for Waza N.P. and the surroundings has been defined, taking into account the results of the PRA's. This management plan proposes an

evolution towards a co-management approach in an attempt to integrate the interests of the park and the population (Bauer, 1999; Scholte *et al*., 1996).

6.3 Methods

The methods used for the exploratory PRA were described by Scholte *et al*. (1999a). The author participated in the regular sessions, using tools such as historical diagramming, participatory mapping, transect walks, semi-structured interviews and participatory problem analysis. During these sessions and during separately organised thematic sessions, the authors had a focus on the problem of stock raiding by wild carnivores. If the problem came up during the plenary sessions it was discussed in little detail in order not to introduce an external bias. Details were later discussed with those that had appeared to be particularly involved. Additional exclusively thematic PRA's were organised in a few settlements that were not visited by the team for regular PRA's.

Specific tools for the thematic part of the PRA's were designed and used. Pictures of predators were photocopied from a field guide and used for visual identification. Once identified, visible differences between sex and age classes of the species were discussed. People were asked to draw footprints in the sand and to imitate animal sounds, possible variations with sex, age and behaviour of the animal were discussed. If it appeared from these tools that people had more detailed ecological knowledge, discussions continued on predator diet, reproduction, hunting strategy etc. In some cases incidents were 'reconstructed' as a play, with a particular focus on environmental factors of importance during various stages of stock raiding.

Participatory mapping on supra settlement territory scale was used by the people to show the extent of the people-predator conflict and was used to discuss links between predator distribution, habitat features and human activity. In every settlement, informants were asked to estimate the loss of livestock due to depredation. Interviews with key informants such as the park warden gave additional information. Sometimes information was gathered in the surroundings, at markets or from passing nomadic shepherd.

Discussions were held in the local language, the first author was assisted by an interpreter (second author) and had a list of the most relevant words in the four most common local languages.

6.4 Results

6.4.1 Local ecological knowledge.

The presence of predators in a given area could easily be assessed with the use of colour pictures. In all settlements on the park border, everyone recognised the main species. In addition, the other tools demonstrated much ecological knowledge. Settlements a bit further away from the park to the north and east were less successful. An adolescent in Ngodeni interpreted a lion picture as showing a monkey, people in Arainaba called a lion a hyena and a mongoose a fish. In these areas, people generally agreed that the species did not occur near their settlement.

To compare the results between different settlements, an indicator was used that combines the level of detail with the validity as compared to scientific knowledge. Local ecological knowledge was classified as detailed and valid if several people were able to give details on at least one species with each tool that was used and if a majority of those details

corresponded with scientific knowledge. The results are shown in Table 6.1. Based on proximity and similarity of responses, settlements were stratified into geographic units, zone 1 to 4. The reliability of this method is indicated by the consistency of responses by individuals in different settlements within a zone. Applicability of this method may depend on local circumstances, however. An important factor is the quasi absence of schools or other institutions where people could learn about animals without actually being face to face.

Table 6.1: Visual identification and ecological knowledge of different species of predators during group interviews in the settlements around Waza N.P. matching with (+) or different from (-) scientific descriptions.

zone	Settlement	Photo recognition			Ecological knowledge		
		lion	hyena	other	lion	hyena	other
	Badaday	+	+	+	+	+	+
1	Amaheiri	+	+	+	+	+	+
	Andirni	+	+	+	+	+	+
	Dieguere	+	+	+	+	+	+
2	Tchede	+	+	+	+	+	+
	Camp 1	-	+	+	+	+	+
	Mahe	+	-	-	+	+	+
3	Camp 2	+	+	+	+	+	+
	Camp 3	+	-	+	-	-	+
	Zina	+	-	+	-	+	+
	Camp 4	-	-	+	-	+	+
4	Sifna	-	-	+	-	-	+
	Camp 5	-	-	-	-	+	+

N.b. Numbered camps are temporary nomadic settlements close to the settlement that precedes it in the table.

There was also a picture of leopards (*Panthera pardus*), which led to some discussion. Older men recognised the animal but disagreed on current distribution. The last time anyone spotted a leopard was over fifteen years ago, and most people concluded that the population is extinct. Others, however, who knew that it is one of the most secretive and best camouflaged felids, did not exclude the possibility that there is still a small population of extremely cautious and exclusively nocturnal leopards. Park personnel and trackers have not seen footprints for at least a decade, the presence of leopards might be a thing of the past.

Two men had visited a zoo with spotted hyena, but when asked to select its picture they pointed at the image of striped hyena instead. From interviews on animal ecology it also appeared that people hardly differentiate between the two species. A majority considered them two varieties of the same species with identical behaviour. Only one of the local languages, Mousgoum, has different words for striped and spotted hyena, other local languages depend on adjectives or descriptions, like English, to distinguish the two species. These factors indicate that people may have difficulties with the determination of hyenas, despite the many morphological, ecological and behavioural differences that biologists have described. This could be explained by the fact that hyenas in the research area are mostly nocturnal and consequently encountered when it is difficult to observe them. The silhouettes of the two species of hyenas are indeed quite similar.

Local ecological knowledge was very detailed in communities on the border of the park. A striking example of the level of detail is the analysis of the use of claws by lions: several people knew that lions have retractile claws that are used only for increased grip

during the final stage of a hunt and for slaying prey. Interpretations of some details tended towards anthropomorphism, that is projection of meaning of human behaviour on similar animal behaviour. Illustrative are the accounts of spotted hyenas often observed in pairs said to be male and female. This implies the ability to distinguish between sexes on the basis of body size. In fact, sexual dimorphism in spotted hyenas is hardly visible with ordinary observation techniques and hyenas hunt in pairs of both different and identical sex (Kruuk, 1972).

6.4.2 The people - predator conflict

Statistics on damage caused by predators to livestock could not be determined very precisely, PRA techniques generally specialise on qualitative assessments and trends rather than precise quantitative data (Chambers, 1997). Table 6.2 presents the size of the herds and the losses declared in 13 settlements around Waza N.P. This table obviously contains controversial data that suffered from bias. People may overestimate damage to convince MINEF of the need to intervene. They may also leave out incidents that occurred inside the park, to avoid inquiries. In addition, owners in the area always declare part of their stock, to reduce taxes and to avoid risks associated with being rich (Scholte, 1998). These biases persisted despite our clearly defined position. Nevertheless, the settlements could be stratified into four zones based on proximity and similarity of responses with respect to the depredation problem.

Table 6.2: Declared herd size and declared annual loss from depredation by large carnivores around Waza N.P.

zone	Settlement	large stock herd	loss	%	small stock herd	loss	%
	Badaday	300	20	6.7	100	30	30
1	Amaheiri	400	20	5	150	30	20
	Andirni	680	5	0.7	450	75	16.7
	Dieguere	80	0	0	300	30	10
2	Tchede	0	--	--	150	25	16.7
	Camp 1	400	5	1.3	0	--	--
	Mahe	40	2	5	325	60	18.5
3	Camp 2	400	4	1	50	0	0
	Camp 3	1100	4	0.4	300	5	1.7
	Zina	0	--	--	200	8	4
	Camp 4	350	1	0.3	125	0	0
4	Sifna	150	0	0	200	3	1.5
	Camp 5	700	0	0	350	0	0

N.b. Numbered camps are temporary nomadic settlements close to the settlement that precedes it in the table.

To get a more reliable assessment of the intensity of the people – predator conflict, results were triangulated. It appeared that observations on local knowledge of predators and on damage by predators had similar patterns. A compilation of Table 6.1 and 6.2 is presented in Fig. 6.1, with circles delimiting zone 1 to 4. In areas with detailed local ecological knowledge, losses from depredation were high, indicating that the people - predator conflict intensity is high. All zones were thus classified by 'conflict intensity'. Table 6.2 gives the order of magnitude of damage, the level of bias and variation does not allow us to give a precise annual average percentage for each zone. Nevertheless, we feel that this classification is

reliable, since it is based on consistent quantitative and qualitative information generated with various tools in various settlements.

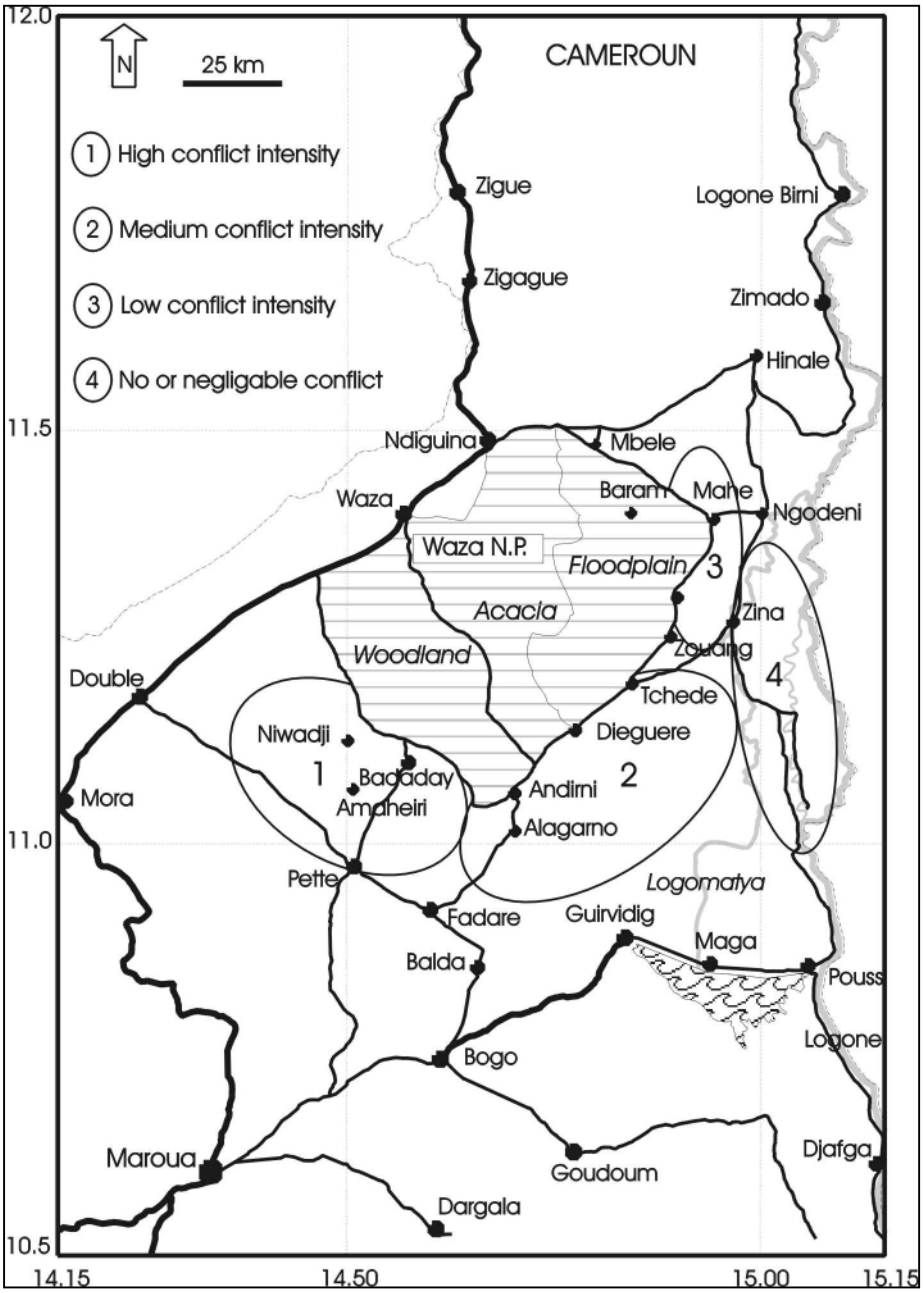

Figure 6.1: Waza N.P. and the surroundings with zones of different conflict intensity, estimated by loss estimates and ecological knowledge in each zone.

People in all settlements gave similar information about the locations and moments at which depredation occurred. Lions attack all species of domestic animals on the pastures at daytime. People know that lions also hunt at night, but cattle is then kept in enclosures inside the villages where lions hardly ever venture. Hyenas are exclusively nocturnal, they attack small stock in or near the settlements at night. They enter enclosures and even houses, but are easily chased away if the owner is awake. Jackals and other smaller predators were reported to be very opportunistic and only attack small stock when it's easy for them, certainly not in the

presence of man. All forms of depredation were said to occur more often in the rainy season, because the grass is tall and the rain makes noise which makes stalking easier.

People generally did not fear for themselves, extremely few human casualties were reported. Lions attack on the pastures, they can easily be chased off by shepherd before an attack. They only become aggressive when disturbed during or after an attack. Three human casualties were reported in the entire area over a ten year period, all under particular circumstances. Only one settlement, Mahe, reported a lion entering a concession once, without accidents. Hyenas had never been much feared, but since the introduction of the torchlight the problem is entirely solved: they are easily chased off with light.

The ability of a lion to attack man and cattle, its status as keystone species (in one local language literally "father of the bush") and its legendary strength make it the most controversial animal with regard to stock raiding. Hyena raids are much more frequent, however, and yet this is only mentioned when all is said about lions first. The reliability of the quantitative data is too low to know exactly whether the economic damage of lion attacking expensive cattle is much higher than hyenas killing much more but cheaper small stock. Table 6.2 indicates that the two are not far apart, however.

One of the shortcomings of PRA methodology was illustrated by the fact that no information on the use of poisoned bait was obtained from the people. An anthropology student got this information later, after a longer stay in one of the same settlements (Schoemaker, 1999). The use of poison, hunting or other illegal activities were apparently too sensitive to be discussed, as mentioned by Scholte *et al*. (1999a).

6.5 Conclusions

The people – predator conflict is serious in the areas around Waza NP, especially on the southern border. During problem ranking and restitution, depredation was confirmed to be a priority problem in these areas. Research is recommended to quantify losses and to study locally practised mitigation measures. This could lead to recommendations for action within the framework of the current revision of park management. Further east, people agreed during the restitutions that the level of conflict is acceptable. Their priorities for action are beyond the scope of this paper.

Thematic PRA can generate a good impression of a situation, advantages are collaboration with the local population, relatively low investments in staff time and material and quick results. Disadvantages are the various biases and contradictions, especially in quantitative data. We found that repetition of the same exercise in several settlements and triangulation of results from different methods were instrumental in clarifying the bottom line and overall tendencies as well as showing local variation. A thematic PRA is useful and feasible and is best undertaken within the context of a general explorative PRA.

Acknowledgements

This study was part of the activities of the Centre of Environmental Science of Leiden University (CML) within the framework of the Waza Logone Project in Cameroon which is executed by the Ministry of Environment and Forests (MINEF), the World Conservation Union (IUCN), CML and the Netherlands Development Organisation (SNV). We are grateful for the support of these institutions and their staff, especially P. Scholte, Dr. H.H. De Iongh

and D. Ngantou. The comments of Prof. W.T. De Groot, Dr. S. Kersten, R. Noorduyn and the editors of this journal are gratefully acknowledged.

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Chapter 7:

Lion Home Ranges and Livestock Conflicts in

Waza National Park

Edited from: Bauer, H. & H.H. De Iongh (submitted) Lion (*Panthera leo*) home ranges and livestock conflicts in Waza National Park, Cameroon.

Photo 9: Lioness removing a thorn from her front paw.

Summary

An isolated population of approximately 50 lions (*Panthera leo*) in Waza National Park, Cameroon, caused considerable damage to livestock. Home range sizes of five collared lions were assessed, the mean is larger than any known study: 630 km^2. The lions differed in their stock raiding behaviour, with two male habitual problem animals, one female non-problem animal and two female seasonal problem animals that left the Park in the wet season. Together, they killed over 100 heads of cattle annually.

7.1 Introduction

The lion (*Panthera leo*) is threatened in West and Central Africa, due to fragmentation and human-lion conflict (Bauer *et al*., 2003). The North of Cameroon is illustrative, with lions restricted to two populations: one in Waza National Park (NP) and the other in the complex of protected areas in the Benoué basin. We describe a telemetry study of lions in Waza NP, to our knowledge the first in West or Central Africa. Many telemetry studies have been conducted in Southern and East Africa, but it is important to differentiate between the regions. Particularly noteworthy is that prey and lion densities are generally an order of magnitude lower in West and Central Africa (Bauer *et al*., 2003; East, 1984).

Stock raiding is often results in the killing of lions, either by authorities (problem animal control) or by local people (poaching or poisoning). Lions are not all equally responsible for creating conflict: Stander (1990) described the existence of 'non', 'occasional' and 'habitual' problem animals; individuals never, occasionally and continuously involved in stock raiding, respectively. The objectives of this study were to verify the existence of problem animals, to calculate lion home ranges and to assess the human - lion conflict in Waza NP.

Waza NP is a biosphere reserve of approximately 1600 km^2 in the Far North Province of Cameroon, with a Soudano-sahelian climate and vegetation. Temperatures range from 15°C (January minimum) to 48°C (April maximum), rainfall is irregular between years with an annual mean of 600 mm (Beauvillain, 1995). The eastern half of the park is part of a floodplain system flooded from September to December, the western half is woodland on higher sandy soils. The terms 'dry' and 'wet' season used here do not correspond with rainfall, but with landscape characteristics during those periods. The dry season from January to June is characterised by dry woodland and plains with sparse sources of water. During the wet season, from July to December, tall grasses predominate and small ponds are scattered throughout the NP, which is partially flooded. Apart from a few inselbergs, the area is flat at approximately 300 m above sea level.

Waza NP is mainly known for its elephant (*Loxodonta africana*), giraffe (*Giraffa camelopardalis*), and diverse avifauna (Scholte, De Kort & Van Weerd, 1999; Tchamba & Elkan, 1995). Leopard (*Panthera pardus*) and cheetah (*Acinonyx jubatus*) have disappeared and lion and hyaena (*Crocuta crocuta* and *Hyaena hyaena*) are the only remaining large carnivores. The prey population includes kob (*Kobus kob*), korrigum (*Damaliscus korrigum*), roan antelope (*Hippotragus equinus*) and some smaller and less abundant species (Anonymus, 1997; Tchamba & Elkan, 1995). Waza NP is surrounded with human settlements, it is a 'hard edged park' with low wildlife densities in the adjoining woodland and most of the adjoining floodplain (Anonymus, 1997).

Lion population estimates for Waza NP have been independent educated guesses: 100 in 1962 (Flizot, 1962), 40-50 in 1986 (Ngog Nje, 1986), 50-60 in 1988 (C.A. Drijver, pers. comm.) and 50 in 2001 (Bauer *et al*., 2003). The methodology of the annual wildlife census is inappropriate for lions, but the count of 22 lions (Bauer, 2001) can be interpreted as an absolute minimum. The population estimates over the past 25 years are fairly consistent with no indication of a marked decline. However, a total population of approximately 50 individuals is well below minimum viable population level (Nowell & Jackson, 1996; Reed & Bryant, 2000).

In view of the species' importance in tourism and conservation, the ministry in charge has been reluctant to authorise the destruction of lions; only two permits were issued over the last decade. However, there were indications of serious human-livestock conflict, now and in the past, especially in the woodland (Bauer & Kari, 2001). In 1998, lion damage was estimated at US$ 130.000 per annum, using questionnaires for cattle owners around Waza NP (H. Bauer, unpubl. data). Stock raiding also occurred inside Waza NP, where herders sometimes lead their herds illegally (Scholte, Kari & Moritz, 1996). There is no damage compensation system, and local people only have the right to kill lions in self-defence, followed by complex administrative procedures. In practice, an unknown number of lions is probably killed by pastoralists every year, which is never reported.

Lions are easily chased away by unarmed herders, whom they rarely attack. Lions resting inside the NP usually allow tourists' cars to approach them, but during other activities they do not tolerate observers. Outside the NP, they are skittish and run off when approached by car or on foot. They are almost exclusively active at night. Unfortunately research at night was not possible due to armed poachers, highwaymen and cattle thieves. These observations suggest that lions in Waza NP fear human activity, except typical viewing tourism. Since lions in Waza NP were never observed hunting, we could not determine kill rates for different prey; instead we calculated stock raiding frequency indirectly.

7.2 Material and methods

Five lions (numbered L1 – L5, see Table 7.1) in the woodland of Waza NP were tagged with VHF-radio transmitter collars and followed with the use of a mobile receiver with an antenna on a 5m pole (MOD 400, MOD 500 and TR-4, Telonics, Arizona). Lion locations, so-called fixes, were determined regularly in 1999 and 2000, and occasionally in 2001. See Appendix 7.1 for more information on observed tool-use after tagging.

The reception range was a maximum of 4 km at ground level and 15 km from the top of the inselbergs. During the dry season, fixes were taken with a GPS receiver close to the animal, estimated accuracy 50m. During the wet season, off-road driving was impossible and some fixes were calculated from the top of one inselberg. This was the only useful elevation in the area, which precludes triangulation; calculations were based on the angle of the bearing and an estimation of the distance based on reception quality. Accuracy of this method was extensively tested under various circumstances (total 832 fixes), showing an overall standard deviation of 4km for the distance and 13º for the bearing (K. Docters Van Leeuwen and P. Meijer, unpubl. data). Whenever low accuracy impeded classification of a lion as being inside or outside the park, an extra bearing was taken from the park boundary.

Fixes and home ranges were calculated and mapped using MCPAAL and IDRISI software. Two methods were used: Minimum Convex Polygon (MCP) was used for

comparison with home ranges in other areas and Harmonic Mean at 50% level (HM) was used to indicate a lion's 'core area' (Dixon & Chapman, 1980). We calculated home ranges for the year 2000 and for all data. To test the influence of sample size on the 2000 home range, the calculation was repeated with 80% of the data, by eliminating every fourth fix. Core areas were also mapped for the 2000 dry and wet season separately.

Table 7.1: Specific parameters of lions tagged in or near Waza National Park.

Lion	L1 ('Hamidou')	L2 ('Paul')	L3 ('Iris')	L4 ('Kari')	L5 ('Magali')
Date of tagging	29/1/99	14/6/99	14/6/99	16/6/99	18/4/00
Sex	Male	Male	Female	Female	Female
Total length	274 cm	294 cm	230 cm	241 cm	229 cm
Shoulder height	105 cm	109 cm	97 cm	95 cm	81 cm
Weight (kg)	155	140	90	110	80
Age (years)	6-8	10-12	5-6	7-8	6-7
Collar circumf.	68 cm	65 cm	50 cm	55 cm	54 cm
Tagging time	6 hr	4 hr	10 hr	1.5 hr	1.5 hr
Observations during or prior to tagging	Found on domestic prey, outside park	Bad teeth, old	Two cubs of 18 months, lactating	Observed with other female	Recovering, signs of past ill-health

N.b. L2 was immobilised for 2 hours on 18/4/00 for surgery; he then weighed 130 kg.

We used the 1999 and 2000 data to calculate minimum and likely stock raiding from the number of days in- and outside of Waza NP, respectively. A lion inside Waza NP was classified as such from the first observation inside until the day before the first subsequent observation outside and vice versa. Minimum livestock killed was then calculated, by making three assumptions: (1) lions hardly prey on wildlife outside Waza NP; (2) a lion outside the NP kills at least one cow per week; and (3) the number of days inside the NP between two fixes outside the NP equals the number of days of the reverse, and vice versa. These assumptions seemed to satisfactorily describe the situation, but careful interpretation of the results is warranted.

In addition, likely stock killing was determined by multiplication of days outside the NP with the following factor. Prey selection could not be monitored continuously, but numbers of livestock killed by one single lion outside the NP were assessed for two fortnights. This was done by investigating all reported livestock losses within 10km of the evening and morning fix and the area between those fixes. To this end, tracks and bite marks were compared with the dimensions of the collared lion, and direct and indirect observations were made to determine if the collared lion was the only individual in the vicinity. The resulting likely stock killing factor was corrected for body weight, i.e. divided by weight of this lion and multiplied by the weight of the lion to which it was extrapolated. The factor was used to calculate likely livestock consumption by multiplication with the number of days spent outside the NP.

7.3 Results

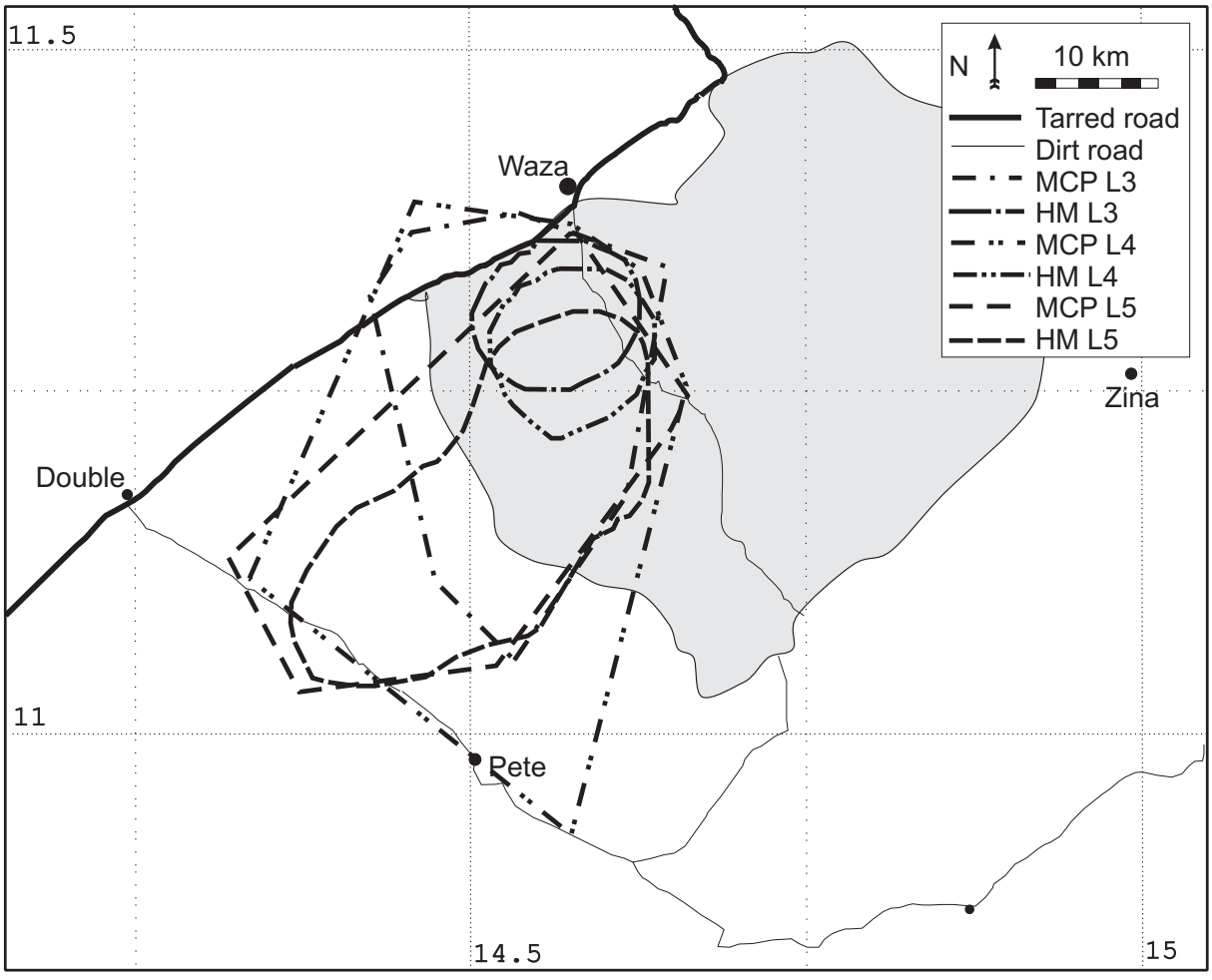
The overall mean MCP home range size for the entire period was 1018 km^2, for the year 2000 it was 630 km^2 (see Table 7.2). Figs. 7.1 and 7.2 depict the home ranges of female and male collared lions, respectively. Fig. 7.3 depicts the seasonal core areas only for lions that had a seasonal pattern, L4 and L5. These figures, combined with field observations, show the following.

Table 7.2: Home ranges of tagged lions in Waza National Park in 2000 and using all data. The effect of small sample size is demonstrated by home ranges based on 80% of the 2000 data. MCP=minimum convex polygon and HM=harmonic mean at 50% level; all in km^2; number of fixes between brackets.

Lion	L1	L2	L3	L4	L5
2000 MCP	482 (21)	1054 (38)	346 (22)	534 (40)	732 (32)
80% 2000 MCP	482 (16)	989 (32)	303 (17)	524 (34)	729 (27)
2000 HM	373 (21)	237 (38)	172 (22)	100 (40)	540 (32)
All data (1999-2001) MCP	1061 (80)	1613 (66)	584 (52)	1101 (60)	732 (33)
All data (1999-2001) HM	227 (80)	697 (66)	130 (52)	140 (60)	506 (33)

Three females had greatly overlapping home ranges and core areas (Fig. 7.1). Two of them occasionally left the park only in the wet season (L4 and L5, 10 and 16 fixes outside the NP, respectively, Fig. 7.3), and livestock owners close to those fixes reported losses. The other female (L3) was observed outside the park during two short periods only, she was not reported killing livestock. She had the smallest home range, possibly because she had two cubs. She was found dead inside the NP in 2002, too decayed to determine cause of death, while one of the other females died in a fight with an unknown female on 2 February 2001.

Figure 7.1: Home ranges of three female lions in Waza National Park (shaded area), all data



(MCP=minimum convex polygon, HM=harmonic mean at 50% level).

The male L1 had a large home range (Table 7.2), with the core area entirely outside the park (Fig. 7.2). He was reported killing livestock throughout his stay outside the park, cattle raids were observed on three occasions. One female (L4) joined him in his core area in the 1999 wet season, while he spent three months of the 2000 dry season in her core area, during which they were observed mating. In the 2001 dry season, he moved into the park again, where he stayed for three months and was observed mating with L5. During his first observed excursion outside the NP afterwards, he was killed by nomadic herdsmen (park warden, pers. comm.). L1 was monitored during two field trips of two weeks each, in the 1999 and 2000 wet season. He was shown to have killed 7 cattle, 9 sheep and 9 goats during these four weeks

Another male, L2, had an even larger home range (Table 7.2) and a core area largely inside the park, not overlapping with L1's (Fig. 7.2). His core area was in a marginal area (no permanent water source, low wildlife densities). He was never observed with females in this area. In February 2000, he was shot in the right front leg with pellets typically fired with a muzzle loader (often made and used by local poachers), resulting in fractures and wounds. Before this incident, he was observed primarily inside the NP, with occasional reports of stock killing just across the border. After the incident, he limped and lost weight; he stayed outside Waza NP, right on a cattle corridor. In April 2000 he was immobilised to remove the pellets, treat the wounds and administer antibiotics, after which he soon recovered. He then took up the pattern observed before the incident until 2001, when his range shifted to the eastern part of Waza NP. Here he was observed with two female lions, no problems with livestock were reported.

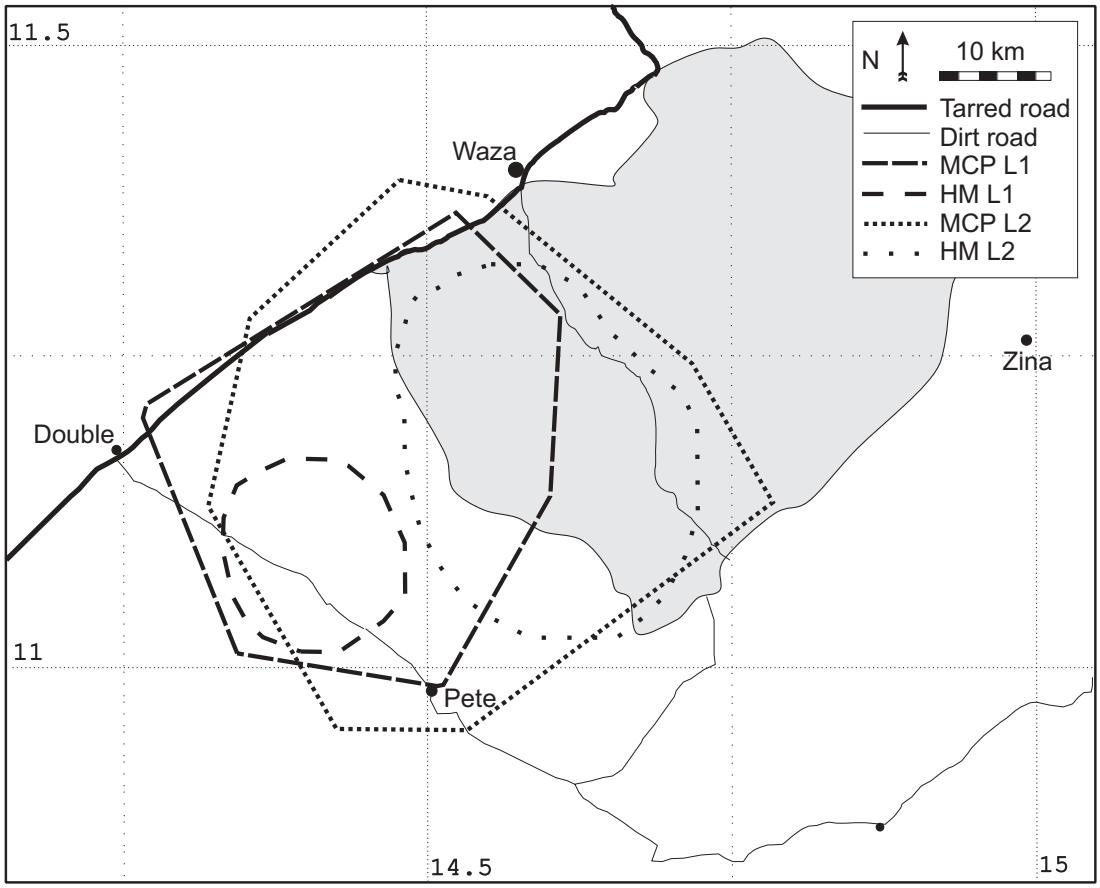


Figure 7.2: Home ranges of two male lions in Waza National Park (shaded area), all data (MCP=minimum convex polygon, HM=harmonic mean at 50% level).

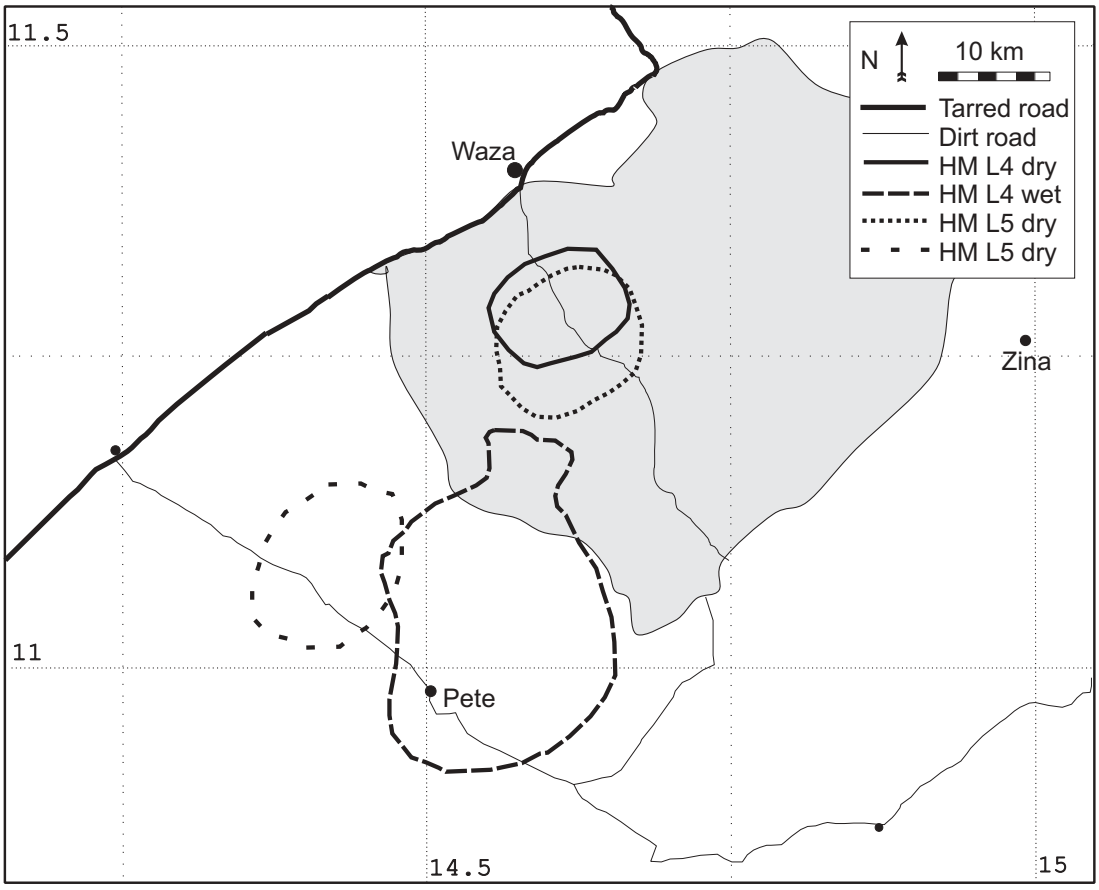


Figure 7.3: Seasonal core areas of two female lions in Waza National Park (shaded area) in the year 2000 (HM=harmonic mean at 50% level).

Table 7.3 presents the number of days spent by each lion in- and outside Waza NP, respectively; it shows considerable variation. If stock raiding outside the NP was one head of cattle per week, a realistic minimum, the five collared lions would have killed 100 cattle. Extrapolating the mean number of livestock killed per day by L1 but correcting for body weight to the number of 'lion days' outside the park gives a likely mean annual livestock consumption of 143 cattle, 183 sheep and 183 goats by the five collared lions.

Table 7.3: Number and percentage of days of collared lion presence in- and outside Waza National Park, and minimum and likely Mean Annual Stock Killing (MASK).

	Inside Waza NP,	Outside Waza NP		
	Days	Days	Minimum MASK	Likely MASK
L1	200 (28%)	503 (72%)	38 cattle	66 cattle, 84 sheep, 84 goats
L2	283 (50%)	284 (50%)	26 cattle	41 cattle, 53 sheep, 53 goats
L3	528 (93%)	39 (7%)	4 cattle	4 cattle, 5 sheep, 5 goats
L4	436 (77%)	128 (23%)	12 cattle	13 cattle, 16 sheep, 16 goats
L5	152 (59%)	106 (41%)	21 cattle	18 cattle, 25 sheep, 25 goats
Total			100 cattle	143 cattle, 183 sheep, 183 goats

7.4 Discussion

The number of fixes was small and below the level normally required for home range calculations estimated at 60 (e.g. Spong, 2002). However, calculation of home ranges of all collared lions using 80% of the fixes showed a mean MCP reduction of 4%, suggesting that

more fixes would not have increased home ranges substantially. Nevertheless, the values must be interpreted as minimum values. The limiting factors for research, accessibility and security, are beyond researchers' control, and improvements are not expected in the near future.

The low number of fixes also reduced the accuracy of calculations on the number of days spent outside the NP and the calculations on stock raiding. Here too, results were probably an underestimate, since lions were more likely to hunt outside the NP and spend the day inside than vice versa, thus passing undetected more frequently outside than inside. Elephants in the same area were significantly less at ease outside the NP (Tchamba, Bauer & De Iongh, 1996), and the hypothesis that this is similar for lions is supported by observed differences in lion behaviour between the in- and outside of the NP. For that matter, the probability of undetected NP border crossing is further reduced by the fact that the core area of lions outside the park is at a considerable distance from the border, at between *c.*10 and 25km (see Figs. 7.1 and 7.2).

Mean MCP home range size in 2000 was large, 630 km². Van Orsdol, Hanby & Bygott (1985) reviewed literature available at that time, and found that home ranges in east and southern Africa varied between 22 and 226 km². They found a significant relation between range size and lean season prey density. In more recent literature, only Stander (1991) reported one male with a larger home range (2075 km²) while the mean was 600 km² in Etosha NP, Namibia a semi-arid area of low prey density. Prey density in Waza NP is low, between 400 and 800 kg/km² (H. Bauer, unpubl. data), a further indication that lion range size may be inversely related with prey density. Prey density is correlated with a combination of soil nutrient status and rainfall (East, 1984), rainfall is therefore a less proximate determinant of lion density and range size (no significant correlation; Van Orsdol, Hanby & Bygott, 1985).

We suggest that different lions in Waza had different tendencies towards livestock depredation. L1 was a habitual problem animal during the research period; he spent most of his time outside the park feeding primarily on livestock. One female, in contrast, was never observed or reported stock-raiding. The other collared lions periodically left the park, where they presumably killed livestock. The case of L2 was peculiar. He occasionally left the NP when healthy, but permanently when wounded. This suggests that stock raiding can be reversibly induced by adverse circumstances.

Our results confirm the existence of habitual problem animals and lions feeding exclusively on wildlife, as described in Etosha NP by Stander (1990). He also coined the term 'occasional problem animals', which is not well defined in literature. Based on the figures of Table 7.3, all lions except one female would probably qualify as habitual problem animals; not occasional problem animals, even though the females spent the dry season inside the NP. In our context, therefore, it would be more useful to discern habitual, seasonal and non problem animals, respectively. The numbers of livestock killed during the research period are considerable. The human lion conflict in other parts of Africa generally tends to be less intense: studies in Namibia and Zimbabwe report lower damage estimates (Butler, 2000; O'Connell-Rodwell *et al*., 2000). Nevertheless, both studies identify lions as the species causing most damage in financial terms. This is caused largely by the relatively high financial value of cattle, making lions more 'expensive' than other large predators (preying on sheep and goats) and elephants (damaging crops). More intense human lion conflict was reported in the Gir NP in India, with approximately 300 lions getting 75% of their food requirements from livestock in 1975 and around 30% in 1995 (Singh & Kamboj, 1996). A compensation

system has been applied there, but people considered this insufficient, and Saberwal *et al*. (1994) identified lion translocation, village translocation, culling, destruction or sale of problem lions and additional compensation payment as management options.

The Waza lion population is at a critically low level, removing lions is therefore undesirable. An option often proposed is a damage compensation system, but implementation of such systems has repeatedly shown to be problematic in Africa (Anonymus, 2001). However, if no action is undertaken, people may kill uncontrolled numbers of lions. Problem animal control may be inescapable; if it is decided upon we recommend that it takes place during the dry season. This is the season with less stock raiding (Bauer & Kari, 2001) and less lions leaving the park (this study, see Fig. 7.3), but problem animal control may be more effective at that moment. Apart from logistical feasibility, this is based on our findings which suggest that lions killing stock in the dry season are the worst problem animals.

Acknowledgements

We thank Ministry for the Environment and Forests for the necessary permits and Per Aarhaug and Magali Jacquier for all the veterinary work. Furthermore, we acknowledge the assistance of Wouter de Groot, Paul Scholte, Paul Loth, Mbida Mpoame, Adam Saleh, Falama Soudi, Vincent Ngomena, Sylvain Tiawoun, Youssouf Maty, Elisa Kroese, Godelieve Kranendonk, Gerard Persoon and Graham Hemson. Fieldwork was based at the Centre for Environment and Development studies in Cameroon, of which we thank all personnel.

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Appendix 7.1: Use of a tool by a lion in Waza National Park

Edited from: Bauer, H. (2001) Use of tools by lions in Waza National Park, Cameroon. *African Journal of Ecology* **39**, 317.

This publication describes an observation made on 16 June 1999 between 12:30 and 13:30 of a female lion wearing a radio collar. This female had been immobilised and fitted with a radio collar on 14 June 1999, during recovery she was stimulated to stand up at regular intervals to see to which degree anaesthesia was reduced. Since this involved a lot of tumbling and semi-controlled steps by the lion in a habitat dominated by the thorny shrub *Acacia seyal*, she probably trampled on a thorn without immediately removing it. Two days later she was observed lying in the shade, obviously disturbed by a thorn in her right front paw.

At 12:30, upon arrival, we approached slowly and stopped at a distance of 35 m. to observe her behaviour. First, we observed her trying to take out the thorn from her paw with her teeth. She tried in vain, with both pairs of canines. Then she scraped her mouth over the ground, and we saw her picking up one single large thorn. She shook her head several times to move the thorn to a position pointing forwards while holding it between a pair of canines. She then started scraping the infected spot, using one thorn as a tool, obviously trying to get the other thorn out. For 30 minutes, we observed her attempting the same thing, shaking her head from time to time to move her 'tool' in the right position.

This lion had two large cubs that were chased off during the immobilisation, they were obviously still very scared two days later. They ran off as soon as we approached, leaving their mother at the shady spot. We observed them monitoring our activities from about 100 m., sometimes trying to get closer to the mother but obviously afraid to do so. To reduce stress and allow them to join the mother in the shade, we decided to stop our observations and leave at 13:30.

On 22 June 1999 she was observed from 11:00 to 13:00. No particular behaviour was displayed, she did not seem to be bothered by the paw anymore. Even during subsequent observations she was not observed using tools or treating here paw.

The use of natural elements in the environment as tools by animals has been reported for several species (Whiten *et.al*., 1999). To our knowledge, however, this is the first observation of such a technique on lions.

Chapter 8:

Lion Social Behaviour in West and Central Africa

Bauer, H., H.H. De Iongh & I. Di Silvestre (2003) Lion (*Panthera leo*) social behaviour in the West and Central African savannah belt. *Mammalian Biology* **68**, 239-243.

Photo 10 (by P. Loth): Tagged lions mating.

Summary

The lion in West and Central Africa is largely restricted to small isolated populations inside protected areas. The combination of fragmentation and low density is typical of the region and different from most areas where lions have been intensively studied. Mean group size in three study areas across the region was assessed and was significantly lower than those found in East and southern African literature. A telemetry study showed that pride structure was also affected in one group. Three hypotheses are proposed to explain low mean group size: low mean prey density, low mean prey body size and high mean proportion of domestic animals in lion diet.

8.1 Introduction

Lion (Panthera leo L., 1758) numbers West and Central Africa were described as largely unknown but probably declining (Nowell & Jackson, 1996). Two independent recent surveys estimated lion numbers in the region at 1800 (Bauer *et al*., 2003) and 3978 (Chardonnet, 2002), respectively. The surveys concur that this is approximately 10% of the estimate for Sub Sahara Africa. Combining the estimates with protected area size (East, 1999) demonstrates low lion densities throughout the region; typically below 1, and everywhere below 5 lions/100km^2. This corresponds with low standing biomass or prey densities in West and Central Africa (East, 1984; De Bie, 1991). Here, we examine the sparsely available information on lion social behaviour in relation to ecological conditions in West and Central Africa, based on information from three study areas in the Soudano-sahelian savannah belt: Niokolo Koba National Park (NP) in Senegal, Pendjari NP in Benin and Waza NP in Cameroon.

Many publications describe lion social organisation, demography and behaviour in East and southern Africa (e.g. Schaller, 1972; Packer & Pusey, 1997; Stander, 1991; Heinsohn & Packer, 1995; Funston *et al.*, 2001; Ogutu & Dublin, 2002; Spong, 2002). In the absence of data from West and Central Africa, many textbooks, fieldguides and reviews have generalised these findings into the species' characteristics (e.g. Macdonald, 1983; Van Orsdol *et al*., 1985; Bothma, 1998; Stuart & Stuart, 1997). The core-concept of lion social organisation in all studies is the pride as the highest level of organisation. The aforementioned literature indicates that a pride (10-20 lions) is composed of groups (3-6 lions) with varying composition that may regularly be observed together, so-called fission-fusion. A pride typically has a territory, defended by 1-3 males for 2-4 years against nomadic males.

In our study areas, lion group size was assessed, defined as the number of lions observed together on an encounter, excluding cubs (<2 years; Smuts *et al*., 1970). In Niokolo Koba NP, group size was assessed by road transects with total length of 23,000 km in 1995-1997. In Pendjari NP, group size was assessed from lion encounters by tourist guides and during 70 calling stations along road-transects in 2001 and 2002. In Waza NP, two types of data were obtained. Firstly, specific information on interactions between five lions was obtained by monitoring the movements of five lions with radio collars. These lions were all first encountered solitary, after tagging they were tracked and observed 291 times ('fixes') from 1998 to 2001. Their home ranges were assessed as Minimum Convex Polygon (total area) and Harmonic Mean (core area, a line around the 50% most clumped fixes). Secondly, occasional encounters (without use of telemetry equipment) were used to assess group size for

the entire park and for the three vegetation zones separately; floodplain, Acacia-shrubland and woodland. These data were obtained during radio tracking fieldwork and questionnaires to guides in 2000 and during a calling station survey in 2002.

Group sizes for different habitats in Waza NP were compared with a Kruskall Wallis test in SPSS 10.0. Group sizes of the three study areas were compared with group sizes in 8 East and southern African studies (Van Orsdol *et al*., 1985) with the same test. For more information on the study areas and on calling station and telemetry methodology, see e.g. Tchamba *et al*. (1995), Di Silvestre *et al*. (2000), Mills *et al*. (2001) and Sin Sin *et al*. (2002).

8.2 Material and methods

Table 8.1 shows that encounters with lions in groups of 1-5 individuals are most common in Soudano-sahelian ecosystems. Mean group size was not significantly different between habitats in Waza NP (K_2=2.5, n.s.). Mean group size in our three West and Central African study areas was significantly lower than group sizes in East and southern Africa (K_1=6.0, $p<0.05$). Solitary lions are of both sexes and solitary females with cubs were regularly encountered. If there was a level of organisation higher than the small groups, their interaction was rare and hardly ever observed. This was confirmed by more anecdotal information from ecologists and tourists throughout the region.

Table 8.1. Lion group size reported for Niokolo Koba NP (Senegal), Pendjari NP (Benin) and Waza NP (Cameroon); and for the three vegetation zones of Waza NP separately.

Frequency and percentage of observations of lion group size								Mean group size
	1	2	3	4	5	6	7-10	
Niokolo Koba NP	8 (38%)	10 (48%)	1 (5%)	1 (5%)	1 (5%)			1.9
Pendjari NP	24 (36%)	21 (31%)	16 (24%)	1 (1.5%)	1 (1.5%)	2 (2.9%)	2 (2.9%)	2.3
Waza NP Total	43 (65%)	16 (24%)	5 (8%)	1 (2%)	1 (2%)			1.5
Waza Floodplain	9	3	1	1				1.6
Waza Acacia	10	2						1.2
Waza Woodland	24	11	4		1			1.6

Overlap between the home ranges of 5 radio collared lions in Waza NP was substantial (Fig. 8.1). Yet these lions were hardly ever observed together. The three females were observed together only once, one female was not seen with any other lion afterwards. The two other females were observed together at 11 fixes in two consecutive months, without any other lion in the vicinity; at the other 71 fixes they were solitary. They were both observed without each other but with Male 1 for one and two short mating periods, respectively. Male 2 was not observed in the presence of any other lion, despite the fact that his home range has most overlap with all the others and that his core area overlaps with the core areas of all three females (Fig. 8.1). After this study, Male 2 was regularly observed North of his 1999-2001 home range, together with two uncollared females for several consecutive months. Uncollared and unknown lions were encountered inside the joint home ranges on a few occasions. They were in groups of 1-3 individuals, but never together with any of the collared lions.

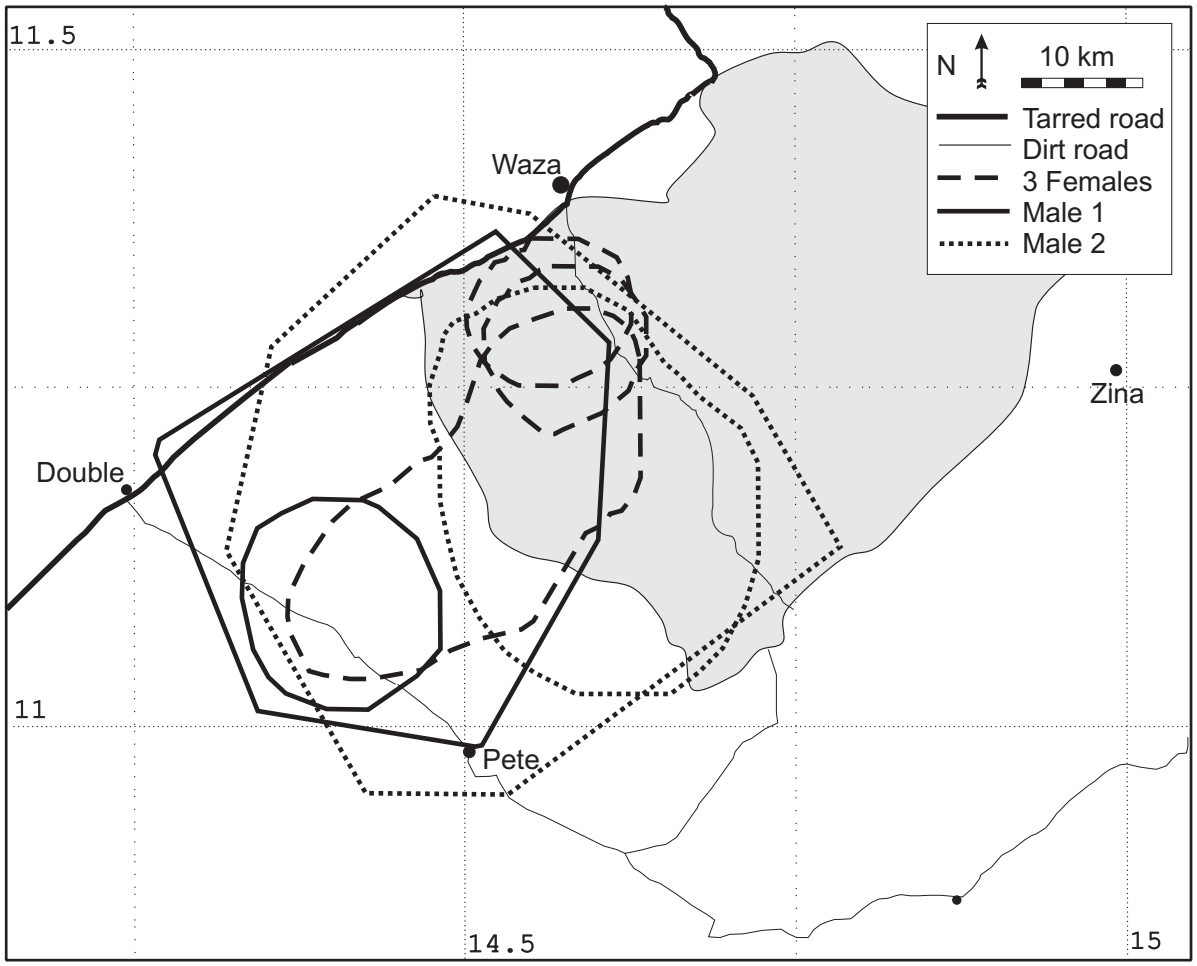

Fig. 8.1. Home ranges of 5 lions in Waza NP, Cameroon (shaded area), 1999-2001. Round shapes are Harmonic Mean home ranges and were depicted for all 5, angular shapes are Minimum Convex Polygon home ranges and depicted for 2 male lions only.

8.3 Results and discussion

Schaller (1972) defined a pride as 'resident females with their offspring and attending males, sharing an area and interacting peacefully'. Typical associated behaviour includes patrolling, communal cub-rearing, coalitions between males, etc. While interactions between pride members are normally frequent, prolonged observation may be necessary to define a pride. Male 1 and the three females could be considered members of a pride. Male 2 would have to be considered a sympatric nomad who later took over a different pride in a different range. This description is not entirely satisfactory, however. For example, the core area of Male 1 does not overlap with the overlap between the three females' core areas (Fig. 8.1). Despite his hypothetical status as pride male, he was not observed patrolling or seeking conflict with Male 2 inside his pride's range. In addition the number of and frequency of interaction between pride members is extremely low. We conclude that the use of the word 'pride' is not useful in describing the observed social system, or should at least be redefined.

The climate of the West and Central African savannah is within the range of climates in East and southern African lion habitats and comparable to e.g. the Kalahari and Etosha areas in Southern Africa. Studies in these areas have shown larger home ranges than elsewhere, the relation between rainfall, prey density, lion density and range size has been

established (Van Orsdol *et al*., 1985; Stander, 1991; Hemson, pers. comm.). Pride structure and group size in the Kalahari and Etosha ecosystems were not significantly different from other studies, however, which weighs against climate as determinant of social structure. Instead, we formulate three hypotheses about the influence of ecological factors on lion social organisation in West and Central Africa.

Firstly, small lion group size could be caused by low prey density. Wildlife densities in West and Central Africa are generally relatively low, even in undisturbed ecosystems; in the order of magnitude of 500 – 3000 kg/km^2 (East, 1984; De Bie, 1991). If we exclude elephant (Loxodonta africana), a heavyweight which rarely serves as prey, figures are even lower. For example, combining data from mammal surveys (unpubl. data) and animal weights (Stuart & Stuart, 1997), mammal density in Waza NP is approximately 600 kg/km^2 without and 2500 kg/km^2 with elephants. Both lion and prey densities in West and Central Africa are outside the range of 13 studies in East and southern Africa reviewed by Van Orsdol *et al*. (1985), with mean middle-sized prey density of 4850 kg/km^2 and mean lion density of 21 lions per 100 km^2. That review indicated that a relation between group size and prey abundance was likely but statistically not significant; it may have to be revised, however, now that more data are available over a wider range of conditions.

Secondly, low mean prey body size could explain small lion group size. This hypothesis has been tested and rejected by Van Orsdol *et al*. (1985), but here again there could be a discontinuity in view of the large differences between the two regions. The hypothesis is that, in the absence of large prey species (adult body mass > 200 kg), the advantage of co-operative hunting is likely to be outweighed by the cost of aggression during feeding (Van Orsdol *et al*., 1985; Packer & Pusey, 1997). This could not be proved based on the 13 southern and Eastern African studies, each with their own ungulate species assemblage but with up to 9 large species. In West and Central Africa, however, there are only 4 large species, and these rarely occur together and rarely in high densities. Mean prey body size is therefore likely to be smaller than in any of the cases dealt with in previous reviews, and the relation with mean group size could be significant across the entire range of African situations.

Thirdly, small lion group size may be a result of high per capita livestock consumption. Livestock may well be an important component of lion diet in the region, since all West and Central African lion populations are relatively small and fragmented (Bauer et al. 2003). Because of the so-called edge-effect (exponentially increasing circumference/surface ratio with linearly decreasing surface), the interface between lions and cattle is large. Human livestock conflict is indeed a regional problem (Bauer *et al*., 2003.; Bauer & Kari, 2001). Since stock-raiding is usually done by 1-2 lions, this is another possible explanation of small group size.

These hypotheses are not mutually exclusive and not exhaustive. The two first hypotheses are based on ecological conditions that have been amplified by human impact over the last few decades, but which are basically natural. The third hypothesis is based on a relatively recent man-made situation, historical research can therefore also indicate its relative importance. We have no reason to assume that there is a regional sub-species with different innate social behaviour, and expect to find the explanation by continued ecological research.

Acknowledgements

We acknowledge the assistance of E. Kroese, G. Kranendonk, R. Turk, S. Schultz, O. Novelli, G. Hemson, E. Sogbohossou, A. Tehou, P. Scholte, H.A. Udo de Haes, W.T. De Groot, G.B. Hartl and F. Zachos. We also thank the Cameroon Ministry for Environment and Forests, the Wardens of Waza, Pendjari and Niokolo Koba NPs, and two anonymous reviewers.

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PART III

DISCUSSION

Part III comprises three chapters (Chapters 9-11) and focuses on conservation aspects by discussing the findings of part II in relation to the context as described in part I. It starts with a comparison of different research methods as different angles to look at human-lion conflict (Chapter 9). It continues with an examination of various conservation strategies and proposes a new strategy which addresses the specific difficulties of carnivore conservation (Chapter 10). Chapter 11 offers an overall discussion and concludes how the findings relate to the management of Waza National Park and formulates recommendations.

Photo 11: Traffic sign on the main road, North of Waza NP.

Chapter 9:

A Comparison of Three Methods to Study

Human - Predator Conflict around Waza National Park

Photo 12: Ostich in the floodplain, Acacia zone in background.

9.1 Introduction

Three methods have been used to study human-carnivore conflict around Waza NP: Participatory Rural Appraisal (PRA), structured interviews and telemetry. In the present chapter, costs and benefits of these methods will be compared. The three methods represent three different paradigms. These are the participatory, social and natural science paradigm, respectively. Interparadigmatic comparisons are rare, scientists generally have more interest in improvements within one paradigm and few research projects therefore combine paradigms (Kuhn, 1970; Hulme & Taylor, 2000).

PRA was described in chapter 6, telemetry was described in chapter 7 and structured interviews were described by Sonne (1998) while his results were quoted in chapters 5, 6 and 7. Each method has its advantages and limitations, the required inputs and the results, or outputs, of these methods will be described in the present chapter. The objective of comparison was to highlight strong and weak points, cost-effectiveness, complementarity and synergy of the different research methods.

9.2 Methods

The three methods were compared by listing inputs and outputs in a common format. For the inputs, the common unit chosen was a monetary unit, the US$, always rounded to the nearest 100. Section 9.2.1 describes how different inputs were expressed in monetary form. We could not calculate all items with equal precision, most were estimated and converted into financial terms using realistic indices for the 1995-2001 price level. 'Hidden costs' were included, i.e. amounts that were not actually paid from the research budget but which are real expenditures for the research project. Outputs remain in their own terms (e.g. number of publications, impact on policy-makers, etc.), section 9.2.2 describes the categories we discerned and the methods we used to score outputs in each category.

9.2.1 Inputs

The following inputs were included.

Labour: expressed in man months and differentiated into a category 'researcher' and 'assistant'. For monetary comparison, these were valued at $ 5,000 and $ 300 per man-month, respectively, including secondary benefits, field allowances and taxes. These amounts reflected our situation, but they vary with nationality and experience of the person. In the discussion (section 9.8), calculations of the costs under different alternative scenarios are presented.

Transport: expressed in km and assuming a 4x4 vehicle. For monetary comparison, a km was valued at $0.3, based on the long term average cost of insurance, consumables (filters, tyres, oil etc.), fuel, depreciation and regular maintenance. The figure was based on several years of accounting under local conditions, but may vary with price fluctuations and circumstances. It did not include the cost of a driver, who was counted as an assistant (see above). It also does not include damage to vehicles in the field, which is typically not covered by insurance. The cost of transport by motorcycle, boat or public transport was considerably lower, but these were not practical for most field visits and were only used occasionally, with negligible cost.

Various: real costs of all items purchased specifically for the study (with the local currency set as CFA 650 =US$1). This did not include non-consumable equipment typically present at a research institution, such as computers, office space, tents, kitchen material, torches, etc.; these were partially included in the next item.

Overhead: cost of support staff and university infrastructure. For monetary comparison, this was valued at 13% of total research cost, which was the standard at Leiden University.

Staff training: the real cost of very specific training especially for the purpose of using a particular research method which is not included in curricula of regular education at the level described for that staff position's requirements.

Time: the duration of a project from the first design to the final result. This was not expressed in terms of monetary value, but as an important descriptive parameter.

9.2.2 Outputs

The following outputs were included.

Scientific publications: the most valuable academic output for both the researcher and the research institution. A meaningful statistic can be obtained by dividing inputs by the number of publications, possibly weighted by an impact factor. In our case this was difficult, however, since some studies were reported in non-rated journals or only in the present dissertation. Therefore, we used a simplified method: 1 point for an unpublished report, undergraduate thesis or extensive use in any publication on a related topic, 2 points for a book chapter, 'grey' report or professional journal, and 3 points for an article in or a manuscript submitted to a peer-reviewed journal.

Training opportunities: this was expressed as the number of undergraduate students writing an MSc or BSc thesis on a component of one of the studies. Students were only mentioned as output, the only input was supervision time which was included in labour costs. Students had scholarships to cover their board and lodging, a common condition to participate in most research programs.

Relevance of results to society: an important product of applied science is the formulation of scientifically sound recommendations for solutions of, alternatives for or mitigation of the problem being studied. We described the nature of the recommendations based on each method qualitatively in terms of reliability, spectrum of applicability and appreciation by those who receive the recommendations (managers and decision makers).

Public relations profile: various types of research had different consequences for the status of the researchers and the research institution. Within the academic community, status is determined to a certain extent by the number of publications, but also to considerations that count outside that community: reports in the media, expectations among local people, appreciation by peers, popular attractiveness of the results, reputation. These are subjective and cannot be quantified, but they did vary between the research methods and were described.

Coverage or scope: some methods focussed on one aspect or one species, while others were more comprehensive and covered a wider range of aspects of the problem. This was qualified as a descriptive parameter without referring to monetary value. The parameter is important, since wider coverage is potentially more important for applied research while a narrow focus often increases the potential of scientific output.

9.3 Participatory Rural Appraisal: approach, inputs and outputs.

Chapter 6 described the use of PRA to assess the human carnivore conflict. Here, we give background information on the organisation of the study and some details which were not relevant to the content of chapter 6, but which allow the assessment of all input and output factors described above.

9.3.1 Approach of the PRA study

The work described in chapter 6 was part of a much larger initiative of the Waza Logone Project to explore livelihood conditions of people using the project area (the entire Logone floodplain on the Cameroon side plus the area around Waza NP). PRA was used much more extensively both geographically and thematically in the Waza Logone Project than in our work. It was not possible to isolate the inputs and outputs of our specific study, but it was possible to isolate PRA activities around Waza NP from those in the floodplain, since these were executed by different teams with different budgets. Therefore, we described the inputs and outputs of comprehensive PRA's in 10 villages in the periphery of Waza NP as organised by the Waza Logone Project. As a consequence, our analysis does not refer to the assessment of the human carnivore conflict only, but includes parts of the study of Scholte (PhD thesis, in prep.). This can be justified, however, since PRA requires the research team's presence in a village for at least five days to participate in and discuss daily life, so even if one would be interested in depredation only, one would have to go through the entire PRA sequence as well.

The PRA sessions were undertaken by a team of 10 people: three resident researchers (Mbouche, Scholte and Bauer), three extension workers, two interpreters and two drivers. The extension workers and interpreters had different qualifications from a research assistant but were financially equivalent and classified as such in the present chapter. This team typically went to a village using two cars, stayed there for five days, returned to the office for reporting and went to the next village two weeks later. Variations to this pattern occurred, team members may not have participated in all sessions, one of the cars may have been used for other project activities during the stay in a village, team composition may have varied slightly between sessions, etc., but the calculations were based on the general pattern.

9.3.2 Inputs of the PRA study

Labour was evaluated at 6 months for each of the researchers, 5 months for each of the assistants and 2 months for each of the drivers. Car mileage for each mission was estimated at 600 km for the two cars together. Cost of living was not a real cost since lodging was provided by villagers and food supplies were paid with team members' field allowances. A small amount was added as 'various' for office stationary, the cost of snacks and small gifts for villagers, fees for local interpreters, etc. Researchers had knowledge of PRA, but the extension workers had to follow a two-week course. Therefore, the fees for the training of five

extension workers and their labour foregone were added. Amounts are listed in Table 9.1; the total cost of the PRA study was evaluated at US$ 119.000.

In general, PRA sessions, analysis and publication of results take a minimum of one year. In our case, however, fieldwork and editing of an unpublished report took one year while data were processed into articles and published several years later (time span 1995-2001).

9.2.3 Outputs of the PRA study

The results of the PRA study were first reported in two unpublished reports of the Waza Logone Project and were later used to produce two articles in a professional journal. The results of the study were also used to complement four 'grey publications' and two peer-reviewed articles (see table 9.8). Only assistants were trained in the process; no students were involved, no undergraduate theses were produced.

The PRA study was instrumental in understanding the interactions between Waza NP and the surrounding people. It changed the view of decision makers, project staff and scientists on local people. Many members of the PRA team were later involved in drafting the management plan for Waza NP (Anonymus, 1997) and used the PRA information. PRA information covered many aspects of local natural resource management. For the theme of human carnivore conflict, it covered all carnivore species in the entire park periphery. It also gave a basic understanding of the problem which allowed subsequent formulation of hypotheses for other studies on depredation. It was also the first assessment of the importance of the conflict and an argument to conduct more studies, leading to the present dissertation. Therefore, impact on policy, science and society can be considered as being important and having a wide spectrum.

In terms of public relations the impact was most noticeable among the research subjects, the villagers. They had a positive impression of team members and their institutions because of the interest in their livelihoods. Some team members mentioned the development of friendship and trust in their contacts with some villagers. To the donor community, PRA's were a positive and visible indication of the participatory nature of project intervention. However, the impact on the international scientific community outside PRA specialists was limited. PRA studies are typically rated relatively unimportant at non-specialist conferences and are rarely published in journals with a high impact factor (Chambers, 1997).

Table 9.1: Inputs and outputs of the PRA study.

Inputs	Quantity	Cost (US$)
Labour: researcher	18 months	90,000
Labour: assistant	29 months	8,700
Car transport	6000 km	1,800
Training	5 assistants	2,800
Various	-	2,000
Overhead	13%	13,700
Total	-	119,000
Outputs		
Reviewed articles	0; substantial part in 2 others	
Other articles/reports	2; substantial part in 4 others	
Students trained	0	
Impact on public relations	Medium	

In our case, the PRA knowledge on the human predator conflict was indisputably valuable in identifying the general principles and some specific variations between geographic units. Despite the inherent bias, a reliable broad picture emerged from triangulation and cross-checking between different PRA tools (Bauer & Kari, 2001). This broad picture was fairly extensive: it included all large predator species, it showed limits and variations in predator presence, it described relative conflict intensity in time and space, and it gave an indication of the order of magnitude of predator related livestock damage.

9.4 Structured interviews: approach, inputs and outputs

The human predator conflict was also assessed by means of structured interviews using questionnaires administered to owners of livestock. This has not been described in a published article or a separate chapter in the present dissertation, only in an unpublished student report. This method will therefore be presented more elaborately than the other two.

9.4.1 Approach of the structured interview study

A questionnaire was designed, tested and administered to 236 livestock owners in all 42 villages around Waza NP in 1998. In small villages (with less than 10 owners), the questionnaire was administered to all livestock owners, in larger villages to 50% of the owners. The main objective was to calculate the number of livestock killed annually by predators and the variation between species (cattle, sheep, goat and poultry on one hand and lion, both species of hyena, jackal and civet or other small predators on the other), between different zones of the periphery (North, South, East, West), between different seasons (rainy, dry) and between different moments (night, day). Questions on losses were asked for each of the previous five seasons (2½ years) and also included questions on other mortality factors, such as animal disease or theft, for comparison. Local market prices in US$ at the time of the study were used for financial analysis, in presentations rounded to the nearest $1000. Comparisons were statistically tested with ANOVA at $p<0.05$. Finally, some questions were included about measures to avoid depredation.

Most of the work was done by a Cameroonian BSc. student in two phases: three months for literature survey and for the development and testing of the questionnaire in 1997, followed by six months for fieldwork and reporting in 1998. The student was taken to the research area by car but moved between villages by bicycle. The project's research assistant acted as an interpreter whenever available; alternatively, an educated villager was contracted. Researcher input consisted of monitoring, facilitation and supervision. Most time-consuming was help with statistics since the student had never used computers during his education.

9.4.2 Inputs of the structured interview study

All students received benefits and budgets of a fixed amount, determined by the university, this covered almost all expenses (interpreter, gifts, stationary, etc.) and was listed under 'various'. Another input was labour, evaluated at 2 months for the researcher and 2 months for the assistant and driver. Car mileage consisted of 6 trips to and from the study area. Amounts are listed in Table 9.4; the total cost of the structured interview study was evaluated at US$ 12.900.

9.4.3 Outputs of the structured interview study

The results were reported in an unpublished BSc. thesis and contributed to the present chapter (see Table 9.8). A few key statistics were cited in several publications, especially the value of depredation by lions. They were not enough for a scientific peer-reviewed article, but most articles and conference presentations on human-predator conflict in Waza NP used the key statistics to give an indication of the importance of the problem. Impact on public relations was limited, both the academic and local communities did not pay much attention to it. Impact on decision makers was probably a bit higher, mostly because the method was well known and the results were comprehensible without specialist training.

In terms of coverage, the outputs were well focused on the theme of human predator conflict, within that theme they covered many aspects. The study identified daily, seasonal, spatial and financial patterns and put them into perspective by comparison with the two other main causes of livestock loss. This study was completed within a year. Since the student report is not easily accessible, the results are summarised below.

The damage by depredation totalled US$ 220,000 per year, while damage due to disease was US$225,000 per year. Disease ranked as the most important mortality factor for cattle, depredation ranked first for small stock. Both were statistically significantly more important than theft for all species of livestock (Table 9.2). Despite this ranking, people considered theft to be a more important problem than depredation; indeed there have been more local initiatives to reduce theft than depredation. When faced with figures, respondents said that they were influenced by the perception of disease and depredation as 'natural', as opposed to theft, and by the fact that thieves sometimes wound or kill cattle owners or herders while predators hardly ever attack people.

Table 9.2: Annual livestock mortality (in heads and in percentage of stock, average 1996-1998) and monetary value (in US$) in the periphery of Waza NP.

	Size of herd in 1998	Disease (%)	Theft (%)	Depredation (%)	Value ($) of depredation
Cattle	34,282	1,091 (3.2%)	292 (0.9%)	727 (2.1%)	112,000
Sheep	18,858	1,345 (7.1%)	267 (1.4%)	2,794 (15%)	54,000
Goats	14,818	1,577 (11%)	129 (0.9%)	2,997 (20%)	48,000
Poultry	18,346	6,148 (34%)	7 (0.04%)	6,204 (34%)	6,000
Total value ($)	5,891,000	225,000	57,000		220,000

Cattle was significantly more depredated by lions and poultry by small predators like civets, differences between predators in depredation of sheep and goats were not significant. Since cattle had the highest value per head, lions were the most 'expensive' species: total annual lion damage around Waza NP amounted to US$ 130,000 annually, an average of US$ 370 per cattle owner. (An amount of $140.000 was mentioned in some of the earlier publications, the difference is due to updated exchange rates and rounding.) In absolute and financial terms, most depredation occurred to the South of the park (Table 9.3). However, stocks in this area were also larger, and the rate of mortality by depredation in the South was actually the lowest of all areas for all species of livestock.

Table 9.3: Livestock depredation (average 1996-1998 in heads; value in US$) by different predators and in different areas of the periphery of Waza NP.

	Predator				Area			
	Lion	Hyena	Jackal	Other, small	South	East	North	West
Cattle	699	27	1	0	550	113	29	35
Sheep	742	1,141	911	0	1,484	887	390	33
Goats	507	1,227	1,263	0	1,200	1,132	583	82
Poultry	0	867	40	5,297	3,928	1,379	669	228
Value ($)	130,000	47,000	38,000	5,000	136,000	54,000	22,000	8,000

The results described above must be interpreted with some caution. First, data were probably biased because respondents were likely to declare more damage than real damage in order to win sympathy or because they expected some form of damage compensation. This bias was avoided as much as possible by appropriate interviewing techniques. Secondly, some respondents tended to count every attack by predators, whereas not all predator attacks are lethal. Thirdly, it was observed that predators kill livestock differently than wildlife: instead of a careful hunt and a targeted attack they often jumped into a herd and created chaos, they decided what to eat afterwards which was often only a fraction. Predators were even regularly chased off kills by herders, resulting in an even higher ratio of livestock killed / livestock consumed. This ratio was highly variable and not quantified, therefore the number of livestock killed could not easily be converted into predator carrying capacity.

Other interesting results are the following. Cattle moved in herds guided by a herder, mostly a relative of the owner. If no relatives were available, cattle owners would find a herder for a monthly salary of $10. The East of the periphery is a floodplain area which is only accessible for cattle in the dry season. In that season, grazing continued at night because of high day temperatures and scarcity of food, otherwise cattle was kept in enclosures at night. Small stock was always kept in enclosures at night, during the day they were released and grazed around the village, mostly unguarded, while poultry usually stayed in the compound. Respondents said that depredation occurred mainly at night for all species. Most respondents also said that depredation tended to be more severe in dry years. They offered an explanation themselves: they entered the park more in dry years, when resources outside the park were depleted towards the end of the dry season, which increased livestock exposure to predators.

Table 9.4: Inputs and outputs of the structured interview study.

Inputs	Quantity	Cost (US$)
Labour: researcher	2 months	10,000
Labour: assistant	2 months	600
Car transport	1200 km	300
Various	-	500
Overhead	13%	1,500
Total	-	12,900
Outputs		
Reviewed articles	0	
Other articles/reports	1; substantial part in 1 other	
Students trained	1	
Impact on public relations	Low	

Respondents were also asked for measures to solve or mitigate the problem of depredation. As preventive measures by themselves, respondents mentioned in order of preference 'magic' (prayers, amulets, traditional sorcery), enclosures, dogs and herders. When asked what they wanted authorities to do, they requested permission to shoot predators, damage compensation or the creation of waterholes so that they do not have to enter the park. These statements should be interpreted with caution, the question was intended as an inventory of locally proposed policy options. A next step would be to make an inventory of policy options proposed by the authorities and then make a local ranking by preference.

9.5 Telemetry: approach, inputs and outputs

Chapter 7 described the use of a method used in biological sciences for the study of animals in their natural habitat: telemetry. This literally means 'measuring from a distance', it involves marking an animal in order to follow and observe it. Telemetry can be done with several techniques, we used radio telemetry.

9.5.1 Approach of the telemetry study

The intention to start a telemetry study dates back to 1997, when collars were ordered, permits were obtained and a Dutch veterinary doctor was contracted for the immobilisation. Unfortunately, the national airline of Cameroon lost the collars during transit from the USA to the nearest airport. The collars were insured, but apart from causing a year's delay, it incurred the cost of organising the immobilisation procedure a second time. Simultaneously, time was lost in suing the airline, a 4-year legal procedure which eventually resulted in the payment of an amount equivalent to the ticket and expenses of the Dutch vet who had come to the research area in vain. Thus, there was no net financial impact, only an increase in time spent and project duration.

In 1999, five lions were immobilised for a short period to fit them with a radio collar with an operational lifetime of 2-3 years, during which they could be tracked using a radio receiver. Their movements were monitored intensively in 1999 and 2000 and extensively in 2001. For safety reasons, telemetry was done by car, leading to visual contact with the lions to allow observations on social and feeding behaviour. During the rainy season this was not possible in certain areas, which were then visited by motorcycle leading to determination of the animals' location from a distance, but to little additional information.

This study was executed under supervision of one resident researcher, with the aid of one research assistant and the participation of 6 undergraduate students doing fieldwork for 5 months each. Field visit organisation aimed at a 2-weeks-on-2-weeks-off pattern, but in practice the fieldwork pattern was much more variable and several missions had to be aborted prematurely due to mechanical or health problems. Fieldwork was done by a team of a driver, a research assistant, a local guide and sometimes students. The researcher typically participated an average of three days per month, either as surprise or planned checks on the assistant's activities or during student supervision visits. In addition, the researcher led longer missions aiming at particular objectives, such as collaring, finding lions who moved to a new territory, maintaining contact with local people and authorities, training of assistants or students, etc. Another researcher was primarily involved in backstopping and student supervision in The Netherlands.

The immobilisation and collaring of wildlife in protected areas in Cameroon was subject to a permit which expired six months after delivery. These were delivered free of charge by the Ministry of Environment and Forests and signed by the minister, the director of wildlife and the head of the legal support department with copies to several other services. In theory, one could send the application through the provincial representation and wait for the permit to be collected there a few weeks later, in practice it took at least three months and one personal visit to the Ministry. In total, we needed three permits and had to pay three visits to the Ministry, but these visits could be combined with other activities, therefore only one mission to the capital was attributed to the telemetry study.

9.5.2 Inputs of the telemetry study

Labour was evaluated at 36 months for the assistants, 24 months for the researcher, 12 months for the drivers and 6 months for the researcher in Holland. A local guide was always present during fieldwork at a daily rate of $3. Car mileage was estimated at 500 km for each of the 45 regular missions, in addition to 5000 km for collaring and 5000 km for special missions. In addition to car mileage, an amount was included for car repairs, because this method requires off-road driving under extreme conditions which structurally led to higher car maintenance costs.

Assistants and students had to be trained in telemetry techniques, but this was achieved by joining the researcher on his missions without extra costs. The cost of research material (collars, receivers, GPS, etc.), the collaring operation (pharmaceutical products, veterinary's fee, etc.), and various costs are listed in Table 9.5, the total cost of the telemetry study was evaluated at US$ 207,800.

The telemetry study took five years of intermittent activity (1997-2002), of which only the first year can be considered as an incidental waste due to the missing collars.

9.5.3 Outputs of the telemetry study

The results of the telemetry study were reported in three manuscripts for peer-reviewed journals and in one book chapter. Results of this study were also used to complement one peer-reviewed article and three ‘grey publications’. In addition, two MSc. and two BSc. theses were produced by six students (see Table 9.8).

The telemetry study produced very detailed information on the movements and behaviour of five lions in the habitat that was previously characterised as being the area with most problems. The quantity of livestock attacked by one lion for a short period was assessed very accurately and reliably. Variations of depredation patterns were identified, and the presence of ‘problem animals’ was confirmed. In short: the findings were very detailed but of limited scope: only one species, only a few individuals, for specific topics, and only for short periods of time. The findings were relevant to an important specific category of management options: problem animal control.

In terms of public relations, the impact of the telemetry study was very large. To the general public it was interesting simply because it was considered spectacular. A documentary on TV and several newspaper articles reached a large audience, with a positive result for the persons and institutions involved. To the scientific community, it was the most reputable method for the assessment of predator damage and an inescapable standard procedure in animal movement studies. But the scientific community was also simply interested in spectacular stories and beautiful slides, as demonstrated by reactions at conferences.

The impact on relations with the local people was ambiguous. On the one hand they found it magnificent, an excellent campfire story. It was also clear that their problem was being investigated, a positive thing to the more educated people while neutral to people who didn't see the need for detailed studies. On the other hand, the arrival of the research vehicle in the village was a foreshadow of the presence of lions. Some people were actually convinced that researchers were not following but radio controlling collared lions and thus responsible for damage to livestock. Park managers have always been requested to 'keep their pets in the park', now we were sometimes requested to take 'our cats' elsewhere. The person whose cattle was most heavily damaged by a collared lion was surprisingly positive. It appeared that he appreciated the presence of the research team for logistical reasons: the car was once used to save his daughter's life by taking her to hospital when she had difficulty giving birth in the middle of the night.

Table 9.5: Inputs and outputs of the telemetry study.

Inputs	Quantity	Cost (US$)
Labour: researcher	30 months	150,000
Labour: assistant	48 months	14,400
Car transport	32.500 km	8,000
Permit	3 days in capital	300
Collaring	-	3,000
Research equipment	-	3,000
Car repairs	-	2,500
Various (+guide)	-	2,700
Overhead	13%	23,900
Total	-	207,800
Outputs		
Reviewed articles	3; substantial part in 1 other	
Other articles/reports	5; substantial part in 3 others	
Students trained	6	
Impact on public relations	High	

9.6 Comparison of inputs

Sections 9.3.1, 9.4.1 and 9.5.1 mentioned the inputs involved in the different studies, they were combined in Table 9.6. The most conspicuous difference was the financial disparity between the studies, with PRA as intermediate between telemetry (most expensive) and structured interviews (least expensive). The largest component of all budgets was time spent by the researcher, approximately 60% of the total for each of the studies. Much labour for the structured interview study was provided by a student, a 'free' source of labour. It would have been quite possible to put a price on student labour, but in practice students always have stipends or scholarships, from the research project's perspective this was free. Without the student, we estimated that labour input of the assistant would be increased by two months, which would not change the budget substantially.

Researcher labour was evaluated at $5,000 per month plus 13% overhead costs, which was a realistic amount in our situation. Only half of that amount was gross salary, the other half consists of taxes, fringe benefits, housing, international travel of the researcher with dependants and a correction factor of 12/11 for holidays. Our calculations also assumed that the person has a continuous salary of which only time effectively spent on research is imputed. This was true in this case, because the researcher resided in the region, but in practice it may be difficult for researchers to be in the field e.g. two days a month for several

years and use time in between efficiently for other activities. Alternatively, research could be undertaken as a consultancy or as free-lance assignment to a resident researcher, this would allow to only pay productive days. Resident expatriate researchers are considerably more expensive than local researchers; Table 9.7 presents three scenarios. It shows that labour costs vary from 62% to 78%, depending on researcher salary.

Table 9.6: Financial inputs of three studies (rounded to the nearest 100)

Item	Quantity	Cost (US$)
Method: PRA		
Labour: researcher	18 months	90,000
Labour: assistant	29 months	8,700
Car transport	6000 km	1,800
Training	5 assistants	2,800
Various	-	2,000
Overhead	13%	13,700
Total	-	119,000
Method: structured interviews		
Labour: researcher	2 months	10,000
Labour: assistant	2 months	600
Car transport	1200 km	300
Various	-	500
Overhead	13%	1,500
Total	-	12,900
Method: telemetry		
Labour: researcher	30 months	150,000
Labour: assistant	48 months	14,400
Car transport	32.500 km	8,000
Permit	3 days in capital	300
Collaring	-	3,000
Research equipment	-	3,000
Car repairs	-	2,500
Various (+guide)	-	2,700
Overhead	13%	23,900
Total	-	207,800

Table 9.7: Three scenarios for researcher labour costs.

Method		National researcher ($2000/month)		National consultant ($3000/month)		Resident expatriate ($5000/month)	
		Amount (US $)	% of total	Amount (US $)	% of total	Amount (US $)	% of total
PRA	Labour	36.000	62	54.000	69	90.000	76
	Other	22.000	38	24.000	31	29.000	24
	Total	58.000		78000		119.000	
Interview	Labour	4.000	66	6.000	72	10.000	78
	Other	2.000	34	2.000	28	2.900	22
	Total	6.000		8.000		12.900	
Telemetry	Labour	60.000	57	90.000	64	150.000	72
	Other	46.000	43	50.000	36	57.800	28
	Total	106.000		140.000		207.800	

Apart from inputs that can be monetarised, there were non-monetary inputs: reputation and time. Here, we do not mean time as labour but the time span of a study from first design to the final product (publications and recommendations). Time span is important, especially in situations with no long term security (short-term projects, politically unstable countries, non-permanent staff contracts or permits, etc.). In those situations, it is important to know that both the PRA and structured interview study were undertaken within a year, whereas the telemetry study took 5 years to complete. Some PRA publications were produced 5 years after finalisation of the initial report, but that was due to case-specific circumstances; they could have been submitted within a year after fieldwork.

The impact of the studies on public relations was described as an output, but in one case it should also be mentioned as an input. The process of starting and doing research has a marked impact on reputation, especially in the case of the telemetry study. The permits required for this study were a source of frequent contact between the researcher and various levels of MINEF. Once, an immobilisation permit was delivered too late and lower level authorities had to be persuaded to allow continuation of the work under their responsibility while straightening things out with their superiors afterwards. In the very hierarchical Cameroonian administrative system, this consumes much goodwill, which can be interpreted as an investment in the telemetry study.

Finally, a non-monetary input factor was knowledge or experience. None of these studies could be done efficiently unless both the institutions and the persons involved have relevant knowledge and experience. PRA is a special technique that required training and especially experience. For the structured interviews, it required knowledge of what one can realistically ask from local people and how to ask it. For telemetry, the people involved needed specialist technical expertise, but equally important were the capacities of the institution. This had to be flexible enough to make extra staff and material available whenever something special happened, it had to have stocks of spare equipment and financial reserves to react quickly to unforeseen circumstances, it had to have highly specialised documents and computer programs and it had to have credibility and good contacts with authorities. 'Institutional experience' helps: the first telemetry study is more difficult to organise than subsequent studies.

9.7 Comparison of outputs

In the methods section (9.2), we introduced a rating system for publications to assess the relative ranking of scientific output. We attributed 1 point to an unpublished report, undergraduate thesis and the substantial use of data to complement any other publication, 2 points to a book chapter or 'grey' report and 3 points to an article in a peer-reviewed journal. On this scale, the score was 12 for PRA, 2 for the structured interviews and 19 for telemetry, which was almost proportional to the inputs (Table 9.8).

Ranking in terms of number of students trained was 6 for telemetry, 1 for structured interviews and 0 for PRA. Additional output was informal training, a short professional PRA course for five project extension workers and on-site training of two research assistants in telemetry techniques.

Table 9.8: Comparison of output in terms of publications. Figures in columns represent 'points': a combination of the importance of the publication and the degree to which it can be attributed to a particular method (see text for details).

Publication	Method		
	PRA	Inter-views	Tele-metry
Bauer, H. (1995) Carnivores and Cattle. Report of a survey on predation by carnivores of Waza National Park on livestock in the surroundings. Centre of Environmental Science, Leiden University.	1		
Bauer, H. (2001) Use of tools by lions in Waza National Park, Cameroon. African Journal of Ecology **39**, 317 (=appendix 7.1).			3
Bauer, H & H.H. De Iongh (2001) Current issues on conservation of lions in Waza National Park, Cameroon. In: H. Bauer, H.H. De Iongh, F.P.G. Princée & D. Ngantou (eds.) Status and needs for conservation of lions in West and Central Africa, pp. 63-70. IUCN CBSG, Apple Valley.	1		1
Bauer, H. & H.H. De Iongh (in press a) Lion conservation in West and Central Africa. In: Conference proceedings, IUCN/SSC African Lion Working Group, Bloemfontein.	1		1
Bauer, H. & H.H. De Iongh (in press b) Lion movements with special reference to stock raiding in Waza National Park, Cameroon. In: A. Madi, P.E. Loth, H. Bauer & H.H. De Iongh (eds.) Management of fragile ecosystems in Northern Cameroon: the need for an adaptive approach.			2
Bauer, H. & H.H. De Iongh (submitted) Lion home range and livestock conflicts in Waza National Park, Cameroon. African Journal of Ecology (=chapter 7).			3
Bauer, H., H.H. De Iongh & I. Di Dilvestre (2003) Lion social organisation in the West and Central African savannah belt. Mammalian Biology **68**, 239-243 (=chapter 8).			3
Bauer, H., H.H. De Iongh, F.P.G. Princée & D. Ngantou (2003) Research needs for conservation of lions in West and Central Africa. Comptes Rendus Biologies 326, S112-S118 (=chapter 5).	1		1
Bauer, H. & S. Kari (2001) Assessment of the people - predator conflict through thematic PRA in the surroundings of Waza National Park, Cameroon. Participatory Learning and Action Notes **41**, 9-13 (= chapter 6).	2		
Kranendonk, G. & E. Kroese (2000) A study on the lion *Panthera leo* population in Waza National Park, Cameroon. Unpubl. MSc. Thesis, Leiden University, Leiden.			1
Maty, Y. (2000) Analyse du domaine vital et de la zone preferentielle d'habitation du lion lion *Panthera leo* dans le Parc National Waza. Unpubl. BSc. Thesis, University of Dschang, Dschang.			1
Mbouché, J.H. (1995) Une étude exploratoire des villages riverains et internes du Parc National de Waza. Unpublished report, UICN/PWL, Maroua.	1		
Ngomeni, A.F. (2000) Etude de quelques aspects de l'éthologie du lion *Panthera leo* dans le Parc National de Waza. Unpubl. BSc. Thesis, University of Dschang, Dschang.			1
Nieuwenboer, C. & T. Wiegman (1998) Livestock predation by lions and spotted hyenas in Waza National Park, Cameroon, Africa. Unpubl. MSc. Thesis, Leiden University, Leiden.			1
Scholte, P. (2003) Immigration, a potential time bomb under the integration of conservation and development. Ambio **32**, 58-64.	1		
Scholte, P. (2000) Towards collaborative management in Waza National Park: the role of its management plan. In: H. Bauer & A. Madi (eds.) People, parks and wildlife, contributions from Cameroon, pp.41-54. CEDC, Maroua.	1		
Scholte, P., S. Adam, S. Kari & J.H. Mbouche (1999) Walking a tightrope: using PRA in a conflict situation around Waza National Park, Cameroon. Participatory Learning and Action Notes **35**, 7-12.	2		
Sonne, N. (1998) Prédation des animaux domestiques par la faune sauvage dans les périphéries du Parc National de Waza (Cameroun). Unpubl. BSc. Thesis, University of Dschang, Dschang.		1	
The present chapter	1	1	1
Total	12	2	19

In order to compare the figures of depredation damage, we extrapolated, converted and compared without looking at confidence intervals or statistics, just as an assessment of orders of magnitude. The figures of Table 6.2 in chapter 6 showed that during PRA people declared a variable predator related annual livestock mortality, with a mean value of 1.33% for cattle and 14% both for sheep and goats. The figures from structured interviews were 2.1% of heads per year for cattle, 15% for sheep and 20% for goats. These percentages are not identical, but considering that especially PRA had limited quantitative accuracy, they were considered as non-contradictory, indeed in the same order of magnitude. Moreover, the spatial pattern of depredation was similar: both studies identified the South as the area with most human predator conflict.

The telemetry study focused exclusively on the southern area, and only on lions, therefore we cannot compare the figures with the PRA study in which damage was only assessed for all predator species together. However, we could compare the telemetry results with the structured interviews. The woodland zone covers 30% of Waza NP and borders the South of the park. If we assume a homogeneous distribution of lions over the park we expect a sub-population of 15 lions in this area, of which the collared lions would represent a 33% random sample. This sample fortunately reflected the sex ratio of lions in Waza NP. We assume that only this sub-population killed livestock to the South of the park, and only during the percentage of time spent outside the park, as listed in Table 7.3 of chapter 7. This telemetry based calculation resulted in a figure of 429 cattle, 549 sheep and 549 goats killed annually by lions in the South, with a value of $86,000. We compared these figures to the results of the structured interviews presented in Table 9.3 of the present chapter, according to which lions were responsible for 96%, 27% and 17% of cattle, sheep and goat depredation, respectively, giving annual lion depredation figures for the South of 528 cattle, 401 sheep and 204 goats, worth $92,000. While the results in terms of financial value were similar, figures obtained with structured interviews were somewhat higher for cattle but lower for small stock, compared to telemetry figures.

We conclude that the data on livestock damage of the three methods concur; mean values of comparable parameters were of the same order of magnitude. Damage assessments by structured interviews were only slightly higher than those by telemetry and PRA. This is noteworthy, because PRA and structured interviews give a measure of perceived damage, whereas telemetry gives a measure of inferred damage. Our results are different from the comparison of primate damage based on PRA and biological methods, respectively, in a nearby conservation area (Van Oosten, 2000). In that case, perceived damage was considerably higher than inferred damage, which is often the case with larger mammal damage (Naughton-Treves, 1997). Damage by carnivores, primates and pachyderms is often overestimated, and damage by rodents and insects underestimated (Deodatus, 2000; Gittleman *et al.*, 2001; Hoare, 2001). There is even a case of perceived serious red colobus (*Procolobus kirkii*) damage on Zanzibar, whereas harvest was demonstrated to be higher in the presence of red colobus due to the pruning effect of immature coconut consumption (Siex & Struhsaker, 1999).

The output of mitigatory recommendations was different in nature between methods. The PRA study gave a good general impression and put depredation in the context of people's livelihood systems (wide scope), which was useful for the management plan. Statistics on damage were imprecise and biased, however, and not good enough for the formulation of a specific depredation policy. The structured interviews showed the extent and value of all

forms of depredation (medium scope), parameters which are particularly useful in assessing damage compensation systems as management option. The telemetry study confirmed that some lions attack large amounts of livestock, which puts it unequivocally on MINEF's agenda. But results could not be extrapolated to the entire region or to other species (narrow scope), and recommendations were limited to problem animal control.

The output of these studies had markedly different effects on public relations. The PRA study was relatively original in its approach, and it was published in a journal which was much more interested in the methodology than in the results. Locally, the effects on public relations were positive, both with the local people and authorities. In contrast, the structured interview study went by relatively unnoticed, few words were wasted. The methods used are so commonly known, that the study could be explained to all possible audiences using only little detail. Since the methods are not original and the results have only applied local relevance, it was considered as one of the basic activities of the persons and institutions involved. The telemetry study, however, had undoubtedly most impact on the local and international reputation of the research team as capable of logistically and technically complex high input research; but certainly also because it was considered spectacular, as described in section 9.5.3.

The PRA study was appreciated by peers, an ambiguous qualification since PRA practitioners are on the margins of science. The school of PRA practitioners and applied development scientists is convinced of the validity and reliability of PRA methodology within its inherent limitations (Chambers, 1994; Chambers, 1997), while other schools show little appreciation and criticise the absence of classical scientific criteria as repeatability and statistical analysis (Hulme & Taylor, 2000). Chambers (1997, p. 141-146) concluded the following in a review of comparisons between PRA and other research methods: "in these three cases, with good practice, the outcomes of PRA approach, compared with the more formal questionnaire, were variously more valid, less costly, more timely and more useful". Our case contradicts this conclusion: contrary to the conviction of most PRA practitioners, structured interviews can be cheaper and quicker than PRA, and equally useful. Two factors were important in our case. First, the structured interviews were published as MSc thesis while the PRA study included the editing of scientific articles, which was time-consuming and thus costly. Second, the topic of interest was fairly well defined and relatively easy to quantify.

9.8 Discussion

In this final section, we reflect on the complementarity of and synergy between the three methods, and on cost-effectiveness. Throughout this section, the three methods are considered valid research methods, each with inherent advantages and limitations and highlighting different aspects of reality. The outcomes were triangulated, meaning the use of multiple methods and sources of data, which is commonly used in social science to reduce bias (Trosset & Caulkins, 2001). This does not mean that one method was used to validate or check another method. Instead of validation of one method by the other, triangulation rather implies a mutual improvement in reliability if two or more methods give non-contradictory results.

The three studies showed different aspects of the human predator conflict and were all relevant to policy formulation to address the problem. Each had a particular set of policies to

which it was particularly relevant as described below and summarised in Table 9.9: management principles, prevention, and compensation, respectively.

The PRA study gave much information on the context of people-park interactions and showed that people have both advantages and disadvantages from the presence of the park. Apart from the high value of elephant and lion damage, the net impact on people's livelihoods was not negative. This finding led to the principle in the management plan of the need for specific action to mitigate elephant and lion damage while all other negative impacts of the park are not compensated for but considered as balanced by benefits. More specific recommendations could not be sustained in view of the large variation in depredation figures; the other two methods were an essential complement. Still, PRA-generated figures were consistent with that complement, which confirms earlier nuances of the general impression that PRA is weak in quantitative data (Chambers, 1994; Loader & Amartya, 1999).

Options to address the problem of depredation are compensation and prevention, structured interviews and telemetry each addressed one of them. The structured interviews gave a precise estimate of predator damage, which was relevant to the policy option of damage compensation systems. The structured interview study gave an indication of the amounts involved and of the area and species to focus on (viz. lion damage to cattle in the South). In the present situation, with an academic exercise raising few expectations, perceived damage was close to actual damage, especially for cattle. This is likely to change, however, in the context of compensation (Tchamba, 1996; Siex & Struhsaker, 1999). Damage assessment and verification have often been weak components of compensation systems, together with corruption (see section 11.3). The weakness of assessment and verification is not the application of forensic techniques, which is fairly straightforward (Bowland & Mills, 1993, Hoare, 2003), but the absence of a network of independent enumerators. It is unlikely that structured interviews can be a reliable instrument in that context, but they can give valuable baseline information.

The telemetry study was much more relevant to damage prevention. It confirmed the existence of habitual and seasonal problem animals, which raises the potential effectiveness of lethal problem animal control (shooting a most damaging lion). It also identified patterns in lion movement, which can be useful in non-lethal problem animal control (chasing occasional raiders back into the park). Thus, the three studies were clearly complementary with respect to the policy recommendations.

The use of three methods to study the same phenomenon showed the synergy between these methods. Two synergistic effects were important: increased reliability through triangulation and improved calibration by 'zooming'. The latter synergy effect is only obtained if the studies are executed in the sequence PRA – interviews – telemetry: decreasing scope and increasing detail. PRA served as a pilot to help formulate hypotheses and questions for the structured interviews and both were useful in the identification of the area and species to focus on for a detailed telemetry study.

In this final paragraph, an assessment of cost-effectiveness is presented. Table 9.9 shows the costs of the three methods and some parameters of effectiveness. This table shows that no single method had the highest cost-effectiveness under all circumstances, optimum cost-effectiveness really depends on the objectives of the study. The table also shows that methods with a wide scope were less precise and concise and vice versa, a trade-off between 'width' and 'depth'. As outlined in the present chapter, each method had its characteristics which made it cost-effective for a particular purpose. However, one recommendation can be

made: if either a PRA or a telemetry study is decided upon, it can be very cost-effective to complement the study with structured interviews. This will give synergistic benefits while it will not change the budget drastically.

Table 9.9: Comparison of key characteristics of three research methods.

	PRA	Structured interviews	Telemetry
Financial input	US$ 119,000	US$ 12,900	US$ 207,800
Reliability	High	High	High
Precision	Low	Medium	High
Scope	Wide	Medium	Narrow
Publication points	12	2	19
Policy impact	High	Medium	Medium
Policy category	General management principles	Compensation: quantification of all forms of damage	Prevention: problem animal control

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Chapter 10:

Fortress Conservation versus Community Based

Conservation in Africa Revisited

Bauer, H. & H.A. Udo De Haes (submitted) Fortress Conservation versus Community Based Conservation in Africa revisited.

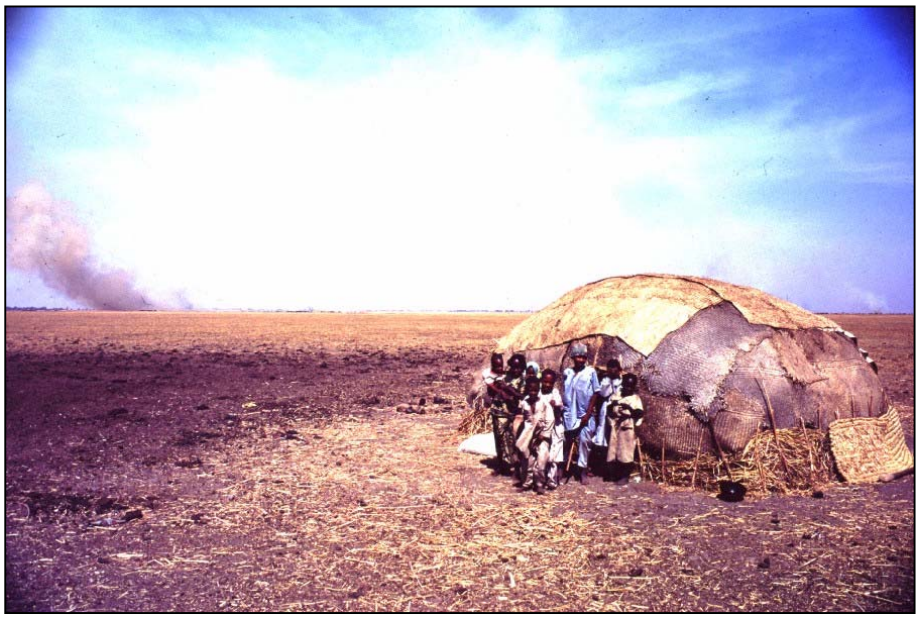

Photo 13: Nomadic pastoralist family near Zina.

Summary

Two important amendments are made to the conditions for effective Community Based Conservation (CBC). The first is to take wildlife damage into account in the assessment of a local cost-benefit analysis of conservation, which reduces the scope for CBC considerably. The second is to take structural political and financial influence of international organisations into account, which increases the scope for conservation in general. Both amendments are illustrated by the case of Waza National Park, Cameroon.

10.1 Introduction

A recent debate in the journal 'Oryx' focused on the choice between 'Fortress Conservation' (FC) and 'Community Based Conservation' (CBC) in Africa (Adams & Hulme, 2001; Western, 2001; Spinage, 2002). Both have their own caricature: 'fences and fines' and 'if it pays it stays', respectively. They are opposites in a continuum of participation, with governments on one end and local communities on the other (e.g. Anonymus, 1994; Pimbert & Pretty, 1997). Barrow & Murphree (2001) described steps in this continuum as FC – Park Outreach – Co-management – CBC.

Adams & Hulme (2001) in principle favour CBC, but presented conditions under which CBC can not be expected to meet conservation objectives. They described FC as a failing concept throughout Africa, due to the high cost-benefit ratio and for moral or socio-political reasons. Spinage (2002) disagreed with the moral objections against FC, especially in National Parks (NP), but argued that "the most that the majority of NP's can muster is a weak policing". This is in line with the argument that FC is increasingly ineffective. The effectiveness of tropical protected areas was also questioned by IUCN (1999), showing that 23% of a sample was degraded while 60% was threatened with degradation in the near future (IUCN, 1999). Bruner *et al.* (2001) showed that effectiveness is significantly correlated with the number of park staff and damage compensation. The costs thereof are to be borne by governments, who have other priorities and only spend a fraction of the required amounts (Inamdar *et al*., 1999).

This all points to the important role of CBC, certainly for biodiversity conservation outside NP's (see also Western, 2001), but possibly also as an alternative for ineffective FC inside NP's. However, in our opinion the argument in this debate is not complete. In particular, we propose two amendments to the list of conditions presented by Adams & Hulme (2001). The first is the substitution of 'sustainable revenue flows' in their first condition by 'sustainable net benefits', i.e. after deduction of wildlife damage. The second is that, in some cases, neither FC nor CBC may be effective, and that a third actor must be added: the international community. The scope for CBC is decreased by the first amendment, but the scope for conservation in general is increased by the second. Both aspects will be illustrated by the case of Waza NP in Cameroon.

10.2 Discussion

Waza NP is a biosphere reserve of approximately 1600 km^2 in Northern Cameroon, with a Soudano-sahelian climate and vegetation, partially wetland. Waza NP hosts amongst others elephant *Loxodonta africana* (population estimated at 1100), lion *Panthera leo* (population

estimated at 60), various antelopes and a diverse avifauna (Tchamba & Elkan, 1996; Scholte *et al*., 1999). Waza NP is surrounded by human settlements, it is a so-called 'hard-edged park'. There is no safari hunting inside the park, outside there is a mean annual offtake of 10 elephants out of a sustainable quota of 30. For the lion there is no hunting quota; the population is too small for sustainable off-take. Conservation in Waza NP was purely FC until 1993, after which it progressively shifted towards CBC. Amongst others, this was due to the adoption of a new forestry law, reduced law enforcement capacity, and the creation of an Integrated Conservation and Development Project (ICDP).

Multi-disciplinary research on people-park relations started in 1990, with particular attention to human-wildlife conflict. First, the focus was on crop raiding by elephant (Tchamba, 1996) and then on stock raiding by carnivores (Bauer, in press), with the following results. Participatory Rural Assessment and structured interviews were used to assess wildlife damage, the accuracy of the figures was confirmed by monitoring elephants and lions with the aid of radio collars. In order to attribute the total revenues from tourism to separate species, tourists were interviewed to determine the relative importance of different species. This factor was combined with the revenues from tourism as recorded in local archives, resulting in assessed revenues per species. Results are listed in Table 10.1, they show that both elephant and lion were a net cost to local people, also under the condition that all revenues would be distributed locally and management costs would not be taken into consideration. Table 10.1 also shows the potential revenues if the existing hunting quota would be fully utilised and if both hunting and entry fees would be increased to the level that tourists alleged to be willing to pay. Even then, damage outweighed revenues for both species.

Table 10.1: Financial value of wildlife damage and tourism revenues in Waza NP, assessed between 1992 and 2002 (in US$ per year). Top two rows are real values, bottom two rows are potential revenues, based on full safari quota utilisation at present prices and tourist and safari prices at Willingness-To-Pay (WTP) level, respectively.

	elephant	lion	other carnivores	other wildlife
Damage	- 200,000	- 130,000	- 100,000	- 0
Current revenues	+ 38,000	+ 8,000	+ 0	+ 9,000
Max. safaris (present)	+ 68,000	+ 8,000	+ 0	+ 9,000
Max. safaris (WTP)	+151,000	+13,000	+ 0	+ 9,000

The first condition for CBC mentioned by Adams & Hulme (2001) is the presence of wildlife that can yield a sustainable revenue flow. In view of the above, we argue that revenue flow is only partly relevant, the condition should rather be "a net benefit from wildlife", i.e. corrected for damage. Of course, the contribution of wildlife in Waza NP to the national economy is larger than the amounts mentioned (travel costs, visa , foreign exchange, off-site expenditure, etc.), but those benefits are not relevant to the local actors. Presently, local communities in fact subsidise conservation and tourism, but under CBC they are unlikely to continue doing so. Human wildlife conflict is too serious to be solved by the local and national stakeholders, who feel that global money is needed to facilitate an equitable arrangement: "if the world wants elephants and lions, they have to start paying for them" (park warden, pers. comm.).

This points at the second amendment which concerns the role of the international community. Adams & Hulme (2001) introduce this role in their condition 6 as donor investment, this refers to short or medium term projects, the accomplishments of which must be perpetuated afterwards by wildlife based self-financing. In contrast, we suggest a

permanent global influence on conservation and a perpetual financial flow (Fig. 10.1), which is fundamentally different from and complementary to short and medium term donor investments. This global influence is usually exercised through either governments or communities, in the form of international conventions, bi- and multi-lateral cooperation, subsidies and projects. We propose the term Globally Mediated Conservation (GMC) for the actions of the international community, which adds a new dimension to the FC-CBC continuum.

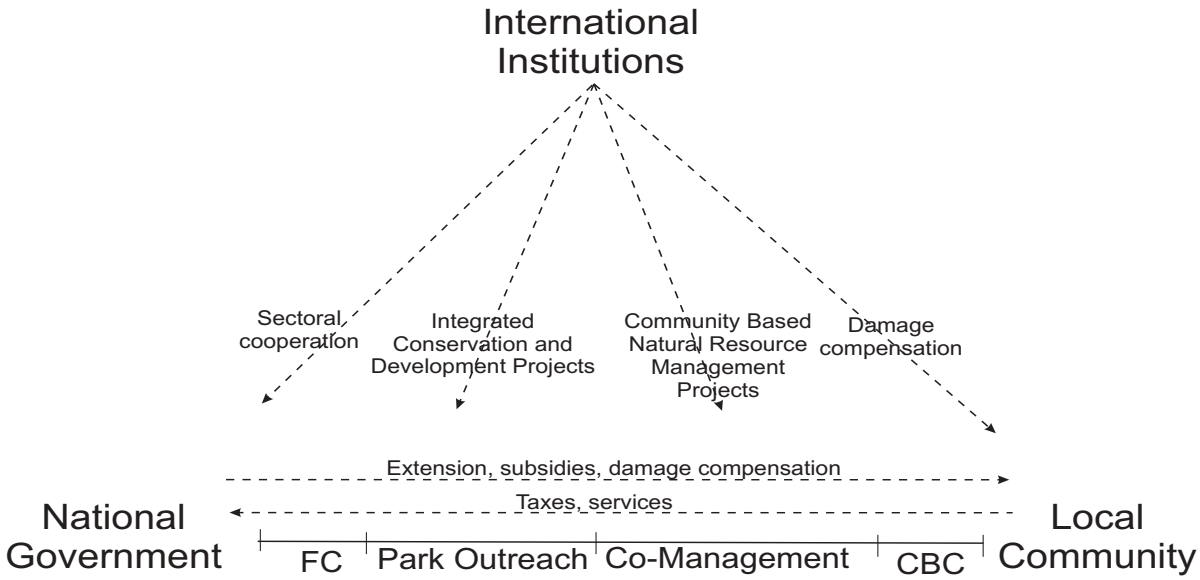

Figure 10.1: Diagram showing actors in biodiversity conservation, base line represents the continuum of power-sharing described by Barrow & Murphree (2001), dotted lines represent financial flows.

Conceptually, GMC puts financial value on conservation interests that are not limited to the local and national level, but are in fact global. Balmford *et al.* (2002) calculated that effective conservation of wilderness would benefit the global community at least 100 times more than the US$ 45 billion it would cost. The heterogeneous global community has shown consensus on some political, cultural and financial aspects of conservation in some cases, as demonstrated by the cases of Antarctica, the system of World Heritage Sites and the Global Environment Facility, respectively. These examples show the high potential of GMC.

GMC becomes especially relevant if neither FC nor CBC are effective. Adams & Hulme (2001) acknowledge that some species may be redundant under CBC (condition 4), but when wildlife damage is taken into account this becomes a major category. Many West and Central African ecosystems cannot 'pay their way', because of low wildlife densities (and thus low offtake quota), little investment in tourism and high human population densities (East, 1984; Oates, 1999). This particularly pertains to carnivores, as they generally occur at low densities (apex of the nutrient pyramid) and as they do damage to livestock (usually more expensive than crops), which suggests a high propensity for an adverse cost benefit balance. In such cases, GMC can shift the cost benefit balance of conservation.

The structural nature of global influence on conservation has been institutionalised in conventions etc., but the financial flows generally only depend on short or medium term commitments and show a lack of institutionalisation. To address this weak point, Macdonald (2001) proposed a permanent biodiversity fund comparable to the Kyoto protocol for international offsetting of carbon emissions. This is just one idea, more possibilities exist

(biodiversity tax, interest from charity deposits, private or corporate fostering, sponsoring or purchase of natural lands). Equally crucial is how the money is spent. Possibilities include the set of tools currently employed by ICDP's and Community Based Natural Resource Management Projects, not for a restricted project period but in the form of long-term support. Another possibility concerns damage compensation, although this has proven very difficult to implement (Anonymus, 2001). Yet, some of the arguments against compensation systems, such as financial unsustainability and donor dependency, would be irrelevant under GMC.

In the European Union, several policies invest international taxes in national or local conservation (damage compensation, green services of agriculture, etc.). Apparently, these are sustainable and show that there is no inherent problem with such policies. The multitude of 'green' conventions and projects in Africa demonstrate that the international community invests in GMC, albeit not in a similarly institutionalised way. Institutionalisation is difficult, due to political instability and low institutional capacity of most African countries, but this may be less of a problem at lower spatial and administrative levels (cf. Hamilton *et al.*, 2000). In our opinion, it is important to conceptualise GMC as an existing factor with important potential for effectiveness.

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Chapter 11:

Final Discussion and Recommendations

Photo 14: Roan and crowned crane near a natural waterhole.

11.1 Introduction

The present thesis is composed of chapters that almost all contain their own discussion. In addition, Chapter 10 contains an elaborate methodological discussion. In order to avoid repetition, I have selected three themes for a more integrative discussion in the present chapter. The discussion is based on the findings in previous chapters and some additional illustrative material concerning: (a) lion ecology, (b) human-lion conflict resolution strategies, and (c) the management plan of Waza NP.

11.2 Lion ecology

Chapters 4 and 5 contain an estimation of lion population numbers in Africa in general and in West and Central Africa in particular. These chapters show that the species *Panthera leo* is not threatened with extinction in the short or medium term, as many large and small populations exist in East and Southern Africa, and several small and large populations are the subject of intensive research and management. Elements of intensive management are, *inter alia*, monitoring of population size, identification of problem animals, addressing human-lion conflict (see section 11.3), monitoring the epidemiology of lions and prey, monitoring genetic variability, fertility management (*in vitro* fertilisation, vasectomy, contraception), translocation and/or, if necessary, introduction and bonding of new individuals from elsewhere. In West and Central Africa, however, all populations are small, most are not being studied or managed, and some are diminishing. This does not mean that the lion will soon disappear from the region, but it increases the probability of exactly that happening in the long term.

By evolutionary standards, it would probably be insignificant if the lion would disappear from West and Central Africa. The species is relatively secure in other regions, where it may survive in the medium and long term. As long as East and Southern Africa are a conservation stronghold, the species will not go extinct. Severe population decline in that region is not likely to go unnoticed because of intensive research and monitoring and because of the intention of the IUCN African Lion Working Group to regularly update the African Lion Database (Chapter 4). If the lion would disappear from West and Central Africa, it is likely to remain absent in the medium term, since the forces that led to the current situation (see Chapter 5) are not likely to change over the next few human generations. However, the possibility of habitat regeneration and subsequent lion re-invasion (or re-introduction) in a distant future cannot be excluded. The only evolutionary reservation is that the West/Central and East/Southern Africa populations have been genetically separated under different selective pressures (Chapter 8); the West and Central African sub-population may therefore constitute, or evolve to, a separate regional taxon.

There are four reasons, however, why regional extirpation would matter. The first is that the lion can be considered an ‘early warning system’; being at the apex of the food-web, living at low densities and having large home ranges, it shows the signs of failing conservation before other species do. Extinction of other species does matter on an evolutionary time-scale, since the West and Central African region is a ‘biodiversity hotspot’, with many endemic species (Myers *et al*., 2000). The second reason is the value of biodiversity below species level. Chapters 7 and 8 contained information on region specific lion weight, range size and social organisation; still more variability may exist, future research

could even identify the West and Central African lion as a distinct regional taxon. The third reason is the economic value, since lions increase the attractiveness of a protected area for tourism, for example (but benefits may currently be outweighed by costs, see Chapter 10). The fourth reason is the 'regional cultural value'. Three national football teams in the region have names containing the word 'lion' (Morocco, Senegal, Cameroon). The president of Cameroon, H.E. Paul Biya, was called 'the lion-man' in a publicity campaign. Many wildlife related organisations carry the lion in their name or symbol (one hunting zone in the Benoue area is called 'Beautiful Lion'). Many ethnic customs refer to or use the lion as a symbol of power and dominance (many traditional chiefdoms possess at least one lion skin, and lion hunting is a 'rite de passage' in hunting fraternities).

The main driving forces of extinction are poaching and habitat loss, but there is a threshold of fragmentation beyond which genetic, demographic and environmental stochasticity contribute to extinction probability. This threshold is called the Minimum Viable Population (MVP) size, and there is extensive literature on the assessment of MVP through modelling, so-called Population Viability Analysis (PVA) (e.g. Beissinger & McCullough, 2002). A common shortcoming of PVA is that much data is needed on a range of biological and environmental parameters in order to obtain a reliable result. Several models propose default values and algorithms to fill information gaps, leading to illustrative probabilistic scenarios that must consequently be interpreted carefully. The best known example is the computer program VORTEX. Appendix 11.1 describes a VORTEX-based PVA illustrative of lions in Waza NP, using educated guesses or default values as input parameters. Four scenarios were simulated: (1) no human lion conflict (only wildlife based carrying capacity and 'background-poaching' of 1 female and 1 male lion annually); (2) managed conflict, i.e. livestock killing without increase in poaching (livestock and wildlife based carrying capacity and 'background-poaching'); (3) medium conflict, i.e. livestock killing without increase in poaching but with problem animal shooting (livestock and wildlife based carrying capacity and offtake of 2 female and 2 male lions annually); and (4) unmanaged or serious human wildlife conflict (livestock and wildlife based carrying capacity and annual offtake of 2 females and 4 males). The model indicated low long term viability without intervention under all scenarios, little difference between scenarios (1) and (3), but substantial decrease in viability under scenario (4). This suggests that human livestock conflict is usually, but not necessarily, a direct threat to population viability, depending on lion damage management (see Appendix 11.1).

We conclude that, if not all West and Central African lion populations can be conserved, conservation of some populations is important. Waza NP, then, is a good candidate to represent the region and to focus lion conservation efforts on. The number of mammal species in Waza NP has decreased over the last two decades (Chapter 1), but the diversity is still high compared to the surroundings and to other protected areas in the region. Also, numbers of several species are increasing (elephant, kob, etc.; Scholte *et al.*, in prep.). Waza NP is a conservation stronghold for several species which have become extremely rare throughout the region (e.g. elephant, giraffe, korrigum), and could serve as such for lion.

The topic of small population management is beyond the scope of this chapter, here we suffice to say that sustainable management of small populations is technically possible (e.g. Princee, 1998) and that considerable experience exists with sustainable management of lion populations of less than 100 individuals across the continent (e.g. Madikwe Game Reserve; G. Van Dyk, pers. comm.). It would necessitate pro-active and intensive

management, though, which requires funding and institutional capacity beyond the present level. This may be difficult to achieve, but here we concentrate on an even more difficult condition for lion population management: the reduction of human-lion conflict.

11.3 Human-lion conflict resolution strategies

In Environmental Impact Assessment, three problem solving strategies are commonly mentioned: avoidance (elimination, prevention, *c.q*. the conflict is completely solved), mitigation (minimisation, abatement) and compensation (e.g. Anonymus, 2002). These strategies are used below to structure a discussion of human-lion conflict resolution. A cross-cutting issue is capacity building and institutional development: these measures all require people to be organised and trained, which is perhaps the greatest challenge, but not the focus of the present section.

11.3.1 Conflict avoidance

Three options exist for the elimination of conflict: removing predators, removing livestock, or making the interface impenetrable. They are described below.

Fencing. Many Protected Areas in East and Southern Africa are fenced, and some fences are predator-proof. However, lions require fences that are difficult and expensive to build and maintain. In West and Central Africa, Protected Areas are generally not fenced and expertise and supplies are therefore absent. In addition, forces of people going in are at least as strong as forces of animals going out (Chapters 2 and 3), and no fence is likely to withstand such pressures. Fencing of Waza NP to keep lions in, to our opinion, not a viable option, but fencing particularly sensitive pastures, corrals or corridors to keep lions out might be considered as mitigation measure in future, if fencing would become regionally widespread.

Culling / Extermination / Removal. This option is not currently advisable for Waza NP (see section 11.2), but it may be in future. It may also be advisable for specific populations in the region (*i.a.* in cases with only a few individuals, serious conflict and lack of long term management capacity), extermination or translocation of en entire population might be considered. There appears to be a taboo on triage among wildlife professionals, but it is counterproductive to deny that areas with biodiversity conservation as main objective could best be served by giving up a doomed population in exchange for people's collaboration in conserving other species (see 'package deals' below).

Translocation of livestock / Separation by zoning. Theoretically, land use planning could define the area around a Protected Area as devoid of livestock. In practice, and certainly in the case of Waza NP, this is unimaginable in the African context, where almost every rural household has at least some animals. However, wide ranging semi-nomadic pastoralism is increasingly replaced by land-use forms which are less vulnerable to depredation in many areas, including agriculture (Moritz & Kari, 2001).

The above indicates that elimination of human lion conflict is not a promising strategy. Fortunately, prevention is not required biologically or socially: population viability is not

necessarily affected by conflict (appendix 11.1) and local people have a tolerance threshold for conflict (Chapter 6). The next strategy, mitigation, is therefore more appropriate.

11.3.2 Conflict mitigation

Mitigation in this context can be defined as attempts to reduce the human lion interface. Some options for mitigation are described below.

Improved herding and enclosures. This is probably the most important and effective measure. Animal production around Waza NP is of an extensive nature, and some owners do not optimise economic performance beyond the level of maintenance of prestige and capital (Seignobos, 2000). Herders could easily chase carnivores away (Chapters 6 and 7), but not all herds were accompanied by herders, despite the low price of herder labour (Chapter 9). Also, not all stock was kept in enclosures at night and not all enclosures were well built. Low local investment in potentially efficient mitigation of depredation by individual stock owners can be explained by the fact that depredation was perceived as a natural phenomenon, less serious than other problems (Chapter 9). Also, shooting and poisoning may be easier and less labour intensive than herding and corralling from a local perspective, in case of severe problems at a specific location or moment. Herding and corralling have great potential for the improvement of mitigation as compared to current practice.

Problem animal control (e.g. Stander, 1990). Various definitions of Problem Animal Control (PAC) exist, here it refers to the killing or sale (e.g. to zoos or hunters) of problem lions by or with the consent of the appropriate authorities. Some authors include lion killing by livestock owners in their definition of PAC (Nowell & Jackson, 1996), some authors refer to that as 'retaliatory killing', but we have referred to it as poaching throughout the present dissertation, since it does not necessarily target a specific problem animal, in contrast to PAC. In Chapter 7, we argued that lethal PAC may be inescapable, but this should be done carefully since the PVA described in appendix 11.1 demonstrated a high sensitivity to harvesting. Effective PAC would require monitoring, identification and removal of habitual problem animals only.

Translocation of lions (review in Linnell *et al*., 1997). Translocation of problem lions is known as non-lethal PAC, but translocation can also include non problem animals as alternative to culling and extermination (see above). In the case of Waza NP there are three options for translocation destinations: Kalamaloue NP, the Benoue area or abroad, but none is ideal. Moving lions to Kalamaloue NP where they have disappeared would create more severe problems, since Kalamaloue NP is smaller and even more intensively used by people than Waza NP. Translocation to the Benoue area is technically feasible, but questionable: the hunting industry active in that area would probably welcome additional lions, but the funds spent to translocate them would not benefit lion conservation since the Benoue population is not likely to increase under the current hunting regime (see also: Mayaka, 2002). Moving lions to Chad or Central African Republic could be an option, depending on bi- or tri-lateral cooperation and information exchange.

Chasing lions back. This has rarely been reported for East and Southern Africa, but has been practised with limited success in Botswana (G. Hemson, pers. comm.). Guinean traditional hunters were reported to have experience with the technique in Chapter 5. The technique of

pepper spraying was introduced for elephant damage control to the South of Waza NP (Tchamba, 1996), and could be successful for lions in some areas. Much work needs to be done, however, to optimise techniques for 'lion herding', a topic on which little has been published.

Conditioned Taste Aversion (review in: Forthman, 2000). Conditioned Taste Aversion (CTA) is a psychological phenomenon, based on the causal link between a signal and a consequence. In the case of carnivores, it involves the injection of livestock carcasses with a nauseating substance, usually lithium chloride (LiCl), to create aversion for livestock (the signal) by the association with illness (the consequence). In theory, it is a good solution, but in practice it has never worked under field conditions and it is not advisable for Waza NP.

Pasture / corridor design. With the use of natural barriers or habitat modification, the probability of lion attacks can be reduced in particular areas. Alternatively, pastoralists could avoid certain pastures and waterholes if alternative sites were available or created.

Livestock Guarding Dogs (review in: Rigg, 2001). In developed countries, the use of specialised guarding dogs to protect livestock from carnivores is a well known, widely practised and generally efficient and effective mitigation measure. In Africa, the only published experience was in Namibia. In Waza NP, dogs already play an important role as early warning system, but they are not used for livestock defence (Bauer, 1995). The potential for introduction is compromised, however, by low investments in livestock production in general and in dogs in particular.

Magic. With 'magic', we mean all traditional and religious practices aimed at preventing predator attacks on livestock; it is the option most favoured by local people (Chapter 9). We will not elaborate on this topic, but even if one assumes that it is not effective in damage reduction one must appreciate its value in psychological or cultural mitigation. Not addressing the issue in future interventions would compromise dialogue between local people and supra-local organisations (see also: Bauer, 1995).

11.3.3 Damage compensation

If environmental impacts cannot be avoided or mitigated, they can be compensated. This strategy does not address the problem but the symptom and is therefore generally less preferred, but widely practised in developed countries (Kaczensky, 1996).

Financial compensation. Currently in Africa, only Botswana has a compensation program for livestock damage. Authorities in Kenya paid damage compensation in the past, but abandoned the system because of corruption (L. Frank, pers. comm.). In Cameroon, the only experience has been elephant damage, some of which was compensated by government services a few times over the last decade on an ad hoc basis (Tchamba, 1996). Compensation systems for elephant damage have often been described as inefficient, ineffective, expensive, unfeasible, corruption-prone, and particularly damage assessment has been difficult (Anonymus, 2001). The issue of sustainability was dealt with in Chapter 10, other objections that are valid in the case of elephants could be less of a problem for lion damage. With forensic methods, damage assessment can be relatively objective, quick and easy (Bowland et al., 1993). In Waza NP,

lion damage consists of a limited number of high value cattle in a well defined area, in contrast to elephant damage which was an unknown percentage of a large variety of crops in an entire region. Lion damage to cattle is a major component of livestock damage (Chapter 9) and an important nuisance to many people (Chapter 3). Compensation will be costly but easier than most other forms of animal damage. Therefore, if wildlife damage is to be compensated, it is advisable to start with lion damage. Currently, however, there is no institutional arrangement or legal provision for compensation; funding is not the only problem.

Compensation in kind. An alternative to compensation payments is compensation in kind with livestock from a government herd kept for that purpose. This could reduce the potential for corruption, but it may complicate administration and management of the compensation program.

Partial compensation. In the case of an Amur leopard (*Panthera pardus orientalis*) conservation project, compensation has been higher than the financial value of losses, in order to foster positive attitudes towards the species (M. Hötte, pers. comm.). This is exceptional: in most cases compensation equals the value of losses, in Botswana between 58% and 76% (Herrmann, 2002). It may be advisable, however, to compensate partially, say 70% of losses, in order to reduce costs and encourage the use of mitigation measures.

Conditional compensation. An important finding of the compensation system in Botswana, is that those involved strongly recommend that compensation, be it financial or in kind, should be conditional (Swenson & Andren, 2002; G. Hemson, pers. comm.). Dyar & Wagner (2003) demonstrated that compensation for losses is less efficient than compensation for precautionary efforts or a combination of the two. Conditions may vary between sites, in Botswana the proposed condition is prove of stock protection measures, like solid corrals at night. In the case of Waza NP, conditions could include the presence of a herder, the location of the incident (outside the NP), the quality of the corral, and the disclosure of information about the incident (patterns in time and space and observations on the problem lion may help detect a habitual problem animal).

Insurance. Public sector compensation has a private sector equivalent: insurance. An insurance program for Amur tiger (*Panthera tigris altaica*) damage is experimented with in Russia (Miquelle *et al.*, 2002), but in the informal economy of our research area it is not currently an option.

Package deals. Compensation systems are often rigid and formalised with almost universal applicability and a one-on-one trade-off. In many cases, 'package deals' can be a more flexible alternative. These deals are typically negotiated case by case between park management and a particular village. For example, it may lead to the acceptance of depredation in exchange for fishing rights in one village and to credit for improved corrals in another. This method is expected to give the solution best adapted to the local situation, but it requires strong negotiation skills on both sides and considerable flexibility in management. A potential problem is differential law enforcement: an activity may be allowed in one village and not in the other, which may lead to difficulties in implementation.

Facilitation of herding. Park management - or another stakeholder - could employ and train a team of local herders, who could accompany unherded herds and/or assist inexperienced non-resident herders. This service, analogous to harbour pilots, could be provided upon request or imposed, free of charge or for a fee, depending on local arrangements.

This list is not exhaustive but limited to practical options; technically complicated techniques were excluded beforehand (e.g. protective or poisonous collars on livestock). Examination of this list shows that mitigation is the preferred strategy, while compensation should be investigated if it is enabled in future wildlife legislation. Concretely, we recommend a combination of lethal PAC for the most serious problem animals and chasing occasional problem animals back into Waza NP at regular intervals. Furthermore, we recommend an information campaign on mitigation measures by local people, and such measures should be a condition for further negotiations and actions towards reduction of the human livestock conflict.

There is no best solution which is universally applicable, our preferred strategy may not be appropriate for other areas in the region, or anywhere else. Depending on local circumstances, however, a selection of one or more of the listed measures can reduce human lion conflict in most cases.

11.4 The management plan of Waza NP

The management plan for Waza NP that was adopted in 1997, formulated relevant policy as follows. Inside the park, some forms of experimental consumptive resource use could be allowed, monitored and evaluated, partly in compensation for certain inconveniences related to the park's presence, and partly in exchange for specific actions as negotiated in a package deal (see also Chapters 2 and 3). In the peripheral zone around the park, the impact of elephants, lions and weavers (granivorous birds) was recognised as too high to be compensated with use rights, but lethal PAC and compensation were excluded in view of the area's biodiversity conservation objective. Instead, the peripheral zone is the primary target for employment opportunities, eco-development, tourism related benefits and experiments to chase problem animals back to the park. Outside the peripheral zone, i.e. in the entire province, lethal PAC, chasing problem animals and possibly compensation were defined as the preferred options.

Our results showed that limited consumptive use of vegetative resources and fish can contribute to more positive attitudes and possibly collaboration in conservation (Chapter 3). Research on the ecological impact of such consumptive use is lacking, and experiments should be defined as action-research. The idea of the park as untouched pristine wilderness is a myth, many forms of utilisation were described (Chapter 2), currently without monitoring and regulation, but not leading to obvious reduction of numbers of the main wildlife species over the last few years. The regulation of consumptive use could in theory be a formalisation of current practice, possibly even leading to a reduction of current pressures (by changing from an open access to a partial common access regime) and to monitoring of the limits to carrying capacity. However, we concur with the management plan that it is unlikely that sustainable use compatible with National Park objectives can ever compensate the damage (Chapter 9). Moreover, we also find it unlikely that other locally generated revenues can

balance local costs and benefits (Chapter 10). The management plan's provisions may be sufficient to offset damage in the North, East and West, with low elephant and lion impact, but not in the South of the peripheral zone (Tchamba, 1996; Chapters 6 and 9).

There are two possible reactions to this shortcoming. The first is to apply more of the mitigation techniques described in section 11.3. Here, the international community also has a responsibility as described in Chapter 10. In addition, lethal PAC could be considered on condition of improved herding and verified identification of a habitual problem animal. PAC is usually incompatible with safari hunting, since the objective is to kill an animal, not to hunt it. The difference is that hunting requires nice scenery, a fair chance of escape of the game, and respect of hunters' ethics which puts constraints on the time, place and techniques. Usually, the risk of increasing the problem (i.e. having to take out a skittish or even wounded problem animal which escaped from an unsuccessful safari hunter) outweighs the potential benefits from marketing of PAC quota as hunting license. In our particular situation, however, not killing the target while earning revenues and probably chasing lions back to the park could potentially be desirable.

The second possibility is to acknowledge the fact that Waza NP represents supra-local values that the state has decided to conserve at the expense of livelihood opportunities in the vicinity. The management plan states that the park's impact on livelihoods may not deteriorate, but it does not say that it must achieve a positive cost benefit balance for everyone. Park management has a moral responsibility to attempt to contribute to local development, but cannot be blamed if it is not capable of doing so. Local people must contribute to a conservation compatible way to deal with the problem or just accept it, as has been the case since times immemorial (Barnes, 1996; Treves & Naughton-Treves, 1999; Chapter 6). Ultimately, it must be stated that those who do not accept depredation should move elsewhere. Currently, park management cannot muster political support for inclusion of such statements in the management plan. Yet, for those who accept the concept of protected areas, it is a justifiable option. It is also a theoretical option, however, since we have not encountered anyone who indicated that depredation could be a motive for leaving. Keeping livestock is apparently profitable, despite the high levels of depredation.

So far, we have discussed the management plan as if it has been implemented. In reality, however, implementation has been selective. The platform for negotiations was established, and debates about consumptive use advanced. Also, the visitor's centre and the tourist facilities were constructed and equipped. Several 'eco-development' initiatives have been implemented, primarily by the Waza Logone Project. In contrast, the number of guards, the quantity and quality of their equipment, the materialisation of park limits, ecological monitoring and the organisation of the park management unit have not improved. There has been some progress recently (MINEF deployed an additional car in Waza NP in 2001), but in general these elements of the management plan have hardly been implemented. Also, apart from an incidental externally funded short project to chase elephants back to the park, none of the measures mentioned for damage reduction has been implemented. This leads to the conclusion that people oriented and donor funded plans were implemented, while wildlife oriented and government funded plans were not. For the human wildlife conflict, this unbalanced implementation has led to unsatisfactory results.

Lack of implementation was probably related to two weak points. First, funding of Waza NP is too limited. Tourist numbers do not justify higher investments, but biodiversity values do justify and require them (Chapter 10). Waza NP has not been able to attract

sufficient outside funding or to diversify funding sources. This is partly attributable to the second weak point: the administrative organisation. Both decision and financial power are centralised, but in different ministries, which makes active management almost impossible. The Park Warden must discuss almost every decision with his superiors in the Ministry of Environment and Forests, and since there is no telephone line this means that he is out of office half the time. Some budgets go through the Ministry of Finance, leading to again more procedures. This is not unique for the park; Cameroon's administration is generally known for its lack of decentralisation, motivation, effectiveness and devolution of power (Cleuren, 2001). Centralisation is in fact symptomatic for the entire region, to varying degrees (McNeely *et al.*, 1994).

In view of the lack of implementation of the ministry's components of its own management plan in the past, making a list of recommendations carries a high risk of being an academic exercise with little applied relevance. Nevertheless, a modest list of ambitious but realistic improvements is proposed.

11.5 Recommendations

Recommendations are divided into two categories: recommendations for further research and recommendation for actions. Based on the present thesis, it is recommended that:

Research

1. Social science research on people's animal production systems, depredation prevention strategies, barriers to adoption of depredation mitigation techniques and the link between local cultures and the lion should be improved and go beyond damage survey and inventory work.
2. Natural science research on lion ecology in Waza NP and in the West and Central African region should continue and focus on the regional particularities of the species' ecology and on factors with relevance to the management of small lion populations.
3. A regional campaign to census lion populations and describe their status and threats should be initiated as soon as possible.

Action

1. A regional network for lion conservation should be strengthened.
2. Full and balanced implementation of the management plan for Waza NP should be a priority for all stakeholders, i.e. all stakeholders should take their responsibilities more diligently and equally diligently.
3. Livestock protection against predators by owners and herders around Waza NP should be promoted. Adoption and application of protective techniques should be a condition for other interventions.
4. The legal, practical and financial feasibility of a conditional and partial compensation system for lion damage around Waza NP should be investigated. The source of funding should be supra-local and sustainable.
5. The identification of habitual problem animals should continue and a small annual dry season PAC quota, which should be inversely related to the level of poaching or poisoning around Waza NP, could be defined.

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Appendix 11.1: Population Viability Analysis

A Population Viability Analysis (PVA) was performed using VORTEX version 8.42 software. This PVA aimed to reflect the parameters of the Waza lion population. However, there were two important shortcomings that warrant careful interpretation. Firstly, Vortex is a generic software program that attempts to model viability of populations of all animal species without accounting for complex social systems. Secondly, many important demographic parameters of the Waza lion population were lacking. The values used here were educated guesses (see Box 11.1). As a consequence, this is only a possible probabilistic approximation of a model for the Waza lion population.

Because of the limited validity of the model, the absolute extinction probability is of limited interest. The model was run over a hundred times, every time with slightly different parameters. More optimistic parameters (e.g. higher proportion of females breeding, less environmental variability or lower cub mortality) invariably led to substantially lower extinction probability. This suggests that the population is near the critical threshold of viability. The objective of the modelling exercise, however, was not an assessment of absolute values but a comparison of four scenarios based on variation in only two variables: carrying capacity and offtake. Carrying capacity was defined as either exclusively wildlife based, or as supplemented with a capacity for 15 adults feeding on livestock, with lower between-years variation. The two states of the variable carrying capacity were represented as "raiding-" and "raiding+", respectively. The other variable, offtake, had three states: either 1♀ and 1♂, 2♀ and 2♂ or 2♀ and 4♂ (annual offtake of adult lions), represented as "killing+", "killing++" and "killing+++", respectively.

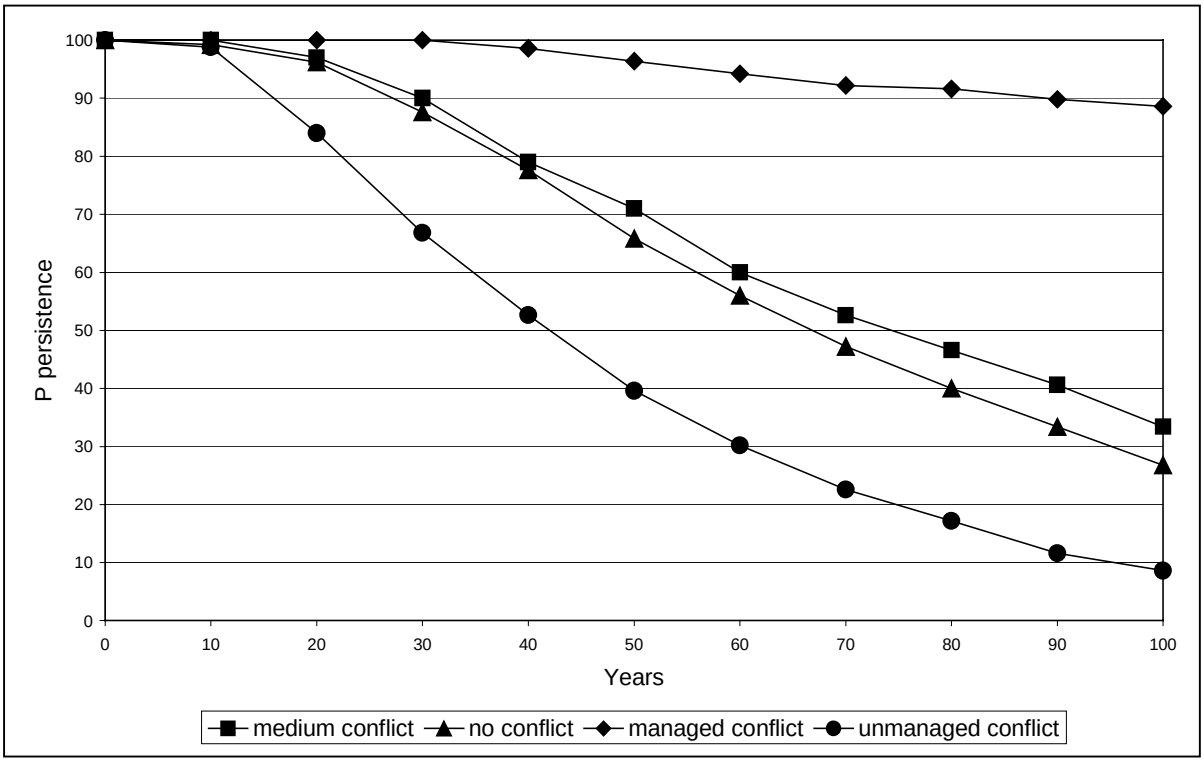

Figure 11.1: Results of the Population Viability Analysis, probability of persistence (the reverse of extinction) over 100 years.

The four scenarios represented: (1) no conflict (raiding-, killing+), (2) managed conflict (raiding+, killing+), (3) medium conflict (raiding+, killing ++) and (4) unmanaged conflict (raiding+, killing+++). Fig 11.1 shows the resulting viability, whereby managed conflict leads to higher viability than no conflict or medium conflict, while unmanaged conflict leads to substantially lower viability in this model.

Box 11.1: VORTEX code used for the Population Viability Analysis

The code below was used to produce figure 11.1, all scenario's were identical except for a few lines that were printed in bold below. Note that the parameters for population size and carrying capacity are twice the estimate, this is to account for the fact that cubs are ignored in estimates for population size. In a stable age structure, cubs represent half the population, therefore our estimates were doubled to give the parameter for this model.

Y ***Graphing Files?***	N ***Details each Iteration?***
500 ***Simulations***	100 ***Years***
10 ***Reporting Interval***	0 ***Definition of Extinction***
1 ***Populations***	Y ***Inbreeding Depression?***
3.140000 ***Lethal equivalents***	50 ***Percent of genetic load as lethals***
Y ***EV concordance repro and surv?***	2 ***Types Of Catastrophes***
P ***Monogamous, Polygynous, or Hermaphroditic***	
5 ***Female Breeding Age***	5 ***Male Breeding Age***
13 ***Maximum Breeding Age***	50.000000 ***Sex Ratio (percent males)***
0 ***Maximum Litter Size (0 = normal distribution) *****	
N ***Density Dependent Breeding?***	Pop1
30.00 **breeding	15.00 **EV-breeding
2.500000 ***Pop1: Mean Litter Size***	1.000000 ***Pop1: SD in Litter Size***
25.000000 *FMort age 0	10.000000 ***EV
10.000000 *FMort age 1	5.000000 ***EV
10.000000 *FMort age 2	5.000000 ***EV
10.000000 *FMort age 3	5.000000 ***EV
10.000000 *FMort age 4	5.000000 ***EV
10.000000 *Adult FMort	5.000000 ***EV
25.000000 *MMort age 0	10.000000 ***EV
10.000000 *MMort age 1	5.000000 ***EV
10.000000 *MMort age 2	5.000000 ***EV
10.000000 *MMort age 3	5.000000 ***EV
25.000000 *MMort age 4	10.000000 ***EV
10.000000 *Adult MMort	5.000000 ***EV
15.000000 ***Probability Of Catastrophe 1***	25.000000 ***Severity--Reproduction***
25.000000 ***Severity--Survival***	5.000000 ***Probability Of Catastrophe 2***
20.000000 ***Severity--Reproduction***	20.000000 ***Severity--Survival***
Y ***All Males Breeders?***	Y ***Start At Stable Age Distribution?***
100 ***Initial Population Size***	**100 or 130** ***K***
25 or 15 ***EV--K***	N ***Trend In K?***
Y ***Harvest?***	1 ***First Year Harvest***
200 ***Last Year Harvest***	1 ***Harvest Interval***
0 ***Females Age 1 Harvested***	0 ***Females Age 2 Harvested***
0 ***Females Age 3 Harvested***	0 ***Females Age 4 Harvested***
1 or 2 ***Adult Females Harvested***	0 ***Males Age 1 Harvested***
0 ***Males Age 2 Harvested***	0 ***Males Age 3 Harvested***
0 ***Males Age 4 Harvested***	**1, 2 or 4** ***Adult Males Harvested***
N ***Supplement?***	N ***Another Simulation?***

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Summary

Lion Conservation in West and Central Africa

Integrating social and natural science for wildlife conflict resolution around Waza National Park, Cameroon

The present dissertation is based on research in Waza National Park (NP), Northern Cameroon, and at Leiden University, The Netherlands, from 1995 to 2002. It contributes to the multi-disciplinary discipline of conservation science and attempts to integrate social and natural science for the analysis of the conflict between local people and lion conservation. It is composed of three parts: background (Chapter 1-3), human - lion conflict (Chapter 4-8) and discussion (Chapter 9-11).

Part I: Background

Waza NP is a protected area of approximately 160,000 ha in the Sudan-Sahel zone of the Far North Province of Cameroon. The Eastern half of the Park is a wetland which is part of the Logone floodplain, the Western half is woodland savannah partly dominated by *Acacia seyal*. Rainfall is erratic between years, with an annual mean of circa 600 mm during the rainy season from June to November. The Park contains important mammal and bird populations, including species that are increasingly rare in West and Central Africa, such as elephant (*Loxodonta africana*), giraffe (*Giraffa camelopardalis*), various antelope species, hyena (*Crocuta crocuta*), ostrich (*Struthio camelus*) and crowned crane (*Balearica pavonina*). There is also a population of approximately 60 lions (*Panthera leo*). The research questions addressed here are: (1) what is the lion's conservation status; (2) how may human - lion conflict around Waza NP be described; and (3) which conservation strategies are most appropriate for lion conservation, particularly in the context of Waza NP. Chapter 1 describes the area and research questions in more detail.

Waza NP is entirely surrounded by human settlements; it is not fenced and there are many interactions between the Park and the surroundings. These interactions have become more intense since the beginning of the 1990's, first with the decline of law enforcement capacity during the onset of the economic crisis and later as a result of a shift towards more participatory management of the Park. The latter trend is omnipresent in Africa and aims to promote local people's participation and collaboration in conservation. Chapter 2 gives a review of this trend with examples from all over Africa and, in the case of Cameroon, gives an analysis of concomitant changes in legislation. The most relevant legal change for National Parks in Cameroon has been the *de jure* freedom for locally adapted management if defined in a duly approved management plan. This policy has only been partially or selectively implemented so far.

The Ministry of Environment and Forests (MINEF) adopted a management plan for Waza NP in 1997 that explicitly addressed the social context, including the creation of a discussion forum, the recruitment of local guards and the promotion of eco-tourism. The management plan also allowed experiments with limited consumptive use of a few natural

resources, in exchange for people's collaboration. In order to determine which resources were desired and which resources were a liability, people in the Park's vicinity were interviewed (Chapter 3). Respondents' attitudes towards conservation were positive, primarily motivated by use values, but partially also by intrinsic values and reference to future generations. Attitudes were significantly related to locally perceived benefits. Respondents found most of the Park's resources useful but differences between user groups were significant. User groups also differed in their complaints about human - wildlife conflicts, but overall they considered the animal species that are most important for tourism as the main nuisance. The analysis showed that local aspirations cannot all be met, but indicates that limited outreach can improve the existing public support for conservation measures.

Part II: Human - Lion conflict

The number of free ranging lions in Africa had never been accurately assessed. Chapters 4 and 5 present an inventory of available information, which gave a conservative estimate of between 16,500 and 30,000 free ranging lions in Africa. The inventory shows that the species still occurs widely in East and Southern Africa, whereas populations are small and fragmented in West and Central Africa. The lion has historically probably been widespread at low densities in West and Central Africa. Nowadays it is largely restricted to small isolated populations inside and around protected areas. The total regional number is probably between 1000 and 2850, the best possible guestimate is 1800. Human influences form the main cause for the suspected decline of lion populations, both inside (ineffective management) and outside protected areas (incompatibility with human land use). Very little conservation and research efforts have targeted West and Central African lions. Waza NP is representative for the regional situation, with livestock depredation by lions as one of the main challenges in the human - lion conflict.

Chapter 6 reports the results of a series of so-called Participatory Rural Appraisals (PRA) in villages around Waza NP, with a strong thematic focus, namely human - predator conflict. Methods included specific tools such as the use of predator pictures to determine local presence. The results showed that the human – predator conflict was serious in the areas around Waza NP. Conflict was mainly caused by depredation of cattle by lions and depredation of sheep and goats by hyenas; other forms of conflict and human casualties appeared to be rare and less important. During problem ranking and restitution, depredation was confirmed to be a priority problem in the woodland zone to the South of the Park. In the floodplain, however, people agreed that the level of conflict with predators was acceptable, while there was hardly any conflict to the East of the river Logomatya. Another conclusion was that thematic PRA can generate a good impression of a situation, despite some biases, especially in quantitative data. Repetition of the same exercise in several settlements and triangulation of results from different methods were instrumental in clarifying overall tendencies and in showing local variation.

Chapter 7 is based on a telemetry study of five collared lions. Their home ranges were assessed; the mean size was 630 km^2 which is extremely large. The lions differed in their stock raiding behaviour, with two male habitual problem animals, one female non-problem animal and two female seasonal problem animals that left the Park in the wet season. Problem animals had a large part of their home ranges outside the Park, up to 30 km South. Seventy-two percent of the observations of one habitual problem lion were outside the Park. He was

demonstrated to have killed 7 cattle, 9 sheep and 9 goats during four weeks of intensive monitoring. This was extrapolated to a mean annual stock killing of 143 cattle, 183 sheep and 183 goats by the collared lions, which does not contradict the results of structured interviews estimating the value of total annual lion damage at US$ 130,000. This chapter has an appendix with a detailed description of a unique observation. After immobilisation for the telemetry study, one adult female lion had a thorn in her front paw. She was observed attempting to remove it with the use of another thorn clamped between her teeth. This was the first record of a lion using a tool.

The combination of fragmentation and low density is typical of lions in West and Central Africa and different from most areas where lions have been intensively studied. Chapter 8 reviews the sparsely available information in order to investigate the effect of these conditions on lion social behaviour. It is suggested that lion group size is substantially lower than in other regions, possibly affecting pride structure. Three hypotheses are proposed to explain the differences between the regions: low mean prey density, low mean prey body size and high mean proportion of domestic animals in lion diet.

Part III: Discussion

A methodological discussion is provided in Chapter 9. Three methods for the assessment of human - lion conflict were compared: PRA, structured interviews (not elaborately presented in previous chapters but reported in paragraph 9.4) and telemetry. These methods represent the participatory, social and natural science paradigms, respectively. Inputs and outputs for each of the studies were assessed and compared, inputs in monetary terms and outputs in terms of publications and recommendations. Quantitatively, inputs and outputs were largest for telemetry and smallest for structured interviews, but the ratio was similar for all three methods. Qualitatively, the methods were shown to be largely complementary, while limited overlap allowed triangulation which showed concurrence of the different results. PRA, structured interviews and telemetry generated different recommendations, with increasing precision and decreasing scope.

A contribution to the discussion on conservation strategies in Africa is presented in Chapter 10. The case of Waza NP is used to enrich the debate on ‘fortress’ or ‘government based conservation’ versus ‘community based conservation’ with two contributions. The first is that wildlife damage should be taken into account in the assessment of a local cost-benefit analysis of conservation, which considerably reduces the scope for community based conservation. The second is to take structural political and financial influence of international organisations into account, which increases the scope for conservation in general. The term ‘globally mediated conservation’ was proposed as a third and more promising alternative, especially for carnivore conservation in West and Central Africa.

Chapter 11 offers a final discussion around three themes: lion ecology, human - lion conflict resolution strategies and the management plan of Waza NP. It is argued that lion conservation in Waza NP is important, which requires addressing the human - lion conflict. Several options to achieve this are presented, organised by strategy: conflict avoidance, mitigation or compensation. The applicability in the case of Waza NP is evaluated for each. Human - lion conflict resolution must be accompanied by general improvements in conservation effectiveness of Waza NP. To this end, the management plan of Waza NP is integrally discussed. Finally, several recommendations are made.

Résumé

Conservation du Lion en Afrique Centrale et Occidentale

Intégration des sciences naturelles et sociales dans la résolution des conflits homme - faune sauvage autour du Parc National de Waza, Cameroun

La dissertation suivante est basée sur des recherches effectuées dans le Parc National de Waza (PN), au Nord du Cameroun, et à l'Université de Leiden, aux Pays-Bas, de 1995 à 2002. Elle contribue aux sciences multi-disciplinaires de la conservation et essaie d'intégrer les sciences naturelles et sociales dans l'analyse des conflits entre les populations locales et la conservation des lions. Elle est composée de trois parties : l'historique (Chapitres 1-3), le conflit homme - lion (Chapitres 4-8) et la discussion (Chapitres 9-11).

Partie I: Historique

Le PN de Waza est une aire protégée d'environ 160 000 ha dans la zone Sud du Sahel à l'Extrême Nord du Cameroun. La moitié Est du parc est une zone humide appartenant à la plaine inondable de la Logone, la moitié Ouest est une forêt en partie dominée par la savane sahélienne à Acacias (*Acacia Seyal*). Les précipitations sont irrégulières selon les années, avec une moyenne annuelle d'environ 600 mm durant la saison des pluies de Juin à Novembre. Le parc contient d'importantes populations d'oiseaux et de mammifères, comprenant des espèces de plus en plus rares dans l'Ouest et le Centre Africain, telles que l'éléphant (*Loxodonta africana*), la girafe (*Giraffa camelopardalis*), des espèces variées d'antilopes, la hyène (*Crocuta crocuta*), l'autruche (*Struthio camelus*) et la grue couronnée (*Balearica pavonina*). On y trouve également une population d'environ 60 lions (*Panthera leo*). Les questions posées par l'étude sont: (1) quel est l'état de la conservation du lion; (2) comment peut-on décrire le conflit homme - lion aux alentours du PN de Waza; et (3) quelles sont les stratégies les plus appropriées pour la conservation du lion, particulièrement dans le contexte du PN de Waza. Le premier chapitre décrit la zone et les questions de recherche dans de plus amples détails.

Le PN de Waza est entièrement entouré par des habitations; celui-ci n'étant pas clôturé, il existe de nombreuses interactions entre le parc et les environs. Ces interactions se sont intensifiées depuis le début des années 90, dans un premier temps à cause du déclin des capacités à faire respecter la loi, au début de la crise économique, et plus tard à cause d'une evolution vers la gestion participative du parc. Cette dernière tendance est omniprésente en Afrique et a pour but de favoriser la collaboration et la participation des populations locales à la conservation. Le chapitre 2 dresse un examen de cette tendance avec des exemples issus de l'Afrique entière et, dans le cas du Cameroun, propose une analyse des changements correspondant dans la législation. Le changement le plus approprié dans la législation pour les PN du Cameroun a été la liberté promise pour les gestions localement adaptées, si elles sont définies dans un plan d'aménagement dûment approuvé. Jusqu'à maintenant, cette politique a été seulement partiellement et sélectivement appliquée.

En 1997, le Ministère de l'Environnement et des Forêts (MINEF) a adopté un plan de gestion pour le PN de Waza, tenant explicitement compte du contexte social et incluant la création d'un forum de discussion, le recrutement de gardes locaux et la promotion de l'éco-tourisme. En échange de la collaboration des populations, le plan de gestion autorise aussi des expériences limitées dans la consommation de quelques ressources naturelles. Afin de déterminer quelles ressources sont sollicitées et quelles ressources consituent un hasard, des personnes ont été interrogées (Chapitre 3). Les attitudes des personnes interrogées sur la conservation sont positives, principalement motivées par les valeurs actuelles, mais aussi partiellement par les valeurs intrinsèques et par les générations futures. Ces attitudes étaient significativement liées aux bénéfices locaux. Les personnes interrogées trouvent la plupart des ressources du parc utiles, mais les différences entre les différents utilisateurs etaient significatives. Les réclamations des groupes d'utilisateurs diffèrent également à propos du conflit homme – faune sauvage, mais globalement les espèces considérées comme étant les plus nuisibles étaient celles les plus importantes pour le tourisme. L'analyse montre que les aspirations locales ne peuvent toutes être satisfaites, mais indique qu'un effort limité pourrait améliorer le soutien public existant pour les mesures de conservation.

Partie II: Conflit Homme - Lion

Le nombre de lions errants en Afrique n'a jamais été exactement évalué. Les chapitres 4 et 5 présentent un inventaire des informations disponibles, qui donnent une estimation d'environ 16 500 à 30 000 lions errants en Afrique. L'inventaire montre que l'espèce est encore largement répandue dans l'Est et le Sud de l'Afrique, tandis que les populations sont petites et fragmentées dans l'Ouest et le Centre du continent. Historiquement, le lion a probablement été répandu en faible densité dans l'Ouest et le Centre de l'Afrique. De nos jours il est largement réduit à de petites populations isolées à l'intérieur et autour des zones protégées. Le nombre total de la région est probablement de 1000 à 2850 individus, la meilleure estimation étant de 1800 individus. Les influences humaines constituent la cause principale du déclin suspecté des populations de lions, que ce soit à l'intérieur (gestion inefficace) ou à l'extérieur (incompatibilité avec l'exploitation des terres par l'homme) des zones protégées. Très peu d'efforts de conservation et de recherche ont porté sur les lions de l'Ouest et du Centre de l'Afrique. Le PN de Waza est représentatif de la situation régionale, avec la déprédation du bétail par les lions comme principale problématique dans le conflit homme - lion.

Le chapitre 6 rapporte les résultats d'une série de recherches basées sur la méthode dénommée Méthode Active de Recherche Participative (MARP) dans les villages environnants du PN de Waza, avec une forte spécialisation thématique, à savoir le conflit homme - prédateur. Les méthodes incluaient des outils spécifiques tels que l'utilisation d'images de prédateurs afin de déterminer les présences locales. Les résultats montrèrent que le conflit homme-prédateur était sérieux dans les environs du Parc. Les sources du conflit étaient principalement la déprédation du bétail par les lions ainsi que la déprédation de moutons et de chèvres par les hyènes; les autres formes de conflit et les blessures humaines se sont montrées rares et moins importantes. Au cours de l'hierarchisation des problèmes et la restitution, la confirmation que la déprédation est un problème prioritaire dans la zone boisée au Sud du parc a été faite. Dans la zone inondable, cependant, les gens convenaient que le niveau de conflit avec les prédateurs était acceptable, alors qu'il n'y avait pas de conflit à l'Est de la rivière Logomatya. Une autre conclusion fut que ces MARP thématiques

permettent d'obtenir une bonne évaluation de la situation, malgré quelques préjugés, spécialement pour les données quantitatives. La répétition du même exercice dans plusieurs villages et la triangulation des résultats provenant de différentes méthodes ont contribué à clarifier les tendances globales et à montrer la variation locale.

Le Chapitre 7 est basé sur l'étude télémétrique de cinq lions marqués. Leurs domaines vitaux ont été évalués; la taille moyenne observée était de 630 km^2, ce qui est extrêmement vaste. Les lions différaient dans leur comportement de chasse aux animaux domestiques: deux mâles posaient régulièrement des problèmes, une femelle ne posait pas de problème, tandis que deux femelles en posaient de façon saisonnière lorsqu'elles quittaient le parc pendant la saison humide. Une grande partie du domaine vital des animaux à problèmes se trouvaient à l'extérieur du parc, jusqu'à 30 km au Sud. Soixante-douze pourcents des observations d'un lion à problèmes réguliers ont été faite hors du parc. Il fut démontré qu'il avait tué 7 bovins, 9 moutons et 9 chèvres durant quatre semaines de surveillance intensive. On a extrapolé à partir de ces chiffres une moyenne annuelle de proies tuées par les lions bagués de 143 bovins, 183 ovins et 183 caprins, celle-ci ne contredisant pas les résultats des interviews qui estimaient la valeur des dommages causés annuellement par les lions à 130 000 $US. Ce chapitre est suivi d'annexe 7.1, donnant une description detaillée d'une observation unique. Après immobilisation pour l'étude télémétrique, une femelle adulte a eut une épine dans une patte antérieure. Elle a été observée tentant de l'enlever en utilisant une autre épine qu'elle serrait entre ses dents. Ce fut le premier cas remarqué d'un lion utilisant un outil.

La combinaison de la fragmentation et d'une faible densité de population est typique des lions d'Afrique Centrale et Occidentale et diffère de la plupart des endroits où les lions ont été intensivement étudiés. Le chapitre 8 réexamine les quelques informations disponibles afin d'étudier les effets de ces conditions sur le comportement social des lions. Il est suggéré que la taille des groupes est considérablement plus faible que dans d'autres régions, ceci affectant peut-être la structure des clans. Trois hypothèses sont proposées pour expliquer les différences entre les régions: la faible moyenne de densité des proies, la faible moyenne de taille des proies et la forte proportion en moyenne des animaux domestiques dans le régime alimentaire des lions.

Partie III: Discussion

Une présentation de la méthodologie est donnée dans le Chapitre 9. Trois méthodes pour l'évaluation du conflit lion-humain ont été comparés : la MARP, les interviews structurées (non présentées en détails dans le précédent chapitre mais reportées dans le paragraphe 9.4) et la télémétrie. Ces méthodes représentent respectivement les paradigmes des sciences participatives, sociales et naturelles. Les entrées et les sorties pour chacune des études ont été évaluées et comparées, les entrées en termes financiers et les sorties en termes de publications et de recommandations. Quantitativement, les entrées et les sorties étaient les plus importantes pour la télémétrie, et les moins importantes pour les interviews structurées, mais le rapport était le même pour les trois méthodes. Qualitativement, les méthodes ont montré qu'elles étaient largement complémentaires, tandis que leur chevauchement limité permettait une triangulation montrant la concurrence des résultats. La MARP, les interviews structurées et la télémétrie ont généré différentes recommandations, avec une précision accrue mais dans un domaine plus restreint.

Une contribution à la discussion sur les stratégies de conservation en Afrique est présentée dans le Chapitre 10. Le cas du PN de Waza est utilisé pour enrichir le débat sur les l'opposition entre 'la conservation gouvernementale' et 'la conservation communautaire', avec deux contibutions. La première d'entre elles, considère que les dommages causés par la faune devraient être pris en compte dans l'évaluation d'une analyse locale coûts-bénéfices de la conservation, ce qui réduirait le champ d'action de la conservation communautaire. La seconde considère que les influences structurelles politiques et financières des organisations internationales doivent être prises en compte, ce qui augmenterait le champ de la conservation en général. Le terme de 'conservation mondialement conçue' a été proposé comme troisième et prometteuse alternative, spécialement pour la conservation des carnivores dans l'Ouest et le Centre Africain.

Le Chapitre 11 offre une discussion finale autour de trois thèmes: l'écologie du lion, les stratégies de résolution du conflit homme - lion et le plan directeur d'aménagement du PN de Waza. Il y est défendu que la conservation du lion dans le PN de Waza est importante, ce qui demande qu'on s'intéresse au conflit homme - lion. Plusieurs options sont présentées, organisées par stratégies: l'évitement du conflit, l'atténuation ou la compensation. La possibilité d'application de ces stratégies dans le cas du PN de Waza est évaluée pour chacune d'entre elles. La résolution du conflit homme - lion doit s'accompagner d'améliorations générales dans l'efficacité de la conservation dans le PN de Waza. A cette fin, le plan de gestion du PN de Waza est entièrement discuté. Finalement, plusieurs recommendations sont faites.

Samenvatting

Leeuwenbescherming in West en Centraal Afrika

Integratie van sociale- en natuurwetenschappen voor de oplossing van wildconflicten rondom Nationaal Park Waza, Kameroen

Dit proefschrift is gebaseerd op onderzoek in het Nationaal Park Waza (Waza NP), in het noorden van Kameroen, en aan de Universiteit Leiden, van 1995 tot en met 2002. Het draagt bij aan de multi-disciplinaire discipline 'conservation science' (wetenschap van natuurbehoud) en beoogt sociale en natuurwetenschappen te integreren voor een analyse van het conflict tussen de lokale bevolking en leeuwenbescherming. Het bestaat uit drie delen: achtergrond (Hoofdstuk 1-3), mens - leeuw conflict (Hoofdstuk 4-8) en discussie (Hoofdstuk 9-11).

Deel I: achtergrond

Waza NP is een beschermd gebied van ongeveer 160.000 ha in de Sudan-Sahel zone van de provincie 'Extreem Noord' in Kameroen. De oostelijke helft is een 'wetland' dat onderdeel is van de overstromingsvlakte van de rivier de Logone, de westelijke helft is een boom savanne, deels gedomineerd door *Acacia seyal*. Regenval varieert sterk tussen jaren, met een jaarlijks gemiddelde van circa 600 mm gedurende het regenseizoen van juni tot november. Het Park bevat belangrijke zoogdier- en vogelpopulaties, waaronder soorten die steeds zeldzamer worden in West and Centraal Afrika, zoals olifant (*Loxodonta africana*), giraffe (*Giraffa camelopardalis*), verscheidene antilopensoorten, hyena (*Crocuta crocuta*), struisvogel (*Struthio camelus*) en kroonkraanvogel (*Balearica pavonina*). Er is ook een populatie van ongeveer 60 leeuwen (*Panthera leo*). De onderzoeksvragen die hier aan de orde komen zijn: (1) wat is de beschermingsstatus van de leeuw; (2) hoe kan mens - leeuw conflict rondom Waza NP worden omschreven; en (3) welke beschermingsstrategieën zijn het meest gepast voor leeuwenbescherming, in het bijzonder binnen de context van Waza NP. Hoofdstuk 1 biedt meer details over het gebied en de onderzoeksvragen.

Waza NP is geheel omgeven door nederzettingen; er staat geen hek omheen en er is veel wisselwerking tussen het Park en de omgeving. Deze wisselwerkingen zijn sterker geworden sinds de jaren '90, eerst door de afname van de capaciteit voor wetshandhaving, tijdens het begin van de economische crisis, en later als gevolg van een verschuiving naar participatiever management van het Park. Die verschuiving is alomtegenwoordig in Afrika en beoogt de participatie en medewerking van de lokale bevolking in natuurbehoud te bevorderen. Hoofdstuk 2 geeft een overzicht van deze trend, met voorbeelden uit heel Afrika, en in het geval van Kameroen met een analyse van bijbehorende wettelijke veranderingen. De meest relevante wettelijke verandering voor Nationale Parken in Kameroen was de *de jure* vrijheid om management aan de lokale omstandigheden aan te passen, mits beschreven in een goedgekeurd management plan. Dit beleid is tot dusverre slechts ten dele of selectief geïmplementeerd.

Het Ministerie voor Milieu en Bossen (MINEF) bekrachtigde in 1997 een management plan voor Waza NP, waarin de sociale context expliciet aan de orde kwam met de oprichting van een overlegorgaan, de rekrutering van lokale wachters en de bevordering van eco-toerisme. Het management plan stond ook experimenten toe met beperkt consumptief gebruik van enkele natuurlijke hulpbronnen, in ruil voor lokale medewerking. Om te bepalen welke hulpbronnen gewenst werden of tot last waren, werden mensen in de buurt van het Park ondervraagd (Hoofdstuk 3). Attitudes van respondenten over natuurbescherming waren positief, in de eerste plaats gemotiveerd door gebruikswaarde, maar ten dele ook door intrinsieke waarde en verwijzing naar toekomstige generaties. Attitudes waren significant gerelateerd aan lokale voordelen. Respondenten vonden de meeste hulpbronnen van het Park nuttig, maar er waren significante verschillen tussen gebruikersgroepen. Gebruikersgroepen verschilden onderling ook significant in hun klachten over mens - wild conflicten, maar in het algemeen vonden zij die soorten die voor toerisme het belangrijkst zijn het schadelijkst. De analyse gaf aan dat niet alle lokale aspiraties kunnen worden waargemaakt, maar dat een tegemoettreding de draagkracht voor natuurbescherming kan verhogen.

Deel II: mens - leeuw conflict

Het aantal in het wild voorkomende leeuwen was nooit precies bepaald. Hoofdstukken 4 en 5 geven een inventarisatie van de huidige beschikbare informatie, die leidt tot een voorzichtige schatting van tussen de 16.500 en 30.000 leeuwen in Afrika. De inventarisatie laat zien dat de soort nog wijd verbreid is in Oost en Zuidelijk Afrika, terwijl populaties in West and Centraal Afrika klein en gefragmenteerd zijn. De leeuw kwam in laatstgenoemde regio in het verleden waarschijnlijk algemeen voor in lage dichtheden. Tegenwoordig is de verspreiding in West en Centraal Afrika voornamelijk beperkt tot kleine geïsoleerde populaties in en rond beschermde gebieden. Hun aantal ligt waarschijnlijk tussen de 1000 en 2850, en wordt geschat op 1800. De invloed van de mens is de hoofdoorzaak van de vermeende afname van leeuwenpopulaties, zowel binnen (door ineffectief beleid) als buiten beschermde gebieden (door onverenigbaarheid met menselijk landgebruik). Zeer weinig activiteiten worden ondernomen op het gebied van onderzoek en bescherming van West and Central Afrikaanse leeuwen. Waza NP is representatief voor de regionale toestand, met predatie van vee als een van de grootste uitdagingen binnen het mens - leeuw conflict.

Hoofdstuk 6 beschrijft de resultaten van een serie zogenaamde Participatory Rural Appraisals (PRA) in dorpen rondom Waza NP, met vooral aandacht voor het thema ‘mens - predator conflict’. De gebruikte methoden omvatten speciale technieken, zoals het gebruik van plaatjes van predatoren om hun lokale aanwezigheid vast te stellen. Uit de resultaten blijkt dat het mens – predator conflict rondom Waza NP een ernstig probleem is. Conflict werd vooral veroorzaakt door predatie van grootvee door leeuwen en kleinvee door hyena's; andere vormen van conflict en menselijke slachtoffers waren zeldzaam en van minder belang. Bij de restitutie en prioriteitsbepaling van alle problemen in de boomsavanne ten zuiden van het Park, kwam predatie naar voren als één van de belangrijkste problemen. In de overstromingsvlakte waren mensen het er daarentegen over eens dat predatie op een acceptabel niveau plaatsvond, terwijl er nauwelijks conflict was ten oosten van de rivier de Logomatya. Een andere conclusie was dat thematische PRA een goede indruk van een situatie kan opleveren, ondanks enige vertekeningen, met name in kwantitatieve gegevens. Herhaling van dezelfde exercitie in verscheidene nederzettingen en triangulatie van de resultaten van

verschillende methoden droeg in hoge mate bij aan de verduidelijking van tendensen en lokale variatie.

Hoofdstuk 7 is gebaseerd op een telemetrie studie van vijf leeuwen die van een zenderhalsband waren voorzien. Hun individuele leefgebied ('home range') werd bepaald, de gemiddelde oppervlakte was extreem groot: 630 km^2. De leeuwen verschilden onderling ten aanzien van hun predatie op vee, met twee mannelijke gewoonte-probleemdieren, een vrouwtje dat geen problemen opleverde en twee seizoens-probleemdieren die het Park uitsluitend in het regenseizoen verlieten. Probleemdieren hadden een groot deel van hun areaal buiten het Park, tot wel 30 km ten zuiden van de rand. Tweeënzeventig procent van de waarnemingen van een gewoonte-probleemdier lag buiten het Park. Er werd aangetoond dat hij verantwoordelijk was voor predatie van 7 koeien, 9 schapen en 9 geiten gedurende vier weken van intensieve achtervolging. Dit levert een extrapolatie van gemiddelde jaarlijkse predatie op vee van 143 koeien, 183 schapen en 183 geiten door de gezenderde leeuwen. Dat is niet in tegenspraak met de resultaten van gestructureerde interviews, waarbij de waarde van de jaarlijkse totale leeuwenschade op US$ 130.000 werd geschat. Dit hoofdstuk heeft een annex met een gedetailleerde beschrijving van een unieke observatie. Na de verdoving ten dienste van de telemetrie studie had één vrouwtje een doorn in haar voorpoot. Er werd waargenomen hoe zij die probeerde te verwijderen met een andere doorn, geklemd tussen haar tanden. Dit is de eerste registratie van gebruik van een hulpmiddel door een leeuw.

De combinatie van fragmentatie en lage dichtheden is typerend voor leeuwen in West en Centraal Afrika en verschilt van de meeste gebieden waar leeuwen intensief bestudeerd zijn. Hoofdstuk 8 geeft een overzicht van de weinige beschikbare informatie, teneinde het effect hiervan op sociaal gedrag van leeuwen te onderzoeken. Leeuwen lijken in deze regio in beduidend kleinere groepen te leven dan in andere gebieden, waarmee ook het systeem van de troep ('pride') ter discussie wordt gesteld. Drie hypothesen worden geformuleerd om de regionale verschillen te verklaren: lage gemiddelde prooidichtheid, laag gemiddeld gewicht van prooidieren, en een groot aandeel van vee in de voeding van leeuwen.

Deel III: Discussie

Hoofdstuk 9 bevat een methodologische discussie. Drie methoden voor de bepaling van mens - leeuw conflict worden vergeleken: PRA, gestructureerde interviews (die in paragraaf 9.4 uitgebreider worden beschreven dan in voorgaande hoofdstukken) en telemetrie. Deze methoden vertegenwoordigen respectievelijk de participatieve, sociale en natuur-wetenschappelijke paradigma's. Inputs en outputs voor de drie studies werden bepaald en vergeleken, inputs uitgedrukt in geld en outputs in publicaties en aanbevelingen. Zowel inputs als outputs waren kwantitatief het grootst voor telemetrie en het kleinst voor gestructureerde interviews, maar de verhouding was voor alle drie de methoden ongeveer gelijk. Kwalitatief waren de methoden complementair, de geringe overlap werd gebruikt voor triangulatie waaruit bleek dat de resultaten met elkaar in overeenstemming waren. PRA, gestructureerde interviews en telemetrie leidden tot verschillende aanbevelingen, met in die volgorde toenemende precisie en afnemende reikwijdte.

Een bijdrage aan de discussie rond beschermingsstrategieën in Afrika wordt geleverd in Hoofdstuk 10. Het voorbeeld van Waza NP wordt aangegrepen om het debat over 'fortress' of 'government based conservation' (bescherming door de overheid) als tegenovergestelde van 'community based conservation' (bescherming door lokale gemeenschappen) te verrijken

met twee bijdragen. De eerste is dat de lokale kosten-batenanalyse van natuurbescherming rekening moet houden met wildschade, waardoor de toepasbaarheid van ‘community based conservation’ beperkt wordt. De tweede is dat er rekening gehouden moet worden met de structurele politieke en financiële invloed van internationale instellingen, waardoor natuurbescherming in zijn algemeen wordt vergemakkelijkt. De term ‘globally mediated conservation’ (natuurbescherming met mondiale inmenging) werd geïntroduceerd als een derde en meerbelovend alternatief, speciaal voor de bescherming van carnivoren in West and Centraal Afrika

Hoofdstuk 11 biedt een afsluitende discussie rond drie thema's; de ecologie van de leeuw, oplossingsstrategieën voor mens - leeuw conflict en het management plan van Waza NP. Er wordt beargumenteerd waarom bescherming van de leeuw in Waza NP belangrijk is, hetgeen noopt tot aanpak van het mens - leeuw conflict. Verscheidene opties worden hiertoe gepresenteerd per strategie: conflict vermijding, vermindering of compensatie. De toepasbaarheid van alle opties in het geval van Waza NP wordt geëvalueerd. De aanpak van mens - leeuw conflict moet gepaard gaan met een algemene verbetering in de effectiviteit van natuurbescherming in Waza NP. Hiertoe wordt het management plan voor Waza NP integraal bediscussieerd. Tenslotte worden er diverse aanbevelingen gedaan.

Curriculum Vitae

Hans Bauer was born in The Hague, The Netherlands, on 12 December 1969. After preparatory education ('VWO') at the Christelijke Scholengemeenschap Overvoorde between 1982 and 1988, he studied at Leiden University where he obtained an MSc. degree in Biology in 1994. He did a 'free doctoral curriculum' on 'Environment and Development', with courses in both natural and social sciences. During his MSc. he did two fieldwork projects in Africa. The first study was on elephants and their conflicts with people in Cameroon in 1993. The second was a study into the relation between deforestation and the distribution of blackflies, the vector of river-blindness, in Ghana in 1994. After graduation, he returned to Waza National Park, Northern Cameroon, for two short assignments related to the study on human-elephant conflict. He continued research in the area but shifted to human-predator conflict, when he was employed by the Centre of Environmental Science, Leiden University (CML) in 1995. At CML, he first did a short study on human predator conflict around Waza NP for the Waza Logone Project and then a more elaborate study as part of his outplacement at the Centre for Environment and Development studies in Cameroon (CEDC) in Maroua. At CEDC, he started as administrator and continued as co-ordinator from January 1996 to January 2001, with a part-time research component. In 2003, he completed the present dissertation at CML, based on the accumulated data. Hans Bauer is a member of the IUCN Species Survival Commission and Cat Specialist Group. He hopes to contribute to the establishment of a West and Central African lion conservation network and the development and implementation of a regional action plan in future.

Photo 15: Researcher with three excellent guides
(f.l.t.r. Moussa, Bauer, Falama, Manga).

Overview of publications in this dissertation

Chapter 3: Bauer, H. (2003) Local perceptions of Waza National Park, northern Cameroon. *Environmental Conservation* **30**, 175-183.

Chapter 4: Bauer, H. & S. Van Der Merwe (in press) Inventory of free ranging lions (*Panthera leo)* in Africa. *Oryx*.

Chapter 5 edited from: Bauer, H., H.H. de Iongh, F.P.G. Princée & D. Ngantou (2003) Research needs for lion conservation in West and Central Africa. *Comptes Rendus Biologies* **326**, S112-S118.

Chapter 6: Bauer, H. & S. Kari (2001) Assessment of the people – predator conflict through thematic PRA in the surroundings of Waza National Park. *Participatory Learning and Action Notes* **41**, 9-13.

Chapter 7: Bauer, H. & H.H. De Iongh (submitted) Lion (*Panthera leo*) home ranges and livestock conflicts in Waza National Park, Cameroon.

Appendix 7.1 edited from: Bauer, H. (2001) Use of tools by lions in Waza National Park, Cameroon. *African Journal of Ecology* **39**, 317.

Chapter 8: Bauer, H., H.H. De Iongh & I. Di Silvestre (2003) Lion (*Panthera leo*) social behaviour in the West and Central African savannah belt. *Mammalian Biology* **68**, 239-243.

Chapter 10: Bauer, H. & H.A. Udo De Haes (submitted) Fortress Conservation versus Community Based Conservation in Africa revisited.